



# Patent rights, developing countries and the economic influence of the multilateral trading system

Douglas Lippoldt

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# **Patent Rights, Developing Countries and the Economic Influence of the Multilateral Trading System**

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*Thèse dirigée par M. Carlos Alberto Primo Braga*

Soutenue le 14 janvier 2011

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## **Abstract**

This dissertation examines the possible influence of the multilateral trading system (MTS) on the evolution of patent rights in developing countries during the period from 1990 to 2005 and associated developments with respect to international economic flows and domestic innovation in those countries. The coverage from 1990 to 2005 is targeted on the years just prior to the entry into effect of the World Trade Organisation's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and continuing through the completion of the transition periods for implementation of most of its requirements. The relationships are assessed primarily using regression analysis techniques, which permit discernment of association but not causality. A variety of data, aggregate at the national level, are employed covering a broad sample of countries including developing countries, least developed countries and, for comparison, OECD countries.

The main contribution of the dissertation is to identify and relevant insights from existing theoretical work and to test empirically a set of hypotheses concerning a positive relationship of international influences on patent reform in developing countries and a positive relationship of that reform to certain economic developments. Chapter one finds support for the hypothesis that international intellectual property rights reforms (in particular the advent of the WTO TRIPS Agreement), operating in combination with industrial interests, have significantly influenced the evolution of patent rights institutions in developing countries during the period from 1990 to 2005. Chapter two presents evidence of a positive relationship between patent right reforms and selected international economic indicators including imports and foreign direct investment. Chapter three finds support for the hypothesis that patent rights reforms were positively associated with certain innovation-related indicators during the study period.

## Résumé

Cette thèse examine l'influence du système de commerce multilatéral sur l'évolution du droit des brevets dans les pays en voie de développement sur la période de 1990 à 2005. Elle analyse les développements économiques associés à ces réformes – par exemple, le rapport entre les réformes du droit des brevets et les flux économiques internationaux et l'innovation domestique. L'étude porte sur les années 1990 à 2005, afin de couvrir les années précédant l'entrée en vigueur de l'Accord de l'Organisation mondiale du commerce sur les Aspects de Droits de Propriété Intellectuelle qui touchent au Commerce (ADPIC) ainsi que les années des périodes de transition pour sa mise en œuvre. Les rapports sont évalués utilisant principalement des techniques économétriques qui permettent de discerner les coïncidences mais pas la causalité. Les analyses reposent sur des données nationales qui couvrent un vaste échantillon de pays en développement, de pays les moins avancés et, pour faciliter les comparaisons, de pays membres de l'OCDE.

La contribution principale de cette thèse est : i) d'identifier des concepts pertinents de la littérature théorique actuelle concernant les droits de propriété intellectuelle et le fonctionnement des marchés et ii) de tester empiriquement une série d'hypothèses sur l'existence d'influences internationales sur les réformes du droit des brevets dans les pays en développement ainsi que sur une influence de ces réformes aux certains développements économiques. Le premier chapitre montre la validité de l'hypothèse que les réformes du droit de propriété intellectuelle internationale (en particulier l'Accord de ADPIC), combinée avec les intérêts industriels, ont influencé significativement l'évolution des institutions en charge du droit des brevets dans les pays en développement. Le deuxième chapitre présente des analyses qui confirment l'existence d'une relation positive entre les réformes du droit des brevets et les indicateurs des flux économiques internationaux tels que les importations, les investissements directs étrangers et les brevets d'origine étrangère. Les analyses du troisième chapitre soutiennent l'hypothèse que les réformes du droit des brevets sont couraillées avec des indicateurs d'innovation.

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## **GENERAL INTRODUCTION**

## General Introduction

This dissertation examines the possible influence of the multilateral trading system (MTS) on the evolution of patent rights in developing countries during the period from 1990 to 2005 and associated developments with respect to international economic flows and innovation in those countries. The coverage from 1990 to 2005 is targeted on the years just prior to the entry into effect of the World Trade Organisation's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and continuing through the completion of the transition periods for implementation of most of its requirements. (Box GI.1 provides background on the MTS and intellectual property rights, IPRs.)

The main contribution of the dissertation is to identify important and relevant insights from existing theoretical work and to test empirically a set of hypotheses developed from this literature.<sup>1</sup> The hypotheses concern the expected relationships between international influences and change in patent rights institutions in developing countries and, in turn, the associated economic implications for developing countries. The relationships are assessed primarily using regression analysis techniques, which permit discernment of association but not causality. Overall, the analyses point to a positive relationship between strengthened patent rights and indicators for economic inflows and innovation, albeit with some variation by country and sector.

### *Motivation: Patent Rights and Economic Development*

The principal motivation behind this line of research is to sketch an empirical assessment of the hypothesized pathways between the strong desire of innovators and patent rights holders – particularly from developed countries – to strengthen protection of their innovations globally and the achievement of patent reforms in developing countries, while considering how such patent reforms may have influenced certain aspects of economic performance in the developing countries. In order to render such an undertaking feasible in terms of scale and availability of information, the present dissertation focuses on a subset of these broader developments.

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<sup>1</sup> The three chapters build on previous work by Park and Lippoldt (2003, 2005, 2008) and Lippoldt (2003, 2006, 2009).

Lippoldt (2006) provides an introduction to this issue noting that, “In recent decades proponents of strengthened IPRs have argued their case from a variety of angles, often including an emphasis on the potentially positive effects for economic growth in developing countries. Stronger patent rights, for example, might encourage foreign rights holders to trade, invest directly or license intellectual property in developing countries.”<sup>2</sup> Where economic development is a priority policy objective, the issue of an appropriate policy framework for IPRs – including patent rights – may be of particular importance via its role in facilitating access to technology. As Lippoldt notes, “The economic well-being of a nation is linked closely to the availability of resources and technology. Progress in the latter plays a central role in boosting output per worker and is an important determinant of income levels.”<sup>3</sup>

Developing countries, particularly in the earlier stages of development, may face limitations in technology resources and may face constraints in the ability of domestic sources of innovation to respond adequately to the incentives from stronger patent rights. Where a developing country is lagging in one of these areas, foreign sources may play an important role in closing the gap (Park and Lippoldt, 2003). If inward trade, foreign direct investment, patent registration, licensing and expenditure on research and development can be influenced by the strength of patent rights in an economy, then governments may be able to exploit IPR policy to enhance these flows and stimulate development. Such inflows from abroad embody various types of intellectual property and represent a form of international technology transfer, but there can also be a significant domestic innovative response once adequate IPR protection is assured.

Lippoldt (2006) notes “Intellectual property has particular characteristics that differentiate it from physical goods. Unlike a material resource, the same bit of intellectual property can be made available simultaneously and repeatedly on a non-exclusive basis to multiple users, generally at a low marginal cost. New ideas embodied in intellectual property, being non-rivalrous, not only can contribute to technical progress but can also have

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<sup>2</sup> Such licensing of intellectual property is considered to be trade in services under the current international statistical framework. That is, royalties and license fees paid in relation to use of intellectual property fall under the current account heading “trade in services” as defined in the *Balance of Payments Manual*, 5th edition (IMF, 2003). The 6<sup>th</sup> edition (2008) is currently being implemented and replaces “royalties and license fees” with “charges for use of intellectual property, not included elsewhere” and clarifies the boundaries. Such charges are included the current account under services, except for the permanent sale or transfer of economic ownership of franchises or trademarks, which are classified in the capital account.

<sup>3</sup> E.g. see WTO (2002) for a discussion and bibliographic references.

‘disproportionate’ impacts on economic growth due to big returns to scale when one idea is applied many times (Jones, 2004). Given this economic potential, policy makers may be particularly motivated to boost development of new domestic intellectual property and access to existing intellectual property from abroad.”

There is mounting evidence of a positive relationship between a nation’s openness or progressive integration into the world economy and its growth or economic development (OECD, 2001; WTO, 2003). At the same time, the absolute size of the stock of relevant and available intellectual property also appears to be a related and important factor in relation to productivity. As Jones (2004) notes, “Because of the non-rivalrous nature of ideas, output per person depends on the total stock of ideas in the economy instead of the per capita stock of ideas.” Since intellectual property can cross borders easily, the scope of the available stock can be nearly global, provided there is an appropriate international framework and the willingness of rights holders to facilitate access. Singapore and Hong Kong-China are examples of economies that have overcome scale limitations in their domestic stocks of intellectual property, in part, through their integration into the global economy; among other initiatives in this regard, they have undertaken commitments with respect to the international framework agreements governing intellectual property.

The power of IPRs to influence trade, foreign direct investment (FDI) and licensing appears related to the nature of intellectual property. The non-rivalrous, non-exclusive nature of intellectual property presents a challenge to the original innovator (or subsequent rights holder) wishing to appropriate an economic benefit from the intellectual property. Weak IPRs in a particular market may discourage the foreign rights holder from making the intellectual property available there through trade, direct investment or licensing. The potential inability to enforce IPRs means rights holders could face greater difficulty in appropriating returns from the use of the intellectual property and this could be doubly damaging to the rights holder in the event a competitor makes use of the intellectual property. Yet, prior to the recent wave of IPR reform, especially prior to the 1990s, many developing countries suffered from relatively weak systems of IPR protection sometimes based on poorly adapted systems dating from a former colonial era or sometimes, in effect, non-existent systems.<sup>4</sup> While it is possible that IPRs could be made too strong, conferring excessive market power on the rights holders

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<sup>4</sup> Annex GI.1 provides an overview of key aspects of the reforms in relation to the WTO TRIPS Agreement.

and thereby unduly limiting access to technologies, this situation does not seem to have been the general case in developing countries in the pre-TRIPS era.<sup>5</sup>

Lippoldt (2006) notes that the importance of patent rights protection to rights holders may vary depending on the ease with which the ideas can be imitated. As Lippoldt states, “An exporter of specialty steel with a unique manufacturing process may not be especially concerned about patents in a particular destination market if the exported good cannot be reverse engineered. On the other hand, a software producer whose code can be easily copied by anyone with a laptop computer may hesitate to sell into a market where piracy is commonplace. An apparel firm may hesitate to invest and manufacture in a country where trademark protection is ineffectual. While a goods producer in a competitive and freewheeling market may get paid the full amount of his/her marginal product, in the absence of a mechanism to protect IPRs there risks to be little or no return to the originators of ideas and hence insufficient incentives to innovate.”

In order to correct such shortcomings in the marketplace, key players in the international community have worked to rebalance things and ensure that those who create ideas have incentives to continue to do so. The result is an international system of treaties and institutions that has evolved over a number of decades to help protect various aspects of intellectual property, subject to certain conditions (*e.g.* one condition for the granting of a patent of limited duration is that the applicant make public the idea to be protected).” During the 1990s, many developing and transition countries moved to strengthen their IPR regimes through adherence to these WIPO-administered agreements (Park and Lippoldt, 2005). For example, during the 1990s, 59 nations became parties to the Bern Convention for the Protection of Literary and Artistic Works bringing the total membership to 157 countries; 60 nations became parties to the Paris Convention for the Protection of Industrial Property bringing the total membership to 168.<sup>6</sup> This is a considerable burst of activity in a relatively short period, given that both treaties date originally from the 1880s. In part, the expanded adherence to WIPO agreements was propelled by the launching of economic transition in former socialist states and by the advent of the WTO and the TRIPS Agreement, which came into effect on 1 January 1995. It resulted in a strengthened application of minimum IPR

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<sup>5</sup> For a discussion of this issue with respect to patents and an extensive reference list, see *Encaoua et al.* (2003).

<sup>6</sup> The membership figures are based on information from the WIPO Internet site: <http://www.wipo.org> (cited on 24 September 2004).

standards in many developing countries, albeit with implementation extended over a number of years due to transitional periods.

While a particular focus of this dissertation is on developments associated with the period of implementation of the TRIPS Agreement, it should be noted that regional trade agreements (RTAs) have also played an important role in motivating developing countries to reform their IPR regimes. Many RTAs – including quite a few involving one or more developing countries – go beyond the TRIPS Agreement in establishing additional minimum IPR requirements, including with respect to patent rights (Lippoldt, 2003). According to the TRIPS Agreement, WTO Members may implement IPR protection that is more extensive than the minimum required under the agreement, provided that this does not contravene the agreement. In a review of 15 selected regional accords, Lippoldt found that they often included one or more provisions going beyond the strict requirements the TRIPS Agreement. Often these additional requirements concerned conformity with, or accession to, other relevant international agreements. There are also examples of RTAs that have special provisions concerning shortened transition periods, enforcement or co-operation, among other issues.

### ***Hypotheses and Methods***

The dissertation starts from the premise that institutions matter for the economy and, consequently, the analysis reflects an institutional perspective. This approach was employed because patent rights institutions were the object of a major international reform effort in recent decades and, as Douglass North (1997) points out, “Institutions affect economic performance by determining (together with the technology employed) the cost of transacting and producing.” Thus, the sketch drawn by the three substantive chapters gives particular consideration to the institutions affecting patent rights. The logic of these chapters is to consider the institutional factors that are associated with the strengthening of patent rights protection, then the possible implications of this strengthening in terms of the associated changes in international economic inflows and domestic innovation.

For the purposes of the analysis, the strength of patent rights institutions is measured primarily using the Patent Rights Index (Ginarte and Park, 1997, and Park, 2008), an index taking into account protection as reflected in laws on the books. The establishment of minimum standards for protection of intellectual property rights (IPRs) under the TRIPS

Agreement was generally associated with increased availability of protection in countries previously extending weak or incomplete protection for intellectual property. Simultaneously with the implementation of the TRIPS Agreement, many advanced countries implemented specific protection going beyond the minimum standards, in some cases seeking to ensure the extension of such “TRIPS-plus” protection to developing country trading partners via regional or free trade accords (e.g., Fink and Reichenmiller, 2005).

As Maskus (2000), Primo Braga (1990, 1991) and others have noted, economic theory is inconclusive on the expected outcomes from a strengthening of intellectual property rights and empirical analysis is required to complement the theoretical perspectives. A strengthening of patent rights may promote market expansion effects as rights holders are better able to leverage their intellectual property and thus act to increase access in a manner that tends benefit users as well as producers of intellectual property. Or, it may increase the market power of rights holders such that they have an incentive to constrain supply and thereby limit the potential economic benefit to society as a whole. Consequently, empirical analysis plays an important role in assessment of patent rights reform and is the approach employed in this dissertation. At the same time, it should be noted that the empirical assessment presented below does not look at these market effects directly, but rather it considers the associated net changes at an aggregate level.

In each chapter, the methodology is implemented over three steps. The first is to review the literature on the central topic. The second is a basic statistical analysis of the evolution of key indicators of relevance. The third involves regression and correlation analysis to determine the association of changes in the observed characteristics of a range of social and economic variables with changes in intellectual property rights. The broad perspective is one of a search for the catalysts of positive institutional change in developing countries with respect to patent rights, which in turn are associated with positive economic effects via the international economy and domestic innovative response.

These issues are examined over three substantive chapters, followed by a concluding chapter that synthesises the results and points to key implications. The overarching hypotheses for each of the three substantive chapters are stated briefly below. In each case the analysis developed in this dissertation found supporting evidence for the hypotheses, albeit with some variation by country or sector.



**1) International organisations have influenced the evolution of patent rights institutions in developing countries in a manner tending to increase stringency of protection during the period from 1990 to 2005.** In particular, it is hypothesised that the scale and nature of change in patent rights institutions in developing countries have been associated with the implementation of the reformed international patent rights regime and in particular, the WTO TRIPS Agreement (see Annex GI.1 of the General Introduction for an overview of this agreement). This relationship might be specified as follows:

- Evolution of developing country patent rights protection =  $f$  (international institutional pressures, domestic institutional pressures, controlling for the level of development and other factors),

**2) Change in the patent rights institutions in developing countries has tended to be positively associated with international economic inflows via imports, foreign direct investment and registration of patents from abroad.** This relationship might be specified as follows:

- Inward international economic flows (imports, foreign direct investment or non-resident patent registration) =  $f$  (strength of patent rights, controlling for level of development and other factors)

**3) The strengthening of patent rights institutions in developing countries has tended to be associated with positive change in domestic innovation resources and intensity.** This relationship might be specified as follows:

- Domestic innovation resources and intensity (patenting by residents, expenditure on research and development, R&D, or investment in intangible assets) =  $f$  (strength of patent rights, controlling for level of development and other factors).

**Box GI.1. The Multilateral Trading System and Intellectual Property Rights**

In the post-WW II era, the MTS delivered a succession of negotiating rounds under the General Agreement on Tariffs and Trade (GATT). The resulting accords provided developed countries with much of the tariff liberalisation they had sought. In time, these countries pushed the MTS to broaden the scope of negotiations in order to address other trade-related issues and advance their economic interests. The first 5 GATT negotiating rounds focused on tariffs (Table GI.1). The sixth – the Kennedy Round – added anti-dumping and development to the agenda. The seventh – the Tokyo Round – added further issues to the agenda, including a late and unsuccessful attempt by the United States and others to introduce anti-counterfeiting protection as an element in the package (Primo Braga, 1995). Ultimately, however, intellectual property rights were not covered until the eighth round, the Uruguay Round.

The conclusion of the Uruguay Round in 1994 marked a significant step in the development of the MTS, substantially expanding the range of issues covered by international trade agreements and providing for establishment of a permanent international organisation – the World Trade Organisation (WTO) – to administer the system. In addition to the traditional focus on trade in goods, the round resulted in coverage of trade related aspects of services and IPRs as subject matter under the purview of the MTS (Table GI.2). Most notably, with respect to IPRs, the round resulted in conclusion of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). Member countries provided further refinement and clarification of the system – including with respect to IPRs (*e.g.* with respect to TRIPS and public health) – at subsequent WTO Ministerial Conferences, six of which were held between 1995 and 2008.

## **Annex GI.1 - The TRIPS Agreement**

WTO (2008) notes that the TRIPS Agreement details “how to give adequate protection to intellectual property rights”, “how countries should enforce those rights adequately in their own territories” and “how to settle disputes on intellectual property between members of the WTO”. The objective of the agreement is clearly stated in Article 7, which notes that “The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.” Subject to this additional notion of “balance”, the TRIPS Agreement affirms the applicability of the basic principles of the trading system, namely, national treatment and most favoured nation (MFN) treatment.

In the TRIPS context, national treatment means that generally “[e]ach Member shall accord to the nationals of other Members treatment no less favourable than that it accords to its own nationals with regard to the protection of intellectual property”. According to the TRIPS agreement, MFN treatment means that generally “any advantage, favour, privilege or immunity granted by a Member to the nationals of any other country shall be accorded immediately and unconditionally to the nationals of all other Members.”

The TRIPS Agreement builds on the framework of previously existing accords administered by the World Intellectual Property Organisation (WIPO), including the:

- *Paris Convention for the Protection of Industrial Property* including the Stockholm Act of this Convention of 14 July 1967;
- *Berne Convention for the Protection of Literary and Artistic Works* including the Paris Act of this Convention of 24 July 1971;
- *International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations*, adopted at Rome on 26 October 1961; and the
- *Treaty on Intellectual Property in Respect of Integrated Circuits*, adopted at Washington on 26 May 1989.

In doing so, the TRIPS Agreement goes a step further by establishing international minimum standards applicable across the WTO membership, though subject to transition periods and certain exemptions and in particular in the case of the Least Developed Countries (LDCs, as identified by the United Nations). Moreover, it provides for enhanced means to ensure IPRs are enforced and that countries abide by their commitments. The agreement established a Council for TRIPS and charged it with monitoring the operation of the agreement and, in particular, WTO Members' compliance with their obligations under the agreement, while providing members with the opportunity of consulting on matters relating to the trade-related aspects of intellectual property rights. In cases of where this mechanism is not adequate members have recourse to the Dispute Settlement Understanding, which applies to consultations and the settlement of disputes under the TRIPS Agreement.

The TRIPS Agreement explicitly discusses each type of intellectual property within the scope of the accord, including copyright and related rights, trademarks (including service marks), geographical indications, industrial designs, patents, layout-designs (topographies) of integrated circuits, and undisclosed information including trade secrets. And, it requires provision of means to enforce these IPRs, in particular with respect to goods and processes in WTO Members' domestic markets but also in some cases with respect to re-export of goods for which entry had been sought.

Enforcement procedures are to be available so as to permit effective action against acts of infringement including expeditious remedies that constitute a deterrent to further infringements. In line with the quest for balance described in the objective of the agreement, these procedures shall be applied in such a manner as to avoid the creation of barriers to legitimate trade and to provide for safeguards against their abuse.

According to the TRIPS Agreement (Article 41.2), procedures concerning the enforcement of IPRs are to be fair and equitable. They should not be unduly complicated or costly, or entail unreasonable time limits or unwarranted delays. This includes first of all availability to right holders of recourse to civil judicial procedures, whereby defendants shall have the right to written notice which is timely and contains sufficient detail, including the basis of the claims, all parties shall be allowed to be represented by independent legal counsel and present all relevant evidence, and procedures shall not impose overly burdensome requirements concerning mandatory personal appearances.

As part of due process, in cases where a party knowingly infringes (or has reasonable grounds to know of the infringement), the judicial authorities shall have the authority to order that party to desist from infringement and may prevent IPR-infringing imports; they may also order an infringer to pay the right holder damages adequate to compensate injuries suffered – including court costs – due to the infringement (or, in cases of abuse of enforcement mechanisms by a right holder, to order compensation for a victim of the abuse).

Preliminary injunctions can be sought by right holders in order to remove from commerce probable infringing goods. Without prejudice to other rights of action open to the right holder and subject to the right of the defendant to seek review by a judicial authority, the TRIPS Agreement requires that competent authorities have the authority to order the destruction or disposal of infringing goods. In the case of counterfeit trademark goods, the authorities “shall generally not allow the re-exportation of the infringing goods in an unaltered state or subject them to a different customs procedure.”

The TRIPS Agreement obliges members to provide for criminal procedures and penalties in the case of willful trademark counterfeiting or copyright piracy on a commercial scale. It specifies that available remedies shall include imprisonment or monetary fines (or both) sufficient to provide a deterrent, consistent with the level of penalties applied for other crimes of a corresponding gravity. Where appropriate, remedies shall also include the seizure, forfeiture and destruction of the infringing goods and any materials or implements used in the commission of the offence.

In some instances, the TRIPS Agreement provides for a reversal of the burden of proof. For example, in case a newly introduced and allegedly infringing product enters the market whereby a process patent exists for obtaining the product, the TRIPS Agreement mandates that the judicial authorities have the authority to order the defendant to prove that the process to obtain an identical product is different from the patented process.

As noted above, among the types of intellectual property covered by the TRIPS Agreement the analysis in this dissertation focuses primarily on the situation and role of patents. Some evidence is also cited concerning copyright and trademarks. The next three sections of the introduction consider each of these three types of intellectual property seen from the perspective of the Agreement. Table GI.3 provides an overview.

### ***The TRIPS Agreement and Patents***

Patents are treated in Section 5 of the TRIPS Agreement. As for the other types of intellectual property, the aim is to establish minimum standards for protection. Article 27 notes that subject to certain conditions “patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step [*i.e.* they are non-obvious] and are capable of industrial application [*i.e.* useful].” Plant varieties must be protected, but are subject to special treatment in that the protection may be provided either via patents or by an effective *sui generis* system or by a combination of approaches.<sup>7</sup> With respect to patented processes, the rights of the patent holders extend to products directly obtained from such processes.

WTO Members may exclude from patentability certain types of inventions where necessary so as to protect public order or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment. Members may also exclude from patentability: (a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals; (b) plants and animals other than micro-organisms, and essentially-biological processes for the production of plants or animals other than non-biological and microbiological processes.

Patents are granted at the national level and must be applied for in each national market.<sup>8</sup> Under the provisions of TRIPS, the minimum term of protection is 20 years from the date of filing. Once accorded, the patent gives the owner the right to prevent third parties from the acts of making, using, offering for sale, selling or importing for these purposes that product (or in the case of a process, then the product obtained directly by that process). Importantly for technology markets, the TRIPS Agreement states that patent owners shall also have the right to assign, or transfer by succession, the patent and to conclude licensing contracts. Importantly for subsequent innovation, the TRIPS Agreement states that members shall require that patent applicants disclose the invention in a manner sufficiently clear and

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<sup>7</sup> WTO Members may provide limited exceptions to the exclusive rights conferred by a patent, provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties.

<sup>8</sup> Internationally, application is facilitated via a standardized approach through WIPO’s Patent Co-operation Treaty (PCT), which is available to nationals or residents of any of the 141 contracting parties. An application cleared through the PCT process cannot be rejected on formal grounds and the applicant is accorded an additional 18 months to file with the various national offices, among other advantages. More information is available here: <http://www.wipo.int/pct/en/treaty/about.htm>.

complete for the invention to be carried out by a person skilled in the art and may require the applicant to indicate the best mode for carrying out the invention known to the inventor at the filing date or, where priority is claimed, at the priority date of the application. In the event a patent is subsequently revoked or subject to forfeiture, the agreement states that an opportunity for judicial review of such decisions shall be available.

On a case-by-case basis and subject to certain conditions, the TRIPS Agreement provides a limited possibility for use of a patent without the authorization of the rights holder. Generally, such use may only be permitted if the proposed user has made efforts to obtain authorization from the rights holder on reasonable commercial terms and conditions and if such efforts have not been successful within a reasonable period of time. However, WTO Members may waive this requirement in the case of a national emergency or other circumstances of extreme urgency or in cases of public non-commercial use. In any event, the rights holder shall be notified as soon as reasonably practicable. Moreover, the rights holder shall be paid adequate remuneration in the circumstances of each case, taking into account the economic value of the authorization (except in situations where, following a due legal process, the authorization is granted to remedy a situation of anti-competitive practice).

In addition, the scope and duration of such use or compulsory license shall be limited to the purpose for which it was authorized and the license awarded on a non-exclusive and non-assignable basis.<sup>9</sup> The TRIPS Agreement states that such action should be authorized predominantly for the supply of the domestic market of the Member concerned, subject to adequate protection of the legitimate interests of the persons authorized for such use, and subject to termination if and when the circumstances which led to it cease to exist and are unlikely to recur. The competent authority shall have the authority to review, upon motivated request, the validity of any decision related to the authorization including whether there is a continued existence of the circumstances provoking the action.

### ***The TRIPS Agreement and Copyright and Related Rights***

The TRIPS Agreement affirms key elements of the Berne Convention (1971), such as national treatment and the automatic availability of protection without formalities. Under the Berne Convention, protection generally includes the exclusive right of the rights holder to

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<sup>9</sup> In the case of semi-conductor technology, such an approach is limited to public non-commercial use or to remedy a practice determined after judicial or administrative process to be anti-competitive.

authorize translation, adaptation or arrangement, public performance, recitation, communication to the public, broadcast, reproduction of the work<sup>10</sup> or use of the work as the basis for a subsequent audiovisual work.

Under the TRIPS Agreement, performers and broadcasters are to shall have the possibility of preventing the fixation of their unfixed performance, the reproduction of their performances and phonograms, the (re)broadcasting and communication to the public of their live performances. The TRIPS Agreement further adds, “[i]n respect of at least computer programs and cinematographic works”, the right to authorize or to prohibit the commercial rental to the public of originals or copies of their copyright works, though subject to some exceptions.

The TRIPS Agreement specifies that copyright protection shall extend to expressions and not to ideas, procedures, methods of operation or mathematical concepts as such. Computer programs, whether in source or object code, are to be protected as literary works under the Berne Convention. Protection is also extended to compilations of data or other material, whether in machine readable or other form, provided that the selection or arrangement of their contents constitute intellectual creations. Such protection does not extend to the data or material itself and shall be without prejudice to any copyright subsisting in the data or material itself.

The TRIPS Agreement affirms the general term of protection specified in the Berne Convention as being 50 years after the death of the author or 25 years in the case of applied art or photography. In most other cases, it is set as 50 years from the end of the calendar year of authorized publication, or, failing such authorized publication within 50 years, 50 years from the end of the calendar year of making. Protection for broadcasts is to be at least 20 from the end of the calendar year of the broadcast.

### ***The TRIPS Agreement and Trademarks***

Trademarks can be registered for all goods and services. The TRIPS Agreement specifies that “any sign, or any combination of signs, capable of distinguishing the goods or services of one undertaking from those of other undertakings, shall be capable of constituting

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<sup>10</sup> States contracting to the Berne Convention may permit, in certain special cases, reproduction without authorization provided that the reproduction does not conflict with the normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the author; A contracting state may also provide, in the case of sound recordings of musical works, for a right to equitable remuneration.



a trademark. Such signs, in particular words including personal names, letters, numerals, figurative elements and combinations of colours as well as any combination of such signs, shall be eligible for registration as trademarks. Where signs are not inherently capable of distinguishing the relevant goods or services, Members may make registrability depend on distinctiveness acquired through use. Members may require, as a condition of registration, that signs be visually perceptible.”

According to the TRIPS Agreement, use cannot be made a condition for accepting trademark *applications* nor shall an application be refused solely on the ground that intended use has not taken place before the expiry of a period of three years from the date of application. If use is required to maintain a registration, the registration may be cancelled only after an uninterrupted period of at least three years of non-use, unless valid reasons based on the existence of obstacles to such use are shown by the trademark owner (*e.g.* import restrictions or other government requirements for goods or services protected by the trademark).

The Agreement requires that “{i}nitial registration, and each renewal of registration, of a trademark shall be for a term of no less than seven years. The registration of a trademark shall be renewable indefinitely.” Members are required to publish each trademark either before it is registered or promptly after it is registered and shall afford a reasonable opportunity for petitions to cancel the registration. In addition, Members may afford an opportunity for the registration of a trademark to be opposed.

An owner of a registered trademark benefits from “the exclusive right to prevent all third parties not having the owner’s consent from using in the course of trade identical or similar signs for goods or services which are identical or similar to those in respect of which the trademark is registered where such use would result in a likelihood of confusion. In case of the use of an identical sign for identical goods or services, a likelihood of confusion shall be presumed.”<sup>11</sup> While WTO members may determine conditions on the licensing and assignment of trademarks, they cannot employ compulsory licensing of trademarks and they must grant owners of registered trademarks the right to assign such trademark with or without the transfer of the business to which the trademark belongs.

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<sup>11</sup> WTO Members may provide limited exceptions to the rights conferred by a trademark, such as fair use of descriptive terms, provided that such exceptions take account of the legitimate interests of the owner of the trademark and of third parties.

With respect to the use of a trademark in the course of trade, the TRIPS Agreement states that this shall not be “unjustifiably encumbered by special requirements, such as use with another trademark, use in a special form or use in a manner detrimental to its capability to distinguish the goods or services of one undertaking from those of other undertakings.” However, this does not preclude a requirement prescribing the use of the trademark identifying the undertaking producing the goods or services.

### ***Building on the TRIPS Agreement***

The Uruguay Round Agreement (1994) proved to be a landmark accord, with a scope going far beyond traditional border measures (Table GI.1). While the prospect of expanded international economic relations was generally welcomed by competitive economic actors, some observers expressed fears that the reformed system may fail to deliver results or could even damage the interests of particularly disadvantaged social groups or even entire countries.<sup>12</sup> The lead up to the next round of multilateral negotiations, launched at the WTO’s Doha Ministerial Conference in 2001, was marred by an intense clash of diverse views on the economic implications of the reforms to-date and the prospects for further trade liberalisation.<sup>13</sup>

Traditional concerns cited with respect to trade liberalisation often focus on the effects of import penetration and structural adjustment. With the expansion of the range of issues covered by the MTS, however, the focus of the debate expanded to take in the economic implications of a number of new “trade plus” issues such as trade-related IPRs, trade and labour standards, trade and environment, trade and investment, or trade and competition. Developed countries promised technical assistance and support for capacity building as part of package deals intended to better integrate developing countries into the MTS.

By the end of the WTO’s Singapore Ministerial Conference (1996), Member countries had clarified their collective approach to dealing with several of the most prominent of these “trade plus” issues under the reformed MTS. Trade-related IPRs would be handled within a framework administered by the WTO (in co-operation with the World Intellectual Property Organisation). Labour standards issues would not be covered by the MTS (with the exception

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<sup>12</sup> E.g. see Aisbett, Emma (2005).

<sup>13</sup> E.g. see the University of Washington *WTO History Project* web site, which documents the context and the clashes in relation to the 1999 WTO Ministerial Conference in Seattle: <http://depts.washington.edu/wtohist/>.

of a prior-existing provision concerning prison labour). While various WTO agreements touch on the remaining three issues in a limited fashion, there was no further agreement among members on broadened treatment for investment, competition and the environment under the rules of the MTS. Rather, these three issues would continue to be studied by various WTO bodies, with limited scope for expanded treatment under the MTS absent a broad consensus.

Initially, non-specific commitments for multilateral and bilateral assistance were built into various MTS agreements and declarations; these were subsequently firmed up in the WTO Hong Kong Ministerial Conference (2005), which launched a task force to operationalise aid for trade and monitoring by the OECD of the aid-for-trade flows, accompanied by increased donor pledges of assistance. These flows are now quite substantial (USD 25 billion in 2007). Some of these flows have gone for assistance to developing countries to improve their IPR regimes.<sup>14</sup>

Of particular relevance for IPRs, at the Doha Ministerial Conference in 2001, WTO members issued the *Declaration on The TRIPS Agreement and Public Health*, to make clear their intention for the TRIPS Agreement to contribute positively to public health.<sup>15</sup> In the WTO's current (Doha Round) negotiations, two outstanding IPR issues concern: i) whether and how to extend coverage to additional products the high standard of protection available for wines and spirits under geographical indications; ii) whether to require disclosure in patent applications of the origin of any related genetic material or traditional knowledge, including information on the permission to use either and the associated sharing of economic benefits. However, on these latter two matters there remain broad differences among WTO Members.<sup>16</sup>

The evolution of the MTS and the implementation of the enhanced international framework for IPR in the context of trade required consensus among WTO Members, though under the single undertaking approach, the choices for some Members were in some cases stark in that they were forced to consider the benefits of the package as a whole and not simply select the parts that were most advantageous to their own interests. Thus, some reluctantly accepted certain elements about which they were less than enthusiastic including

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<sup>14</sup> E.g. the International Development Law Organisation is providing IPR assistance. See: <http://www.idlo.int/DOCCalendar/222DOC.pdf> (available as of 3 August 2009).

<sup>15</sup> The Declaration is available here (as of 3 August 2009): [http://www.wto.org/english/thewto\\_e/minist\\_e/min01\\_e/mindecl\\_trips\\_e.htm](http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm).

<sup>16</sup> For more information, see the web site of the International Centre for Trade and Sustainable Development: <http://ictsd.net/i/news/bridgesweekly/51824/>.

the TRIPS Agreement, a perspective that in some cases persisted even in the decade that followed the completion of the Uruguay Round.<sup>17</sup>

With respect to this period, Lippoldt (2006) noted, “Developing country perspectives vary on the importance of IPRs in their economic policy frameworks. Public debate in these countries is sometimes caught up in emotive issues such as implications for public health and access to medicine or the need to prioritise among many competing demands for limited government resources. Implementation costs of IPR commitments undertaken in the various international agreements can be significant.<sup>18</sup> On the other hand, some developing countries have sought to exploit strengthened IPRs strategically as a development tool. For example, they may see IPR policy as a means to draw in investment and to encourage innovation, with the potential to boost development on both the extensive dimension (overall size of the economy) as well as the intensive dimension (i.e., the value-added per employee). Government officials from a wide range of economies have pointed to strengthened IPRs as a plank in their strategies to enhance FDI inflows and trade.<sup>19</sup> For example, experts in some poor developing countries have seen the institution of trademark protection as a vehicle for reassuring investors in manufacturing industries that they can combat knock-offs. For wealthier countries, enhancement of IPRs is seen as a means to draw in high technology that can boost worker productivity and contribute to intensification of growth.”

As pointed out in the TRIPS Agreement itself, the strengthening of IPRs was intended to have a development dimension, promoting technology transfer and reinforcing incentives for innovation. The TRIPS Agreement and related IPR reforms were clearly seen by the WTO Member states as having important economic potential. Douglass North has provided a more general characterisation as to why such institutional reform is economically important, writing that “Institutions and the way they evolve shape economic performance [...] by determining (together with the technology employed) the cost of transacting and producing. They are composed of formal rules, informal constraints and of their enforcement characteristics; while

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<sup>17</sup> *E.g.* see Deere (2008).

<sup>18</sup> Finger and Schuler (2001) provide an overview of costs related to the implementation of WTO Uruguay Round commitments with respect to IPR reform, customs valuation and sanitary and phytosanitary standards. Deere (2008) considers specifically the TRIPS Agreement.

<sup>19</sup> *E.g.* China and Singapore have integrated IPRs in their national economic strategies and affirmed their importance on government web sites: <http://www.chinaipr.gov.cn/policy/documents/241260.shtml> and [http://notesapp.internet.gov.sg/\\_48256DF20015A167.nsf/LookupContentDocsByKey/DEVT-5UBEYS?OpenDocument](http://notesapp.internet.gov.sg/_48256DF20015A167.nsf/LookupContentDocsByKey/DEVT-5UBEYS?OpenDocument), respectively (available as of 2 August 2009).

formal rules can be changed overnight by the polity, informal constraints change very slowly.”<sup>20</sup>

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<sup>20</sup> North (1997).

Table GI.1. The GATT Trade Rounds

Year	Place	Issues covered	Number of countries
1947	Geneva	Tariffs	23
1949	Annecy	Tariffs	13
1951	Torquay	Tariffs	38
1956	Geneva	Tariffs	26
1960-61	Geneva (Dillon Round)	Tariffs	26
1964-67	Geneva (Kennedy Round)	Tariffs	62
		Anti-dumping measures	
		Development	
1973-79	Geneva (Tokyo Round)	Tariffs	102
		Non-tariff measures	
		Framework agreements on:	
		• Subsidies and countervailing measures	
		• Technical barriers to trade (sometimes called the Standards Code)	
		• Import licensing procedures	
		• Government procurement	
		• Customs valuation	
		• Anti-dumping	
		• Bovine Meat Arrangement	
		• International Dairy Arrangement	
		• Trade in Civil Aircraft	
1986-94	Geneva (Uruguay Round)	Tariffs	123
		Non-tariff measures	
		Rules	
		Services	
		<b>Intellectual property</b>	
		Dispute settlement	
		Textiles and clothing	
		Agriculture	
		Creation of WTO	
		Subsidies	
		Investment measures	
		Government procurement	
		Civil aircraft	
		(Among others)	

Source: Based on WTO, 2008, p. 16.

*Table GI.2. The WTO Context for Intellectual Property*

AGREEMENT ESTABLISHING WTO		
Goods	Services	Intellectual property
Basic Agreement: GATT	Basic Agreement: GATS	Basic Agreement: TRIPS
Other goods agreements and annexes; schedules of commitments	Services annexes and schedules of commitments	
Dispute Settlement		
Trade Policy Review (transparency)		
Source: Based on WTO, 2008, p. 24.		

Table GI.3. TRIPS Agreement: illustrative features for three types of property

	Copyright	Patents	Trademarks
<b>Availability of protection</b>	Automatic	Must apply for it in each WTO Member	Must apply for it in each WTO Member
<b>Minimum term of protection</b>	<p><i>Individual creators:</i> 50 years after author's (or last co-author's) death, except 25 years for applied art or photography</p> <p><i>Most other cases:</i> 50 years from the end of the calendar year of authorized publication, or failing that (within 50 years), 50 years from the end of the calendar year of making</p> <p><i>Broadcasts:</i> at least 20 from the end of the calendar year of the broadcast</p>	<p>20 years from date of filing</p> <p><i>Undisclosed test data submitted in relation to marketing approval of pharmaceuticals or agricultural chemicals:</i> protection against unfair commercial use (the minimum term is unspecified in the Agreement, but in a number of countries taken to mean 5 years for pharmaceuticals and 10 years for agricultural chemicals).</p>	<p><i>Initial registration and renewals:</i> no less than seven years each</p> <p>The registration of a trademark is renewable indefinitely.</p>
<b>Coverage</b>	<p>Every production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression.</p> <p>Computer programmes are treated as literary works (under the Berne Convention).</p> <p>Databases are protected.</p>	Any invention, whether product or process, in all fields of technology, provided that it is new, involves an inventive step [ <i>i.e.</i> they are non-obvious] and is capable of industrial application [ <i>i.e.</i> useful]. Protection of some type must be available for plant varieties, with patents being one possible means.	Any sign, or any combination of signs, capable of distinguishing the goods or services of one undertaking from those of others. <i>E.g.</i> words including personal names, letters, numerals, figurative elements and combinations of colours, or any combination of such signs.
<b>Excluded coverage</b>	Protection extends to expressions and not to ideas, procedures, methods of operation or mathematical concepts as such.	Inventions excluded from commercial exploitation to protect public order or morality, human, animal or plant life or health, or to avoid	In some cases, signs that are not visually perceptible ( <i>i.e.</i> WTO Members may require, as a condition of registration,



	Copyright	Patents	Trademarks
		serious prejudice to the environment. WTO Members may also exclude from patentability: (a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals; (b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes.	that signs be visually perceptible).
<b>Protection: prevention of abuse</b>	Availability of means of redress to protect rights. <i>Also, for performers and broadcasters:</i> the right to prevent the fixation of unfixed performances, the reproduction of performances and phonograms, (re)broadcasting and communication to the public of live performances.  <i>For computer programs and cinematographic works, and potentially other works:</i> the right to authorize or prohibit the commercial rental of copyright works, though subject to some exceptions.	Right to prevent third parties from the acts of making, using, offering for sale, selling or importing for these purposes products that embody the invention (or in the case of a process, then the product obtained directly by that process).	Right to prevent third parties not having the owner's consent from using in the course of trade identical or similar signs for goods or services that are identical or similar to those for which the trademark is registered, where such use would result in a likelihood of confusion.
<b>Key rights: market use of the protected intellectual</b>	Exclusive right to authorize translation, adaptation or arrangement, public performance, recitation,	Exclusive right to conduct the acts referenced above. Also, the right to assign, or transfer by succession, the	Exclusive right to use of trademark. Also, right to assign trademark, but WTO Members may

	<b>Copyright</b>	<b>Patents</b>	<b>Trademarks</b>
<b>property</b>	communication to the public, broadcast, reproduction of the work or its use as the basis for a subsequent audiovisual work.	patent and to conclude licensing contracts.	impose terms and conditions on licensing.
<b>Selected additional requirements</b>		Applicants must disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. They may also be required to indicate the best mode known to the inventor for carrying it out.	
<b>Use of the intellectual property without rights-holder permission</b>	Subject to some conditions: states contracting to the Berne Convention may permit, in some cases, reproduction without authorization (provided that the reproduction does not conflict with the normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the author). Use is tolerated, <i>e.g.</i> for citations or teaching illustrations.	Under certain conditions ( <i>e.g.</i> national emergency or remedy of anti-competitive behaviour), compulsory licensing may be used. Flexibilities are available, <i>e.g.</i> in the interest of public health (remuneration may be payable). In 2001, WTO Members extended until 2016 the exemptions on pharmaceutical patent protection for least-developed countries.	Generally no compulsory licensing permitted. Members may provide limited exceptions to rights: such as fair use of descriptive terms, but such exceptions must take account of the legitimate interests of the owner and third parties.

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## **Chapter I**

# **Developing Countries and the International Institutional Structure for Intellectual Property Rights in the Multilateral Trading System**

## I The International Institutional Structure for Intellectual Property Rights in the Multilateral Trading System

**Abstract:** Drawing on a broad sample of developing and OECD countries, this chapter considers the hypothesis that international intellectual property rights reforms, in particular the advent of the WTO TRIPS Agreement, operating in combination with industrial interests have significantly influenced the evolution of institutions in relation to patent rights, particularly in developing countries, during the period from 1990 to 2005. After reviewing key points from relevant literature and the stylised facts, the text moves to present an empirical analysis that considers a range of objective and subjective indicators for institutional factors that hypothetically could be associated with changes in patent rights in this time frame. The analysis finds that, in the sample of developing countries and in a broader sample of countries, there is a significant association of domestic and international institutional factors with change in the level of patent rights protection and that the relative level of patent rights at the end of the period is associated with the stock of intangible capital and certain institutional factors.

**JEL codes:** O24 (trade policy), O34 (intellectual property rights)

**Keywords:** Intellectual property rights, development

## A Introduction<sup>21</sup>

During the 1990s, a wave of international institutional reform reshaped the landscape for intellectual property rights (IPRs), to some extent taking place in parallel to trade liberalisation associated with the conclusion of the Uruguay Round of multilateral trade negotiations and the progress of economic transition in the formerly socialist countries. The World Trade Organisation's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) came into effect in 1995 and continues to play a central role in this process. The TRIPS Agreement established minimum IPR standards and an international framework to review and enforce those standards.<sup>22</sup> In parallel with the advent of TRIPS, the World Intellectual Property Organisation (WIPO) witnessed a significant increase in adherence to the various international treaties that it administers. More broadly, the wave of IPR reform continues to roll out around the world, including in a number of developing countries where the initial protection of IPRs was weak, at best, at the start of the 1990s.

Patents figure prominently in the list of types of intellectual property covered by these reforms and patent rights are the main focus of this dissertation.<sup>23</sup> As a consequence of the on-going IPR reforms, protection of patent rights has increased globally and, in a few cases, the standards in developing countries are beginning to approach the high levels found in the advanced economies. This strengthening of protection for patent rights merits particular

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<sup>21</sup> Portions of this chapter, as noted in the text, draw on the Patent Rights Index developed by Walter G. Park, American University, Washington, DC, and his colleagues, an indicator used here with his kind permission; the chapter also references previous analyses developed by the present author in co-operation with him. In addition, the author wishes to acknowledge, with gratitude, the advice, references and suggestions received on various aspects of the author's research from Carlos Alberto Primo Braga, Ricardo Cavazos, Patrick Messerlin, Sébastien Miroudot, Jonathan Senft, Charles Tsai and Jayashree Watal, as well as from colleagues and participants at various seminars where early elements of this work were presented (including seminars organised by University of Maastricht, London School of Economics, Réseau de Recherche sur l'Innovation, Stockholm Network, Quaker United Nations Office, Free Market Foundation of Southern Africa, University of Connecticut (Storrs) and OECD). The author gratefully acknowledges the support for this research project of Ken Ash, Director, and Raed Safadi, Deputy-Director, Trade and Agriculture Directorate, OECD.

<sup>22</sup> The inclusion of IPR issues in the WTO was controversial. For example, Jagdish Bhagwati (2002) has commented that protection of intellectual property is "not a trade issue; the WTO ought to be about lowering trade barriers and tackling market access problems. The inclusion of [intellectual property protection] has turned the organisation into a royalty collection agency." Moreover, Bhagwati argued that inclusion of IPR issues has opened the door to increased pressure on the WTO by various lobby groups pushing for the organisation to address a range of causes they deem to be trade related. In the view of such critics, this may encumber the WTO with issues beyond its core mission and weaken its ability to deliver trade liberalisation.

<sup>23</sup> The other main types of intellectual property covered by these reforms include copyright, trademarks, trade secrets, industrial designs, geographical indications, and topographies of integrated circuits.



analytical consideration in that it may be influencing conditions for economic performance in the reforming countries. (Chapters 2 and 3 of this dissertation will address this point in depth.) For example, some empirical studies – controlling for other factors – are pointing to a positive association of strengthened patent rights in developing countries with progress in certain other variables for economic performance including imports (*e.g.* of high technology products), foreign direct investment, technology transfer and domestic innovation, albeit with some variation by sector or country (*e.g.*, Park and Lippoldt, 2008, p. 5; Maskus, 2004, p. 3). Moreover, the strength of patent protection is correlated with the strength of certain other key institutional variables, and some developing countries appear to be taking a strategic approach to IPR reform as one part of their larger economic development strategies. That is, improved performance in the area of protection of patent rights, for example, may be accompanied by improved performance in certain other areas targeted for institutional reform (*e.g.* competition policy).

The multilateral trading system has played a major role in promotion of economic integration, in part by influencing the evolution of institutions related to intellectual property rights in developing countries. In view of the increasing globalisation of markets and the establishment of international standards for patent rights protection, competitive pressures are challenging developing countries to address basic shortcomings in their national IPR regimes. Conformity with the minimum global patent standards has become, in effect, a prerequisite for developing countries wishing to access and exploit the full range of global technologies and know-how.

The chapter begins with a discussion of theory and key points from relevant literature. The text then moves to present an empirical analysis, starting with a review of the stylised facts concerning the evolution of the indicator, followed by consideration of a range of objective and subjective indicators for institutional factors that hypothetically could be associated with changes in patent rights in this time frame. The chapter then considers modelling results highlighting the association of international institutional changes with changes in the protection of rights for patents. Certain relevant domestic factors are also taken into account, including level of economic development and domestic institutions.

## **B Theoretical Motivation and Context**

This section presents the motivation and context for the following empirical assessment. It first reviews the role of institutions and the nature of intellectual property as key elements for this dissertation; it then presents the stylised facts concerning the evolution of the strength of protection for intellectual property rights in developing countries.

### **1 The role of institutions<sup>24</sup>**

As is underscored in a large and growing swath of economic literature, institutional reform can influence the functioning of an economy in important ways. Douglass North, in the introduction to a 1997 paper examining problems of economic transition, provides a useful summary:

“Institutions and the way they evolve shape economic performance. Institutions affect economic performance by determining (together with the technology employed) the cost of transacting and producing. They are composed of formal rules, of informal constraints and of their enforcement characteristics; while formal rules can be changed overnight by the polity, informal constraints change very slowly.”

In an interesting working paper, Jorge Bateira (2009) takes a contrasting and somewhat more abstract and conceptual view of institutions, drawing in part on perspectives from evolutionary economics. He sees institutions as being more than just rules and constraints; rather, they are complex systems formed by the interaction of social systems (e.g., networks and organisations) and culture (in the sense of norms or language – semiotics – that influence an individual’s perceptions of reality and participation in social systems). Innovation flows in an emergent fashion as self-organising problem-driven networks of actors (representing institutions of the economy, state, and science and education) overcome conflicting interests to develop a common vision of a solution. In light of this central role for institutions in innovation, Bateira sees institutional change as being at the centre of development processes.

Nevertheless, institutions are but one factor influencing the evolution of a given economy. Therefore, it is useful to examine the relative importance of institutions in shaping growth. Rodrik, Subramanian and Trebbi (2002), for example, conducted one such study, yielding a particularly striking comparison of the deep sources of economic growth. Striving

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<sup>24</sup> This section draws on material from Lippoldt (2008a).

to peer beyond the first-level determinants (capital accumulation -- human and physical -- and productivity change), they consider three “strands of thought” from the literature on the underlying drivers of growth. These consider geography, international trade integration and institutional quality, respectively, as central factors accounting for differences in average income levels among nations. Using a series of regressions to relate incomes to indicators for geography, integration and institutions, they find that the quality of institutions is the key factor. The institutional indicator exhibits a relatively large, positive and statistically significant relationship to income. Once the authors control for institutional quality, “integration has no direct effect on incomes, while geography has at best weak direct effects.” Moreover, in further assessments of the relationships among these variables, they find institutional quality to have a positive and significant effect on international trade integration, while trade in turn can have a positive influence on institutional quality (suggesting an indirect influence on incomes). However, the authors do not offer policy prescriptions with respect to institutions, rather citing evidence that “desirable institutional arrangements have a large element of context specificity, arising from differences in historical trajectories, geography, political economy or other initial conditions.”

Bénassy-Quéré, Coupet, and Mayer (2007) provide a wide-ranging assessment of the importance of the quality of institutions in attracting foreign direct investment (FDI). They use three approaches to conduct their analysis: first, a standard gravity model, then cross-country regression estimations drawing in part on the relatively new and detailed *Institutional Profiles* database (available via the *Centre d'études prospectives et d'informations internationales*, CEPPII, and constructed in co-operation with the French Ministry of Economy, Finance and Industry) and, finally, a panel data assessment drawing in part on the *Fraser Institute* time-series data set. The authors conclude that host-country institutions matter as determinants of FDI, independently of gross domestic product (GDP) per capita; good institutions are almost always associated with increased amounts of FDI inflows. With respect to bureaucracy, corruption, information, banking sector and law, good institutions are especially important determinants of inward FDI. They also note that institutional convergence between host country and source country tends to help increase inflows of FDI. Summing up, the authors underscore that “[t]he orders of magnitude found in the paper are large”, meaning that moving from a low level to a high level of institutional quality can have a substantial impact on FDI.

In light of the central role that institutions appear to play in the functioning of economies, it may be expected that reform of IPR institutions would be associated with economic impacts. Technological progress plays a central role in boosting productivity (output per worker), which in turn is a first-level determinant of income levels and growth.<sup>25</sup> If inward trade, direct investment and licensing can be influenced by the strength of IPRs in an economy, then governments may be able to exploit IPR policy as one element in a broader policy framework aiming to enhance these flows. Inflows of goods, direct investment and licenses embody various types of intellectual property and represent a channel of technology transfer. Indeed, Park and Lippoldt (2008) find IPR strengthening in developing countries – particularly with respect to patents – is associated with increased technology transfer via trade and investment and with increased domestic innovative activity as measured by domestic patent filings, albeit with some variation across countries and sectors. This conclusion seems in line with the spirit of Article 7 of the TRIPS Agreement, which provides that “the protection and enforcement of intellectual property rights should contribute to the transfer and dissemination of technology.”

## 2 The nature of intellectual property<sup>26</sup>

Intellectual property is differentiated from physical goods by its very nature. Unlike a material resource, a single bit of intellectual property can be made available simultaneously and repeatedly on a non-exclusive basis to multiple users, generally at a low marginal cost. Consequently, as underscored by Jones (2004) and Warsh (2006), new ideas embodied in intellectual property can contribute to technical progress with “disproportionate” impacts on economic growth. A single idea can be applied repeatedly in a non-rivalrous fashion, potentially yielding big returns on investment. Given this economic potential, policy makers may be particularly motivated to design policies with a view to boosting development of new intellectual property domestically<sup>27</sup> and improving access to existing intellectual property from abroad.

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<sup>25</sup> E.g., see WTO (2002) and Hoekman and Smarzynska (2006) for a discussion and bibliographic references on technology transfer and trade.

<sup>26</sup> Portions of this section draw on Lippoldt (2008b).

<sup>27</sup> With respect to the literature on domestic innovation, Branstetter *et al.* (2006) note mixed findings on the impact of strengthened IPRs in reforming countries. They provide a helpful list of key references on this issue.

Demsetz (1967) presents a concise statement of the importance of property rights in general and intellectual property rights in particular. He notes (p. 347) that,

“Property rights are an instrument of society and derive their significance from the fact that they help a man form those expectations which he can reasonably hold in his dealings with others. These expectations find expression in the laws, customs, and mores of a society. An owner expects the community to prevent others from interfering with his actions, provided that these actions are not prohibited in the specifications of his rights.”

With respect to intellectual property rights, specifically copyright and patents, Demsetz states (p. 359),

“If a new idea is freely appropriable by all, if there exist communal rights to new ideas, incentives for developing such ideas will be lacking. The benefits derivable from these ideas will not be concentrated on their originators. If we extend some degree of private rights to the originators, these ideas will come forth at a more rapid pace.”

That is, the non-rivalrous, non-exclusive nature of intellectual property leaves an original innovator or subsequent rights holder facing a challenge in appropriating economic benefits from the intellectual property.<sup>28</sup> The act of legal specification of IPRs provides the owners of such intellectual property with means to prevent abuse of their rights, enabling them to better capitalise on their innovations and thereby providing incentives for further innovation. Without such protection most intellectual property would become, in effect, a public good. While some innovations could be protected via other means (e.g., first mover advantage or secrecy), in most cases the loss of such protection would substantially weaken the ability to profit from innovation and, hence, the incentive for private entities to invest in such goods.

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<sup>28</sup> Maskus (2000, p. 28-29) provides a clear description of these characteristics noting that intellectual property, being based on information, has 2 traits of a public good: i) a nonrivalrous aspect, meaning that one person's use of the intellectual property does not diminish another's use and ii) a non-excludable aspect meaning that it may not be possible by private means to prevent others from using the information without authorization.

Seen from an economic perspective, the incentives for innovators need to provide for an appropriate degree of protection without conferring excessive market power such as might be employed to impede alternate or neighbouring innovation.<sup>29</sup> Under the various systems governing IPRs, the rights of the owner to exclude others from use of intellectual property are balanced against certain obligations (e.g., the public disclosure of certain information related to patents), limits on the extent of protection (e.g., in terms of duration of patents or copyright, granting of research exemptions, or public health waivers) and some other constraints (e.g., with respect to anti-competitive practises in contractual licenses).<sup>30</sup> Maskus (2000, p. 6) describes the characteristics of systems put in place to protect IPRs as having three dimensions: i) standards (i.e., specification of the innovator or creator rights to exclude others from exploiting their inventions or creative expressions), ii) limitations on those rights, and iii) enforcement (i.e., “administrative and judicial actions by public authorities to safeguard the rights granted”).

The absolute size of the stock of relevant and available intellectual property appears to be an important factor in relation to productivity. As Jones (2004) notes, “Because of the non-rivalrous nature of ideas, output per person depends on the total stock of ideas in the economy instead of the per capita stock of ideas.” Since intellectual property can easily be shared across borders, the scope of the available stock can be nearly global, subject to an appropriate international framework and the willingness of rights holders to facilitate access. Singapore and Hong Kong-China are examples of economies that have overcome scale limitations in their domestic stocks of intellectual property, in part, through their integration into the global economy; among other initiatives in this regard, they have undertaken commitments with respect to the international framework agreements governing intellectual property.

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<sup>29</sup> In theory, overly-stringent protection could confer excess market power on rights-holders. For example, this could happen if granted patents are too broad and extend market exclusivity to enable the original innovators to take action to block innovation in neighbouring areas well beyond the scope of the original innovation. Moreover, this may not only impede competitors, but also weaken the incentives in some cases for the original innovator to innovate further (e.g., if they can profitably continue exploiting existing innovations while postponing new innovation efforts). *Encaoua et al.* (2003) offer an extensive reference list on this issue. Also, Jaffe and Lerner (2004) provide an extensive assessment of the need to improve the quality of the patent system in the United States in order to curb incentives to abuse of the market power; such abuse can arise, for example, through the filing “bogus” patent applications and then threatening costly litigation as a means to secure financial settlements or impede competition.

<sup>30</sup> WTO (2006) provides a useful summary of some of these issues in relation to the TRIPS Agreement and pharmaceutical patents.

With respect to patents, the importance of protection to rights holders may vary depending on the ease with which the ideas can be imitated (Mansfield, 1994). An exporter of specialty steel with a unique manufacturing process may not be especially concerned about patents in a particular destination market if the exported good cannot be easily reverse engineered. On the other hand, a software producer – whose code can be easily copied by anyone with a laptop computer – may hesitate to sell into a market where technological literacy is high and piracy is commonplace. While a goods producer in a competitive market may get paid the full amount of his or her marginal product, in the absence of a mechanism to protect patents there risks to be little or no return to the originators of patented ideas and hence insufficient incentives for them to innovate.

Developing country perspectives vary on the importance of IPRs for their economic policy frameworks. Public debate on IPRs in these countries is sometimes caught up in emotive issues such as implications for public health and access to medicine.<sup>31</sup> Some critics point to significant implementation costs that can be associated with IPR commitments undertaken in the various international agreements.<sup>32</sup> Correa (2005) and others have challenged the legal and economic implications of strengthening IPRs, alleging that the system of international IPR rules is imposing an undue burden on developing countries.<sup>33</sup> One accusation is that the emerging standards increase the cost of intellectual content in products sought by developing countries, while developing countries may not have the capacity to capitalise on their own potential in a similar manner. Moreover, some critics allege that the bargain underlying the strengthening of the international IPR regime has not

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<sup>31</sup> At the Doha Ministerial Conference in 2001, WTO members issued the *Declaration on The TRIPS Agreement and Public Health*, to make clear their intention for the TRIPS Agreement to contribute positively to public health; see [http://www.wto.org/english/thewto\\_e/minist\\_e/min01\\_e/mindecl\\_trips\\_e.htm](http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm).

<sup>32</sup> Finger and Schuler (2001) provide an assessment of costs related to the implementation of WTO Uruguay Round commitments with respect to IPR reform.

<sup>33</sup> The criticism is certainly not limited to developing country observers. Scholars such as L. Lessig and M. Boldrin and D. K. Levine have questioned the strengthening of IPRs more generally. E.g. Lessig (2002, 1999) has challenged the privatisation of the so-called “intellectual commons” and the expanded range of patentable innovation in the US that now includes such areas as Internet business methods. Boldrin and Levine (2007) recognise the need for incentives for innovation, including the right of sale with regard to innovative ideas. However, they challenge the right to regulate the use of innovations after their sale, proposing instead that innovators should make better efforts to capitalise on their first-mover advantages.

been satisfied. Namely, they feel that promises of technology transfer (e.g., as in TRIPS, Article 66.2) and FDI do not appear to be yielding adequate results for developing countries.<sup>34</sup>

On the other hand, some developing country governments have sought to exploit strengthened IPRs strategically as a development tool intended to encourage investment and domestic innovation. They see this as having the potential to boost development on both the extensive dimension (overall size of the economy) as well as the intensive dimension (i.e., the value-added per employee).<sup>35</sup> For example, experts in some poor countries have seen the institution of trademark protection as a means to reassure investors in manufacturing industries that they can combat knock-offs. For wealthier countries, enhancement of IPRs may be seen as a means to draw in high technology that can boost worker productivity.

On the other hand, weak IPRs in a particular market may discourage a foreign rights holder from making intellectual property available there because of the potential inability to appropriate the returns from its use.<sup>36</sup> Weak IPRs in such a market could be doubly damaging to the rights holder in the event a competitor makes use of the intellectual property; a rights holder may not only miss out on direct sales in that market but may wind up competing against her own innovation if it is sold by the competitor in third markets.

## 5 Mechanisms Driving the Strengthening of Patent Rights and other IPRs

The literature on economic regulation provides some insights into domestic forces that may drive change in regulation. Stigler (1971), for example, notes that interest groups may seek regulation for money, control over entry, control over substitutes and complements, or price fixing. He notes that the state has the power to coerce (e.g., through taxation) and that makes it an attractive means for interest groups to gain economic advantage. In democratic societies, these groups can advance their interests in changing policy settings through a sort of market-based transaction with politicians or political parties. Those aiming for election have

<sup>34</sup> Expressing similar concerns, Brazil and Argentina made a proposal in 2004 for WIPO to launch a new development agenda. The text of their proposal is available here: [http://www.wipo.int/documents/en/document/govbody/wo\\_gb\\_ga/pdf/wo\\_ga\\_31\\_11.pdf](http://www.wipo.int/documents/en/document/govbody/wo_gb_ga/pdf/wo_ga_31_11.pdf).

<sup>35</sup> E.g., the governments of Cambodia, China and Singapore have integrated IPRs in their national economic strategies and affirmed the importance of IPRs on national web sites: [http://www.cnv.org.kh/2010\\_releases/04feb10\\_new\\_building\\_min\\_commerce.htm](http://www.cnv.org.kh/2010_releases/04feb10_new_building_min_commerce.htm) (recommendation 3), [http://www.sipo.gov.cn/sipo\\_English/news/official/201005/t20100505\\_516934.html](http://www.sipo.gov.cn/sipo_English/news/official/201005/t20100505_516934.html) <http://www.ipos.gov.sg/topNav/abo/Vision+Mission+and+Values.htm>.

<sup>36</sup> However, as noted above, this will vary by sector and the availability of alternate means to protect innovation. It will also depend on the ability of economic entities in the host country market to engage in imitation.



resource needs; interest groups may compete to provide such resources in order to advance their own policy objectives. In other words, interest groups seeking a particular policy setting may be willing to “pay” in terms of mobilising resources (e.g., financial support or volunteers) and votes for a political candidate or party. Peltzman (1976) provides a more formal specification of Stigler’s insights, noting the asymmetry in regulatory forces. He argues that the net benefits of such decisions tend to accrue to relatively small groups of winners with intense economic interests in particular policy settings; the economic benefits more than offset the cost to support the regulators politically. While majorities in society may suffer economic disadvantage as a consequence, their losses are spread over a larger population and consequently their resistance will tend to be comparatively weak.

Drawing on the insights of Stigler and Peltzman, one can hypothesise that innovators and creators (or subsequent rights holders) might constitute such an economic interest group seeking regulation in the form of strengthened patent rights (or other IPRs). Domestically, this might take place via industry groupings, which have the direct economic interest and means to mobilise the necessary resources for a political “transaction”.<sup>37</sup> This may prove to be more challenging for foreign businesses, which may face challenges in mobilising votes and resources for politicians or political parties in another country. For example, in a given foreign market their actions may provoke a nationalist backlash and damage their cause. On the other hand, large foreign firms may be in a better position to influence their own governments. They may choose to use such influence to lobby for their governments to take particular policy stances in international organisations setting global standards. In some cases, they will successfully align sufficient international coalitions to succeed in changing the international standard (e.g., introduction of patent rights issues into the international trade regime through the TRIPS Agreement). Via this channel, they may influence the policy setting in destination markets where they sell their products or have other business interests. In some cases, such interests may be purely defensive, such as preventing competitors from

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<sup>37</sup> In developed countries, one might hypothesize that the political and economic clout of the pro-IPR groups (many of which are well-resourced incumbents) would outweigh that of many opposing groups such as some generic producers of pharmaceutical products or free culture supporters. In developing countries, it is perhaps more difficult to form an hypothesis *a priori*. For example, new market entrants or less innovative producers may seek to benefit from weak IPRs in order to boost opportunities to imitate; they may constitute an influential interest group. However, innovative domestic firms and other producers seeking to partner and acquire technology from firms in developed countries (which may insist on adequate IPR protection as a precondition) may form a lobby in favour of stronger IPR protection. As a country develops, one might anticipate a shift in favour of stronger IPR protection, but it is difficult to predict at what point this might take place.

abusing their intellectual property. In others, the interests may be positively related to the operation of their businesses such as in terms of conducting research, production or sales activities.

While divergences remain between the levels of patent protection in developed and most developing countries (discussed in detail in the next section), many developing countries have moved in recent decades to reform previously weak national systems of IPR protection. In some cases, countries with ineffectual, dated (including some dating from a former colonial era) or poorly adapted systems have moved to join the WTO and adhere to the TRIPS Agreement, to ratify international treaties administered by WIPO, and to engage in regional trade agreements that sometimes include IPR provisions going beyond the TRIPS Agreement. Though improved enforcement may lag changes in law, the reform efforts at the multilateral level do appear to be resulting in concrete changes on the ground.

#### *A The TRIPS Agreement and Regional or Bilateral Trade Agreements*

The TRIPS Agreement has been associated with substantial change in patent-related institutions in both developing and developed countries. In part, the power of the TRIPS Agreement to drive change appears to be associated with the relatively potent review and enforcement possibilities that exist via the WTO's TRIPS Council and Dispute Settlement Understanding. These can have political and economic consequences in cases of government-to-government disputes on IPR issues.<sup>38</sup> Thus, from the outset the TRIPS Agreement drove IPR reform in most WTO founding-member countries, but it also continues to extend its geographic reach as additional countries accede to the agreement.

The TRIPS Agreement, which came into effect on 1 January 1995, covers the main types of intellectual property – including patents<sup>39</sup> – and establishes more effective and geographically inclusive international minimum standards of protection for IPRs than had existed previously. The agreement specifies WTO member obligations to enforce IPRs. Through the WTO's framework for trade policy review, dialogue and dispute settlement it

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<sup>38</sup> Private agents such as firms and individuals do not have direct recourse to these mechanisms in the WTO.

<sup>39</sup> The IPRs covered by the TRIPS Agreement include: copyright and related rights, trademarks, geographical indications (of origin), industrial designs, patents, layout-designs (topographies) of integrated circuits, and protection of undisclosed information (trade secrets). A full text of the TRIPS agreement is available on the WTO web site: <http://www.wto.org>.

also provides pathways for redress among WTO members in cases of non-compliance by governments.

WTO (2008) notes that the TRIPS Agreement details “how to give adequate protection to intellectual property rights”, “how countries should enforce those rights adequately in their own territories” and “how to settle disputes on intellectual property between members of the WTO”. The objective of the agreement is clearly stated in Article 7, which notes that “The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.” Subject to this additional notion of “balance”, the TRIPS Agreement affirms the applicability of the basic principles of the trading system, namely, national treatment and most favoured nation (MFN) treatment. Moreover, it expressly builds on the framework of previously existing accords administered by WIPO (discussed below).

The TRIPS Agreement goes a step further than the WIPO accords in that it establishes international minimum standards applicable across the WTO membership, though subject to transition periods and certain exemptions.<sup>40</sup> Moreover, it provides for enhanced means to ensure IPRs are enforced and that countries abide by their commitments. The agreement established a Council for TRIPS and charged it with monitoring the operation of the agreement and, in particular, WTO Members' compliance with their obligations under the agreement, while providing members with the opportunity of consulting on matters relating to the trade-related aspects of intellectual property rights. In cases of where this mechanism is not adequate, members have recourse to the Dispute Settlement Understanding, which applies to consultations and the settlement of disputes under the TRIPS Agreement.

Patents, an important type of intellectual property, are exclusive rights granted to innovators upon application to national authorities with regard to inventions that are novel, useful and mark an innovative step over existing technology.<sup>41</sup> With respect to patent rights,

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<sup>40</sup> By 2005, most of the transition periods had expired, with the exception of certain that apply for the Least Developed Countries (LDCs, as identified by the United Nations), notably with respect to pharmaceutical patenting.

<sup>41</sup> In another formulation, Delft University of Technology defines a patent as, “a licence issued by government that gives the holder exclusive rights to a process, design or new invention for a designated period of time.” Available here: <http://www.library.tudelft.nl/tulib/glossary/index.htm#P> (as of 1 October 2010).

subject to certain exemptions, the TRIPS Agreement made clear that patents should generally be available for most technologies, cover products and processes, provide at least 20 years protection, and ensure the owner's right to prohibit use by third parties without consent.<sup>42</sup>

According to the TRIPS Agreement, WTO Members may implement in their law more extensive IPR protection than the minimum required under the agreement, provided that this does not contravene the agreement. In this spirit, regional and bilateral trade agreements involving OECD members and developing countries often include IPR references going beyond the TRIPS Agreement (e.g., the Euro-Mediterranean Association Agreements), as do some agreements among developing countries (e.g., Mercosur<sup>43</sup>). For example, Fink and Reichenmiller (2005) reviewed 13 recent or pending US free trade agreement texts and found that all of them included IPR provisions going beyond those of the TRIPS Agreement in some manner (e.g. by requiring the extension of the patent term in cases where there are delays caused by regulatory approval processes). In a review of 15 regional accords, Lippoldt (2003) found that most included one or more provisions going beyond the strict requirements the TRIPS Agreement. Often these additional requirements concern conformity with, or accession to, other relevant international agreements. For example, some agreements require adherence to WIPO's so-called Internet Treaties (*i.e.* the Copyright Treaty and Performances and Phonograms Treaty) as is the case under the EU-Mexico or US-Jordan trade agreements. There are also examples of regional trade agreements that have special provisions concerning shortened transition periods, enforcement or co-operation, among other issues.

### *B WIPO Treaty Ratifications*

WIPO administers a series of international IPR treaties developed over many years. Since 1990, the geographic coverage of the treaties was notably extended via increased numbers of ratifications. This occurred, in particular, in relation to the launching of economic reforms in the former socialist countries and in association with the coming into effect of the TRIPS Agreement, which references four of these treaties.

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<sup>42</sup> The Annex to the General Introduction to this dissertation provides more information on patents in the context of the TRIPS Agreement.

<sup>43</sup> The Mercosur *Treaty of Asuncion* was supplemented in 1995 with *The Protocol On Harmonization Of Norms On Intellectual Property In Mercosur In Matters Of Trademarks, Indications Of Source And Appellations Of Origin*. The accord includes some provisions going beyond the TRIPS Agreement, such an article committing the signatories to address conflicts over its implementation first of all directly via diplomatic consultation and if necessary via the conflict resolution procedures of Mercosur.

The TRIPS Agreement references three WIPO Conventions that are currently in effect.<sup>44</sup> During the period from 1990 to 2005, the number of ratifications expanded significantly for all three:

- The *Paris Convention for the Protection of Industrial Property* (ref. patents, trade marks, industrial designs, utility models, geographical indications) experienced 72 new ratifications. As of January 2010, the total number was 173.<sup>45</sup>
- The *Berne Convention for the Protection of Literary and Artistic Works* (ref. copyright and neighbouring rights) experienced 79 new ratifications (as of January 2010, the total number was 164);
- The *Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organisations* experienced 48 new ratifications (as of January 2010, the total number was 88).

Particularly for the Paris and Berne Conventions, this was a considerable burst of activity in a relatively short period, given that both treaties date originally from the 1880s. Figure I.1 highlights the leap in the number of ratifications of the Paris Convention during the period of the present study (from 1990 to 2005); that treaty is the most germane of the three for patents, the main focus of this chapter. The effect of these ratifications was to extend specific protections for intellectual property and related processes as countries moved to comply with the various provisions. For example, the Paris and Berne Conventions include provisions on “national treatment”, meaning that within the terms specified in the conventions, the ratifying country must offer non-nationals the same protection as it grants to its own nationals.

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<sup>44</sup> That is, the TRIPS Agreement explicitly references: i) Paris Convention for the Protection of Industrial Property including the Stockholm Act of this Convention of 14 July 1967; ii) Berne Convention for the Protection of Literary and Artistic Works including the Paris Act of this Convention of 24 July 1971; iii) International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations, adopted at Rome on 26 October 1961. The TRIPS Agreement also references the Treaty on Intellectual Property in Respect of Integrated Circuits, adopted at Washington on 26 May 1989, but the Washington Treaty is not yet in force.

<sup>45</sup> The Paris Convention concerns industrial property (including patents, marks, industrial designs, utility models, trade names, geographical indications) and repression of unfair competition. Its substantive provisions fall into three main categories: national treatment, right of priority, and common rules. For more information, see the summary on the WIPO web site, available here (as of 20 January 2010):

[http://www.wipo.int/treaties/en/ip/paris/summary\\_paris.html](http://www.wipo.int/treaties/en/ip/paris/summary_paris.html).

## C Data

The data for the central empirical analyses of this chapter are briefly presented in this section (additional descriptive information is provided directly in the tables and figures). The following analyses examine the influence of international institutions on the evolution of patent rights during the period 1990 to 2005 and level of protection for those rights in 2005 drawing on data from various sources. For assessment of the international institutional determinants of the protection of patent rights, the dependent variable is the Patent Rights Index,<sup>46</sup> originally developed by Walter Park and Juan Ginarte of American University in Washington DC (Ginarte and Park, 1997), updated by Park and Wagh (2002), and further refined by Walter Park (2008, with the data first applied in Park and Lippoldt, 2008). For comparison, various subjective indicators of institutional strength are also presented in this section, including several series drawn from the Institutional Profiles 2006 database provided by CEPII<sup>47</sup> (presented in more detail in the next section) and the World Economic Forum's Global Competitiveness Report (2005-2006).<sup>48</sup>

In conducting the present analyses, the author tested a range of potential determinants of the Patent Rights Index, following an initial review of the literature and formulation of the initial hypothesis. The main variables tested as independent or control variables are as follows: i) membership status in the OECD and WTO (the latter implies adherence to the TRIPS Agreement), whereby member lists and dates of accession were found on the websites for each organisation; ii) contracting party status with respect to the *Paris Convention for the Protection of Industrial Property* of the World Intellectual Property Organisation, whereby the list was found on the WIPO web site;<sup>49</sup> iii) GDP per capita (constant 2000, USD),

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<sup>46</sup> The Annex to this Chapter presents a full list of the components and the weights employed in calculating the Patent Rights Index.

<sup>47</sup> The *Institutional Profiles Database 2006* is based on reporting from French economic agents in 85 developing and developed countries around the world. The database was built by researchers from the French Ministry for the Economy, Industry and Employment (MINEIE) and the French Development Agency (AFD) and was constructed from a world survey conducted with MINEIE and AFD agencies present in the countries covered in the database. Data are also available for previous a wave conducted in 2001, though covering fewer questions and countries, and for a later wave conducted in 2009, covering an expanded group of countries with a revised questionnaire. For more information see: <http://www.cepii.fr/anglaisgraph/bdd/institutions.htm>.

<sup>48</sup> The comparative analysis including the three indicators (*Patent Rights Index*, *Institutional Profiles* and *Global Competitiveness Report*) concerned one time period (2005-2006) and a common set of countries for which data were available from all three sources.

<sup>49</sup> The Paris convention contracting parties are listed here (as of 13 January 2010): [http://www.wipo.int/treaties/en/ShowResults.jsp?country\\_id=ALL&start\\_year=ANY&end\\_year=ANY&search\\_what=C&treaty\\_id=1&treaty\\_id=2](http://www.wipo.int/treaties/en/ShowResults.jsp?country_id=ALL&start_year=ANY&end_year=ANY&search_what=C&treaty_id=1&treaty_id=2).

whereby data were drawn from the World Bank's World Development Indicators database; iv) the influence of domestic and foreign lobbies, with data drawn from the *Institutional Profiles 2006* database provided by CEPII; v) the stock of intangible capital, whereby the data were drawn from the study entitled "Where is the Wealth of Nations?" (World Bank, 2006) and are described in more detail below.

With respect to the upper income countries, the expectation with respect to each of these main variables is for a positive relationship to the strength of patent rights. This is due to participation in strengthened international legal commitments or the effects of international pressure via peer review or legal action (i and ii) and it is due to the interests associated with the growing stock of intellectual property and its role in contributing to economic growth (iii, iv and v). However, the expectation is that the direct role of foreign lobbies in patent rights reform may be somewhat attenuated relative to that of domestic lobbies due to political economy issues and the potential for backlash against foreign interests. In less developed countries, the anticipated pattern is similar, with one exception: domestic industrial interests in these developing countries may be supportive of strengthened patent rights if they perceive opportunities for domestic innovation or technology transfer from partners abroad, but they may also be ambivalent or opposed to strengthening of patent rights if they perceive a potential for greater gains from imitation.<sup>50</sup>

## **D The Patent Rights Index: Stylised Facts**

The expanded recognition of internationally established IPRs is evident in key indicators for IPR strength and application. Prior to proceeding with the regression analysis, this section considers the evolution and composition of the Patent Rights Index, which is the principal dependent variable for the subsequent econometric analyses. The Patent Rights Index is an objective indicator of the strength of patent rights based on laws on the books and is presented here in comparison with subjective indicators, as well as being decomposed to highlight the underlying patterns of change for various country groups.

### **1 Characteristics of the Patent Rights Index**

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<sup>50</sup> The latter case may arise, for example, in middle-income countries that have advanced technologically to the point where imitation is feasible but still lack key inputs for truly innovative activity. The empirical assessment presented below aims to shed light on which tendency dominates on average in a broad sample of developing countries.

The principal indicator of the stringency of patent rights protection employed in the following analyses is the Patent Rights Index. This index is part of a family of four indicators of IPR strength developed by Park *et al.* covering patents, copyright, trademarks and enforcement effectiveness (see Annex I.1 for a listing of the components of these indices).<sup>51</sup> This sub-section presents key characteristics of the Patent Rights Index and compares it with other related indicators.

Table I.1 highlights the evolution over the study period (1990 to 2005) in the four indices developed by Park *et al.* The Patent Rights Index (Panels A and B) and the Copyright and Trademark Rights indices (Panel B) are *based on laws on the books*, regardless of the application of those laws in practice. However, as noted by Douglass North (1997), there is sometimes a difference between formal and informal institutions, with the latter generally changing gradually. In addition to the gap between formal and informal institutions, the effectiveness of a change in formal institutions may also be subject to implementation difficulties. The Enforcement Effectiveness Index provides a complementary perspective to the objective laws-on-the-books approach, taking into account subjective business perceptions of the *application of the IPR laws in practice* (based on business perceptions as reported to the Office of the US Trade Representative). The four Park *et al.* indicators vary in their geographic coverage by index, but the samples are quite broad.

Although the central analysis in this chapter focuses on patents, all four indices are presented in Table I.1 in order to provide the reader with a sense of the evolution of the overall environment for IPR protection. The scores indicate a substantial increase in IPR strength over this period particularly with respect to the indices for laws on the books (i.e., the Patent Rights, Copyright, and Trademark Rights Indices). Scores for the patent rights index were substantially higher than scores for the Copyright or Trademark Rights indices. Business perceptions of enforcement effectiveness recognised improvements during the period, but still found performance in terms of application in practice on average to be lagging.

Panel A presents a comparison of the averages for the Patent Rights Index for developing and OECD countries.<sup>52</sup> The data in Panel A are presented for all countries covered

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<sup>51</sup> The relevant references for the four indices are as follows: Index of Patent Rights: Ginarte and Park (1997), Park and Wagh (2002), Park (2008); Index of Copyright and Index of Trademark Rights: Reynolds (2003) and Park (2005); Enforcement Effectiveness Index: Park and Lippoldt (2005).

<sup>52</sup> OECD countries are defined as a group, notwithstanding the fact that certain Members (e.g., Mexico) may assess themselves as developing countries in certain contexts with respect to IPRs.



by the Patent Rights Index and for the sub-sample comprised of any country referenced in the quantitative analysis for this dissertation; a sub-sample was employed because some of the independent variables for the analyses were not available for all countries covered by the Patent Rights Index. In other words, for both developing and OECD country groupings, the use of sub-samples for the detailed analyses was driven by data availability.<sup>53</sup>

The comparison of developing countries to OECD countries underscores the progress developing countries have made in closing the gap on IPR stringency with the OECD countries, nearly doubling the average index scores. Nonetheless, significant gaps remain as the averages are still separated by more than one point each on the scale of 0 to 5.<sup>54</sup> It is notable that the OECD countries have also undertaken significant reforms during the period covered by this study, significantly strengthening their laws on the books. In some cases, this was related to the alignment of basic policy settings catalysed by the advent of the TRIPS Agreement minimum standards. In other cases, this was due to leading OECD countries pushing beyond TRIPS standards (e.g., going beyond the requirements of the TRIPS Agreement with respect to the type of protection implemented for plant varieties or in limiting recourse to compulsory licensing). As for the Patent Rights Index scores for the sub-sample of countries covered at any point in the empirical analysis of this paper, it can be seen that the averages are roughly in line with those for the broader samples of developing and OECD countries.<sup>55</sup>

With respect to the developing countries, the lagging in Patent Rights Index scores during the period of study reflects a combination of factors including: the effects of TRIPS Agreement transition periods, the exercise of legitimate flexibilities available under the agreement, the hesitance of some countries to accept a push towards TRIPS-plus standards, and the apparent failure of some countries to fully comply with the minimum standards (e.g., due to lagging institutional development), among other possibilities. The timing for most of the TRIPS Agreement transition periods available to developing countries began in 1995 and ran for varying lengths (see the Annex to the General Introduction of this dissertation for

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<sup>53</sup> By using sub-samples, the degree of heterogeneity in the data is reduced and this contributes to a robustness check on the findings.

<sup>54</sup> The analysis in Chapters 2 and 3 will highlight the economic significance of variation in the Patent Rights Index in terms of relationship to variation in indicators of international economic performance (e.g., inflows of FDI or imports).

<sup>55</sup> For developing countries a modest difference in the scores of the full sample and the sub-sample developed over time, reaching (in 2005) a magnitude of 0.15 points out of a possible score of 5 points.

more details). For most developing countries, the last of these periods came to an end in 2005. However, following an accord among WTO members in 2002, the Least Developed Countries (LDCs) will continue to benefit from an extended transition period through 2016 with respect to pharmaceutical products.<sup>56</sup> As for flexibilities, these provide substantial latitude in specifying policy settings within the TRIPS-Agreement minimum standards with respect to certain areas of IPR protection. One example concerns plant variety protection, an area where countries may protect innovation through granting of patents or a *sui generis* system or by a combination of both approaches. Concerning issues of non-compliance, it is clear that globally there are challenges for both developing and developed countries to satisfy the requirements of the TRIPS Agreement. One indication is the value of trade in counterfeit and infringing products, which one OECD study estimated as being the equivalent of about 2% of the value of global trade in 2005 (OECD, 2009). Other indications can be found in the trade complaints of some countries such as those found in the US Trade Representative's National Trade Estimate reports or the Japanese Ministry of Economy, Trade and Industry (METI) annual report highlighting "*METI Priorities on WTO Inconsistent Foreign Trade Policies*", which sometimes highlights TRIPS-related issues. The 2005 METI report expressed concerns, for instance, with respect to the abundance of infringing products in China.<sup>57 58</sup>

A longer-term perspective can be garnered from Figure I.2, which presents the evolution of the average Patent Rights Index scores for developing and current OECD countries since 1960. The figure highlights gradual increases in the average scores for both groups up to 1990, followed by larger increases for both groups during the 1990s and into the 2000s. The timing of these increases coincides with the implementation of the TRIPS Agreement, which was implemented in developed countries upon its entry into force in January 1995 and in developing countries roughly in line with the designated transition periods.

<sup>56</sup> During the transition period for LDCs, the requirement to offer patent protection and exclusive market rights for pharmaceutical products is suspended, though these countries must establish a so-called mailbox to receive patent applications for consideration in the post-transition period. For more information see the websites of the WTO (e.g., [http://www.wto.org/english/news\\_e/pres02\\_e/pr301\\_e.htm](http://www.wto.org/english/news_e/pres02_e/pr301_e.htm)) and ICTSD (e.g., <http://ictsd.org/i/ip/39211/>).

<sup>57</sup> The 2005 report on *METI Priorities on WTO Inconsistent Foreign Trade Policies* is available (as of 18 January 2010) at this location: <http://www.meti.go.jp/english/report/downloadfiles/2005WTO/METIPriorities.pdf>.

<sup>58</sup> E.g., these issues are sometimes discussed in the WTO TRIPS Council. More information is available here: [http://www.wto.org/english/tratop\\_e/trips\\_e/intel6\\_e.htm](http://www.wto.org/english/tratop_e/trips_e/intel6_e.htm).

In summing up this discussion of the evolution of the Patent Rights Index, one can see from the evidence presented a substantial overall change in the legal institutions with respect to patents, as reflected in the index. This was the case despite the various shortfalls or delays in implementation. The steps towards strengthening of laws on the books have the potential to provide economic agents globally with a signal as to the future course of government policy. In turn, this may provide an incentive for new innovation and improved diffusion of existing innovation via market mechanisms. (The issue of economic performance and improved patent rights protection will be addressed in the next two chapters of this dissertation.)

A second set of indicators employed here is drawn from the *Institutional Profiles* database available from CEPII. These indicators provide scores for conditions across nine institutional sectors based on a survey of French government economic officials resident in countries around the world. As of the time of drafting, three waves have been conducted – in 2001, 2006 and 2009. The structure of the survey has evolved across the three waves with increasing country coverage (from 51 countries in 2001, to 85 in 2006 and 123 in 2009) and some developments in the questionnaire. The focus of the present dissertation is on the 2006 edition of the database, which corresponds roughly to the end point of the study period and provides subjective information on the environment for IPRs. The indicators considered here concern formal arrangements for IPR protection, respect for IPRs in practice, the effectiveness of competition regulation arrangements, security of formal property rights, pressures arising through WTO membership and pressures arising through RTAs.

Table I.2 presents correlations between the objectively determined Patent Rights Index and a range of subjective IPR indicators and other qualitative institutional indicators, as well as OECD Membership status.<sup>59</sup> The subjective indicators are drawn from the CEPII *Institutional Profiles* dataset for 2006 and from the World Economic Forum's (WEF) Global Competitiveness Report for 2005-2006. The table covers a range of developed (20) and developing (47) countries. The table points to relatively modest correlation between the Patent Rights Index and the subjective indicators of IPR protection including the CEPII indicators of respect for intellectual property, the CEPII indicator for perceptions of the formal arrangements for protection of intellectual property, and the WEF indicator of intellectual property protection. Though statistically significant, all are less than 0.7 in terms

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<sup>59</sup> In order to avoid misinterpretation of correlation coefficients, it is important to keep in mind that while they may indicate association, a high correlation does not imply causality and does not control for other factors.

of magnitude (i.e., not high).<sup>60</sup> Apparently, the objective change in terms of patent laws on the books does not correspond closely with general perceptions of business executives concerning intellectual property protection.<sup>61</sup>

On the other hand, the WEF indicator correlates relatively strongly with the CEPPI IPR and formal property rights indicators shown in the table. One explanation might be that the perceptions of respect and protection of rights lag the change in laws on the books. This might be due to delays in implementation or the time it takes the various parties to learn about the application of new legal instruments or more stringent application of existing instruments. Overall, though fairly modest, the association of the subjective indicators and the Patent Rights Index is non-negligible and indicates some tendency for stronger laws on the books to correlate with stronger appreciation of IPRs in practice.

It is interesting that there is a comparatively strong correlation of the Patent Rights Index with subjective appreciation of the effectiveness of arrangements for competition regulation. The interaction of competition policy and IPR strengthening can be important in balancing interests and promoting innovation. This is because IPR strengthening confers increased market power on the rights holders (e.g., through the exercise of rights to market exclusivity for a given invention), whereas effective institutions for competition can facilitate development of alternatives or collaborative enhancements. Nevertheless, in a survey of the recent economic literature on the interaction between competition law and intellectual property rights, Ganslandt (2008) notes the prevailing view that these regulatory systems are consistent in terms of basic principles, but that it is difficult to balance IPR and competition law in practice.

Table I.2 also presents the correlation between the Patent Rights Index and membership in the OECD. While the OECD lacks a strong body of formal legal arrangements requiring specific levels of IPR protection, its general policy orientations and practices in terms of peer review and accession requirements may be expected to promote among its members development of legal institutions for IPR protection at least at the level of the TRIPS minimum standards, if not even more stringent. For example, there is a de facto requirement

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<sup>60</sup> In view of the sample considered here, as a rough rule of thumb, a correlation coefficient of greater than 0.7 might be considered high. At such levels, variation in one data series corresponds to about 50% or more of the variation in the other series.

<sup>61</sup> The Patent Rights Index also exhibits only a modest correlation with the CEPPI indicator for security of formal property rights.

for OECD members to be members of the WTO. Moreover, in recent years IPR protection has been given increased coverage in OECD studies, policy dialogue and some legal instruments.<sup>62</sup>

## 2 Composition of Change in the Patent Rights Index, By Country Group

Figures I.3 through I.7 present the evolution and composition of the Patent Rights Index during the period from 1975 to 2005, by country group.<sup>63</sup> The current OECD countries are presented together and the non-OECD developing countries are presented grouped according to World Bank Analytical Classifications income groupings.<sup>64</sup> The year 1975 was selected as a starting point for the figures in order to present the evolution of the index from the time of some of the earliest moves to introduce protection of certain IPRs into the multilateral trading system.<sup>65</sup> The figures highlight the contrast not only in the Patent Rights Index levels between OECD countries and developing countries, but also the components driving the change in index scores for each country group. Table I.3 presents the numerical scores for the Index in 1975 and 2005, as well as the contribution of change in each component to the total change, by country group.

For the OECD countries (Figure I.3), a substantial jump of nearly 1 index point can readily be seen in the bars from 1990 to 1995. This points to a significant strengthening of the laws on the books that coincides with the timing of the entry into effect of the TRIPS Agreement. Overall, during the period covered by the figure and table, increased scores for membership in international treaties drove a substantial portion of the change in the index score for OECD countries. This included increased numbers of ratifications for the Budapest

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<sup>62</sup> While there are no formal, binding OECD-wide legal requirements concerning IPR protection, certain OECD legal instruments make reference to IPR protection (e.g., the OECD Guidelines for Licensing of Genetic Inventions, available here: [www.oecd.org/sti/biotechnology/licensing](http://www.oecd.org/sti/biotechnology/licensing)).

<sup>63</sup> See the annex for an overview of the construction and weighting of the index components that contribute to the changes observed in the index scores. Each component of the index is equal weighted and the elements within each component are also equal weighted. See Ginarte and Park (1997) for a discussion of the weighting. In a situation where it is difficult to assign weights to changes in non-numeric elements, the authors opted for a strategy of equal weighting so as to avoid introducing further bias. Thus, the index is capturing movement in the laws concerning any of its components, but it is not assigning differential values to the components.

<sup>64</sup> The World Bank Analytical Classifications are presented in the World Development Indicators database. The classifications used here are based on each country's standing as of 1990, the start of the study period for the regression analysis presented in the next section (E) of this dissertation.

<sup>65</sup> For example, Primo Braga (1995, p. 383) notes that the United States and others proposed that an Anti-Counterfeiting Code be introduced in the GATT already at a late stage of the Tokyo Round of negotiations (which ended in 1979); however, this early initiative failed.

Treaty<sup>66</sup>, the Patent Co-operation Treaty (PCT)<sup>67</sup>, the TRIPS Agreement and – to a lesser extent – the UPOV Convention.<sup>68</sup> Expansion in the coverage of patentable subject matter also played an important role, especially with respect to micro-organisms, plant and animal varieties, software, pharmaceutical products and utility models. Enforcement provisions in law were also substantially expanded, especially with respect to the reversal of the burden of proof (i.e., the accused must demonstrate that he or she did not infringe the intellectual property in question, in particular with respect to process patents) and penalties for contributory infringement (i.e., in cases where the action itself may not infringe, but may otherwise make possible the infringement).

In comparison to the OECD countries, other high-income countries scored substantially lower, despite registering a big increase of more than one point in their average score during the period from 1990 to 2000 (Figure I.4). The gap with the OECD countries was particularly notable in the area of membership in international treaties, especially with respect to ratification of the Budapest Treaty and the UPOV convention. On the other hand, the average scores for duration of patent protection and restrictions on patent protection for the high-income non-OECD country group were the same or close to those for OECD countries (Table I.3). Moreover, the big increase in the overall average score for these high-income countries was driven in part by increased membership in such treaties including the PCT and the TRIPS Agreement. Enforcement provisions were also strengthened on average with respect to reversal of burden of proof and contributory infringement. Coverage of patentable subject

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<sup>66</sup> According to the WIPO web site, the main feature of the Budapest Treaty is that “a contracting State which allows or requires the deposit of microorganisms for the purposes of patent procedure must recognize, for such purposes, the deposit of a microorganism with any ‘international depository authority’, irrespective of whether such authority is on or outside the territory of the said State.” The full summary is available here (as of 20 January 2010), [http://www.wipo.int/treaties/en/registration/budapest/summary\\_budapest.html](http://www.wipo.int/treaties/en/registration/budapest/summary_budapest.html).

<sup>67</sup> According to the WIPO web site, the Patent Cooperation Treaty “makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by filing an ‘international’ patent application. Such an application may be filed by anyone who is a national or resident of a PCT contracting State. It may generally be filed with the national patent office of the contracting State of which the applicant is a national or resident or, at the applicant’s option, with the International Bureau of WIPO in Geneva.” The full summary is available here (as of 20 January 2010), [http://www.wipo.int/treaties/en/registration/pct/summary\\_pct.html](http://www.wipo.int/treaties/en/registration/pct/summary_pct.html).

<sup>68</sup> The International Union for the Protection of New Plants seeks to “provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.” Its work is framed by the International Convention for the Protection of New Varieties of Plants. More information is available on the web site here (as of 20 January 2010): [http://www.upov.int/index\\_en.html](http://www.upov.int/index_en.html).

matter was expanded on average in such fields as microorganisms, plant and animal varieties, software and surgical products.

As can be seen in Figure I.5, the upper-middle income countries (non-OECD) closely trailed the high-income non-OECD countries in terms of their scores for the Patent Rights Index in 2005. The upper-middle income average scores for duration of protection and restrictions on patent production were the same or close to those for the OECD countries and the other high-income countries (Table I.3). This was the consequence of progress in catching up in some areas such as membership in the WIPO Paris Convention and the PCT, as well as nearly matching the performance of the wealthy countries with respect to membership in the TRIPS Agreement (though Russia remained a non-member). Strengthening was evident with respect to increased enforcement provisions, including especially reversal of burden of proof and availability of preliminary injunctions. Average coverage of patentable subject matter increased broadly, but particularly with respect to patentability of micro-organisms, utility models, and pharmaceutical products. Nonetheless, despite increases in these areas, on average these countries substantially lagged behind the OECD countries (and to a lesser extent the other high-income countries) with respect to enforcement, membership and coverage.

Figure I.6 presents the evolution of the level and composition of the average Patent Rights Index scores for the lower-middle income countries. This group substantially lagged behind the OECD Countries, but also the high-income and upper-middle income non-OECD countries. With an average score below 3.0 points in 2005, these countries generally scored well below the wealthier countries in all areas covered by the index except for the average duration of patent protection (Table I.3). This situation existed despite this group having delivered a larger proportional increase in average index score from 1975 to 2005 than the other country groups (Table I.3, bottom line). Substantial increases were made with respect to membership in international treaties (especially the WIPO Paris Convention, the PCT and the TRIPS Agreement<sup>69</sup>) and enforcement provisions (especially reversal of burden of proof and availability of preliminary injunctions). This group turned in the lowest performance of any

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<sup>69</sup> In the lower middle-income sample group, five countries had not yet ratified the TRIPS Agreement as of 2005: Iraq, Iran, Sudan, Syria and Ukraine. NB, Sudan is an LDC, but is included in this group for purposes of the present analysis due to its income levels in certain years.

group with respect to the extent of limitations on patent rights, in particular with respect to recourse to compulsory licenses and working requirements for patents granted.

The low-income country group delivered the lowest average score for 2005, and also the smallest ratio of increase of any of the groups over the period covered by the figures (Figure I.7 and Table I.3). This may not be surprising in view of the availability of extended transition periods under the TRIPS Agreement and the comparatively limited institutional capacity in many of these countries. In the area of duration of protection, their average score approached that of OECD countries (0.9 versus 1.0). With respect to restrictions on patent rights, they turned in a higher score than did the lower-middle income countries.<sup>70</sup> However, in other areas they scored on average substantially lower than the other groups, especially with respect to enforcement provisions. As of 2005, none of these countries had ratified the Budapest Treaty and only 1 had joined the UPOV convention. Although most had ratified the TRIPS Agreement, four had not done so (Ethiopia, Liberia, Somalia and Vietnam). Nonetheless, despite the weakness evident in their protection of patent rights, even the low-income countries delivered a substantial increase in terms of the laws on the books during the period from 1990 to 2005 (as can be seen in Figure I.7).

Summing up this review of the evolution of the Patent Rights Index by country group, it can be seen that all groups substantially increased their protection for patent rights during the period covered by the figures, with especially large increases in the period since 1990. Looking across the entire sample, the dispersion of the national Patent Rights Index scores decreased during the period from 1975 to 2005, as the coefficient for the entire sample decreased from 0.46 in 1975 to 0.27 in 2005. In some dimensions of protection such as duration, a clear international norm is generally in place. The broad acceptance of certain international agreements, such as the TRIPS Agreement and Paris Convention, indicates some convergence that is providing a basis in international law for core principles and procedures. Enforcement provisions were strengthened (notably the reversal of the burden of proof), coverage of various subject areas increased (notably for micro-organisms), and restrictions reduced (somewhat reduced recourse to revocation of patents). However, beyond the core

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<sup>70</sup> Primo Braga *et al.* (2000, Figure 1) draw on the Patent Rights Index to present evidence of a U-shaped curve whereby low-income countries may tend to perform better with respect to certain indicators for IPR protection than middle-income countries. This may be due to the fact that their industrial interests are less well developed and therefore less interested in seeking flexibility to imitate intellectual property from abroad. On the other hand, by setting IPR standards higher than would otherwise be the case these low-income nations may find some diplomatic, foreign assistance, market access or other advantages vis-à-vis developed countries.



points of general accord, there remains some significant variation across country groups with respect to laws on the books as they affect the institutional arrangements and extent of rights including membership in some international treaties (e.g., the Budapest Treaty), coverage of certain subject matter (e.g., software), restrictions on patent rights (e.g., compulsory licensing), and enforcement provisions (e.g., contributory infringement). The economic implications of this variation will be considered in chapters 2 and 3 of this dissertation.

### 3 Countries acceding to the WTO

As the multilateral trading system evolves over time, protection of IPRs has come to play a visible and important role. This has tended to have an impact on institutions globally. This is generally true for countries that have been well integrated and actively participating in the system for decades, but it is also particularly notable in countries that have joined the WTO since its creation in 1995. In joining the WTO, newcomers have been pushed to take on commitments and obligations that now go beyond the ‘traditional’ trade-related border issues and the accession process is working to ensure that implementation of these commitments advances. Evenett and Primo Braga (2009) note the expanding demands that are being placed on countries acceding to the WTO since 1995, including in the service sector and with respect to rules that in some cases may not be obviously trade-related. Figure I.8 highlights change in the strength of the Patent Rights Index in six countries newly acceded to the WTO, compared to the average score for a broad group of developing countries. As can be seen in the figure, each of the countries moved to strengthen its legal framework to a level roughly comparable to – or above – the average for the broader sample of developing countries. Moreover, the slopes of the lines indicate that between 1995 and 2000 all of these WTO accession countries strengthened their Patent Rights Index scores at rates exceeding those of the average developing country in the sample (i.e., the slopes are steeper for the accession countries than for the average). This underscores the extent of the change in the IPR institutions of these accession countries associated with WTO accession.<sup>71</sup>

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<sup>71</sup> While accession to the WTO has generally entailed a need for some IPR reform to strengthen protection in order to comply with TRIPS Agreement minimum standards, some nations have gone further in this IPR reform than others.

## **E Empirical Assessment**

The author conducted an empirical assessment with the objective of considering the possible role of international institutions in influencing the evolution of IPR protection in developing countries during the period from 1990 to 2005, as well as factors associated with the final level of protection at the end of the period (which is comparable in effect to considering in combination the initial level of protection and the change in IPR protection over the period). The analysis proceeded in two steps, first considering the evolution of protection and then the level of protection.

### **1 Institutional Determinants of Change in the Patent Rights Index**

Table I.4 presents the results of a regression analysis of change in the Patent Rights Index during the period 1990 to 2005, considered in relation to institutional factors that may potentially contribute to determination of such change and controlling for change in GDP. Various determinants are considered. In relation to the discussion of Stigler (1971) and Peltzman (1976), above, the role of industrial lobbies has been taken into account using CEPII indicators of the strength of the influence of large firms and banks (foreign and domestic) in a country's political affairs. Also considered is change in a country's status with respect to international institutions shaping IPR standards, in particular with respect to patent rights (i.e., WTO, WIPO and OECD). The regression analysis was pursued in order to reveal the association of change in the Patent Rights Index with possible determinants; however, it should be kept in mind that such analysis does not demonstrate causality.

The model was run four times: first using two different specifications for the full sample of countries for which there were available data, then – for each group in turn – for the developing countries and OECD countries, drawing on the sample. The first iteration of the model considers membership in the WTO and OECD.<sup>72</sup> However, inclusion of these variables creates a problem of endogeneity (countries decide directly whether to become members of these two organisations). Consequently, in the following three iterations two variables are substituted in order to consider qualitative assessment of the pressures that may arise *via*

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<sup>72</sup> An indicator for ratification of the WIPO Convention was included in the analysis on a trial basis, but the regression did not yield a significant coefficient for the variable and its inclusion did not substantially alter the other coefficients or the adjusted R-squared. Since its inclusion did not improve the performance of the model, it was dropped in order to have a more efficient model.

membership in WTO and RTAs (many of which include OECD members).<sup>73</sup> The two specifications of the model are as follows:

For iteration (1)

$$\Delta \text{Patent Rights Index}_i = a + b_1 * \text{Lobby (foreign)}_i + b_2 * \text{Lobby (domestic)}_i + b_3 * \text{WTO Accession}_i + b_4 * \text{OECD Member}_i + b_7 * \Delta \text{GDP p/c} + \text{error term},$$

and

For iterations (2), (3) and (4)

$$\Delta \text{Patent Rights Index}_i = a + b_1 * \text{Lobby (foreign)}_i + b_2 * \text{Lobby (domestic)}_i + b_3 * \text{WTO Pressures}_i + b_6 * \text{RTA Pressures}_i + b_7 * \Delta \text{GDP p/c}_i + \text{error term},$$

where,

$i$  = each country, in turn, from the sample

$\Delta$  Patent Rights Index = the absolute change in the patent rights index from 1990 to 2005 for country (i).

Lobby (foreign) = the CEPII-provided indicator (series A5002) of the influence of large foreign firms and banks in the country's political affairs, 2006 estimate,

Lobby (domestic) = the CEPII-provided indicator (series A5000) of the influence of large domestic firms and banks in the country's political affairs, 2006 estimate,

WTO Accession = a dummy variable to indicate whether the country joined the WTO after its establishment in 1995,

OECD Member = a dummy variable to indicate whether the country was a member of the OECD as of 2005,

WTO Pressures = the CEPII-provided indicator (A8031) of the pressures arising through membership in the WTO on the country's political affairs, 2006 estimate,

RTA Pressures = the CEPII-provided indicator (A8032) of the pressures arising through membership in the RTAs on the country's political affairs, 2006 estimate,

$\Delta$ GDP p/c = the change in percent in the country's per capita GDP during the study period from 1990 to 2005 (based on constant USD valuation).

As can be seen from Table I.4, the model produces significant coefficients for one or more variables in each iteration. However, the results for iterations (2) and (4) include only one weakly significant coefficient in each case. The coefficients for the lobby influence of

<sup>73</sup> See the next analysis (Table I.5) for an alternative approach using instrumental variables.

large *foreign* firms and banks, pressure arising through WTO membership, and the control variable (change in per capita GDP) are not significant in any iterations of the model. The adjusted R-squared indicator points to a fair degree of explanatory power with respect to iterations (1) and (3), but little explanatory power in the case of iterations (2) and (4).

For the full sample and for the developing countries, the coefficients for the *domestic* lobby variable are all significant and positive (i.e., associated with reform to strengthen patent rights). The coefficient for the influence of large domestic firms and banks is significant at the 1% level for iterations (1) and (3) and at the 10% level in iteration (2). The coefficient for this variable was not significant when OECD countries were considered separately (iteration 4). Thus, it appears that the extent of influence of these domestic firms collectively tends to have a positive relationship to the evolution of patent rights as measured by the index during the period 1990 to 2005, particularly in the case of developing countries. Their foreign counterparts may tend to be more reserved or less able to exert such influence, perhaps due to political constraints (e.g., perhaps resulting from concern about provoking an anti-foreign public backlash or perhaps simply a lack of access to local political figures). In the case of OECD countries (4), the lack of a significant coefficient for this variable may be due to the generally strong domestic lobby influence across OECD countries (i.e., a lack of variation).

The significant coefficient for the international institutional variable for WTO membership and, in the case of OECD countries, RTA membership indicates that the international commitments these institutions represent are indeed positively associated with change in the Patent Rights Index. This provides a more formal expression of the relationship that is evident from a brief inspection of Figure I.8 (i.e., the figure showing the evolution of the Patent Rights Index for a number of countries acceding to the WTO during the study period). At the same time the coefficient for OECD membership is significant, but negative (1). The intuition for this result is that most of the OECD countries had relatively strong IPR systems at the beginning of the study period (e.g., half had scores above 3.5 in 1990, including the United States and in Western Europe with scores above 4.0); and hence had less room to advance on the Patent Rights Index scale. Developing countries had much greater growth potential as a result of their much weaker average initial level of patent protection. OECD countries tended to strengthen their Patent Rights Index scores during this period, but the proportional change for these countries was smaller than for developing countries.

Having assessed these institutional factors in relation to the change in the Patent Rights Index over the study period, we turn to assess institutional factors associated with variation in the index scores at the end of the study period (i.e., to consider which institutional factors may be related to higher levels of protection of patent rights based on laws on the books). Again following the points raised in Stigler (1971) and Peltzmann (1976), the possible role of industrial lobbies is considered via the inclusion of the CEPII variables for the influence of large foreign and domestic firms and banks in political affairs. In considering the role of international institutions as a possible source of pressure for reform, it is hypothesized that pressures arising via membership in WTO, RTAs and OECD may be associated with higher scores. OECD Membership is considered as of 2000 in view of the relatively late development of IPR issues on the agenda of the organisation and the lack of an OECD legal instrument with reference to IPRs until the first decade of the new millennium.

The analysis includes, as a possible factor associated with strengthening of patent rights, the per capita stock of intangible capital. An indicator for intangible capital is drawn from a World Bank (2006) study of national wealth, where it is constructed – as a residual in the analysis – in such a manner as to include human capital, skills and know-how embodied in the labour force; social capital (trust and ability to collaborate positively); institutions and elements of governance (e.g., efficiency of the judicial system, clear property rights, and government effectiveness); net foreign assets; some natural capital (fisheries and sub-soil water, included for data reasons); and some measurement error.<sup>74</sup> The authors estimate that approximately 60% of the variation in the indicator is associated with rule of law and approximately 35% is associated with education. The hypothesis is two-fold: i) that as the stock of intangible capital grows, innovators will seek means to formalise those portions of such assets that are associated with their innovations, including through expanding protection through such means as patent rights and ii) as institutional capacity grows, governance systems may improve and make possible more ambitious IPR legal reforms and increased sophistication of means to protect patent rights. This is particularly relevant in light of the obligation contained in the TRIPS Agreement (Article 27.1) that, subject to certain provisions, “patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.” Thus, efforts to ensure compliance with the TRIPS Agreement can

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<sup>74</sup> The year 2000 is the only point in time for which these internationally comparable data are available.

drive legal reforms with respect to new technologies. For example, software may be used to draw on intangible capital and codify know-how and processes, and the range of countries that recognise the patentability of software-implemented inventions has increased substantially since the advent of the TRIPS Agreement may be patented under certain circumstances.

Unfortunately, the use of the indicator for intangible capital introduces a problem of endogeneity into the model (businesses, workers and governments can decide arbitrarily how much to invest). Consequently, an instrumental variable approach was employed. The related variable of GDP per capita served as the instrument, as it is highly correlated with the intangible capital variable (correlation coefficient of 0.91) but not with the error term of the model (correlation coefficient of 0.12).

The model for this regression analysis was specified using two variations. The first includes a dummy variable for OECD membership, which may be a channel for pressure to strengthen patent protection. However, as this variable may introduce endogeneity (governments decide whether to join), it was dropped and the model rerun without it for the subsequent iterations.

#### For iteration (1)

$$\text{Patent Rights Index}_i = a + b_1 * \text{Lobby (foreign)}_i + b_2 * \text{Lobby (domestic)}_i + b_3 * \text{WTO Pressures}_i + b_4 * \text{RTA Pressures}_i + b_5 * \text{OECD Membership}_i + b_6 * \text{IV Intangible Cap}_i + \text{error term}$$

and

#### For iterations (2), (3) and (4)

$$\text{Patent Rights Index}_i = a + b_1 * \text{Lobby (foreign)}_i + b_2 * \text{Lobby (domestic)}_i + b_3 * \text{WTO Pressures}_i + b_4 * \text{RTA Pressures}_i + b_6 * \text{IV Intangible Cap}_i + \text{error term}$$

where,

$i$  = each country, in turn, from the sample

Patent Rights Index = the patent rights index score for country (i) in 2005.

Lobby (foreign) = the CEPII-provided indicator (series A5002) of the influence of large foreign firms and banks in the country's political affairs, 2006 estimate,

Lobby (domestic) = the CEPII-provided indicator (series A5000) of the influence of large domestic firms and banks in the country's political affairs, 2006 estimate,

OECD Membership = a dummy variable to indicate whether the country was a member of the OECD as of 2000,

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WTO Pressures	= the CEPII-provided indicator (A8031) of the pressures arising through membership in the WTO on the country's political affairs, 2006 estimate,
RTA Pressures	= the CEPII-provided indicator (A8032) of the pressures arising through
IV Intangible cap	= the US dollar value of the per capita intangible capital of the country as of 2000 according to the World Bank estimates, instrumented using an indicator for GDP per employee (2000) drawn from the World Bank WDI databank on-line. <sup>75</sup>

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The model was run four times: twice for the full sample of countries for which there were available data, then – for each group in turn – for the developing countries and OECD countries, drawing on the respective samples. The OECD Membership variable was dropped for iterations (2), (3) and (4) due to endogeneity.

Table I.5 presents the results of a regression analysis of the level of the Patent Rights Index as of 2005 considered in relation to: (i) institutional variables that may potentially contribute to determination of the index levels and (2) the stock of intangible capital. As can be seen from the table, for each country group the results were most significant for the coefficient for the IV intangible capital variable. For the Full Sample (1 and 2), the significance of this variable was at the 1% level, while for the Developing and OECD country groups (3 and 4, respectively) this was at the 5% level. For the Full Sample and OECD Country iterations, the coefficients for the variable for lobby influence of large domestic firms and banks were significant as well, but either the 5 or 10% level. In the case of the Developing Countries, the coefficient for the influence of these domestic lobbies was not significant. The coefficients for the comparable variable for foreign firms were not significant in any of the specifications of the model. For the Full Sample iteration (1), the coefficient for the OECD membership variable was significant and positive.

The intuition for this outcome is that across most countries there is a tendency for increased stocks of intangible capital to be associated with increased effective motivation to protect intangibles –including via patents – and also an increased ability of institutions to deliver such protection. Also, large *domestic* firms and banks may tend to be effective in their collective lobby efforts in support of patent rights protection, though the coefficient is not significant in the case of Developing Countries. The model does not support the hypothesis that pressures arising via membership in the WTO are associated with relatively high levels of

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<sup>75</sup> Missing values for 5 developing countries (out of 62 in the sample) were estimated using supplementary information from the CIA World Factbook on-line and the ILO LABORSTA database on-line.

patent rights protection as measured by the Index. This result may be due to a lack of variation in the data, whereby WTO membership led to similar pressures for reform across most countries. This may also be the case with respect to RTAs. Membership in OECD does appear to be associated with relatively high levels of such protection (see Table I.5, iteration 1).<sup>76</sup> The OECD indicator may be positive and significant in this case because OECD countries tend to have relatively high scores with respect to the Patent Rights Index; recall that the dependent variable here concerns the level and not the recent change in the index scores, whereby the OECD countries had relatively high scores at the outset of the study period and further strengthened them during the study period, even if their increase during the period was proportionally smaller than the average increase for most developing countries (see Table I.3 bottom row).

## **F Conclusion**

Institutions matter for the economy and patent rights are a potentially important institution in term of technological innovation and diffusion. Consequently, it is of interest to examine factors that are associated with the wave of patent rights reform taking place across the developing countries in recent decades (i.e., the country group and timeframe of focus for this dissertation). In terms of laws on the books, how has protection of patent rights changed and what factors may be associated with this?

The answer is that patent rights have been strengthened significantly in both developing and OECD countries. Since 1990, however, the change has been proportionally larger in developing countries, particularly the middle and high-income developing countries. Reform of patent rights is being cemented by increased commitment to key international treaties, and emerging standards in duration and coverage of subject matter, as well as reduced numbers of restrictions on patents and increasingly aligned approaches to enforcement. The strength of patent protection in terms of laws on the books appears correlated with reform of protection for other types of intellectual property and the strength of certain other key institutional variables (e.g., competition policy); this may be an indication that some countries may be taking a strategic approach to IPR reform as one part of their larger economic development

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<sup>76</sup> This result should be interpreted with caution, due to the possible influence of endogeneity on the result. Note that the Patent Rights Index makes no reference to OECD and that this result is not therefore a direct result of the manner in which the index is constructed. However, it should be noted that all OECD members are contracting parties to both the Paris Convention and the TRIPS Agreement.



strategies. While domestic firms in certain sectors in developing countries may oppose such reform (e.g., due to business strategies based on imitation), it appears that on average large firms and banks in these countries have tended to either support the reforms or to be less than effective in exerting influence to oppose the reforms in the face of intellectual property interest groups and international pressures.

Clearly, the stock of intellectual capital appears to be one factor motivating stronger protection of patents, possibly as a function of economic stakeholders seeking to defend their interests and the capacity of the state institutions to act. In many cases, domestic lobby activity of large firms and banks appears to play a significant role in patent reform. However, there is also some evidence that international institutions are associated with effective promotion of patent rights reform. This tends to include countries acceding to the WTO, but also those in the OECD and, to a limited extent, RTAs. While membership in OECD is associated with relatively high levels of patent rights protection, its role in fostering patent reform since 1990 is at best ambivalent. At the same time, there is no indication in the present analysis that foreign firms are effective in lobbying for patent reform in either OECD or developing countries.

While the multilateral trading system has played a major role in promotion of economic integration, its influence appears more nuanced with respect to the evolution of institutions related to intellectual property rights in developing countries. Clearly, the advent of the TRIPS Agreement was associated with patent reform across all WTO members. While the present analysis did not find significant variation in the reform pressure arising via the WTO, notable positive change in the strength of patent rights may arise, in some cases, via WTO accession or participation in RTAs (which can bring further pressure for reform).

As Lippoldt (2008b, p 258) points out, with the increasing globalisation of markets and the establishment of international standards for IPR protection, competitive pressures are challenging growth-oriented developing countries to address any basic shortcomings in their national IPR regimes. Conformity with the minimum global IPR standards may have become, in effect, a prerequisite for OECD and developing countries wishing to access and exploit the full range of global technologies and know-how. In this regard, the next chapters of this dissertation will consider the relationship of patent rights protection to certain indicators of international economic performance in terms of international flows of trade and FDI, development of domestic innovation, and accumulation of intellectual capital.

## G Tables

*Table I.1: Evolution of Average IPR Index Scores for Developing Countries, 1990 – 2005.*

Panel A.	Patent Rights Index, Full Sample, By Country Status		Patent Rights Index, Sub-Sample Covered in This Paper, By Country Status	
	Developing Countries	All OECD Countries (as of 2005)	Developing Countries	OECD Countries
Year				
1990	1.63	3.06	1.62	3.12
1995	2.13	3.97	2.18	4.01
2000	2.67	4.22	2.76	4.26
2005	3.00	4.39	3.15	4.43
<i>N</i> =	92 <sup>(1)</sup>	30	73 <sup>(2)</sup>	28 <sup>(3)</sup>

Panel B.	Patent Rights Index	Related IPR Indices - Developing Countries Only		
	Full Sample, Merged (Dev'g Co's+OECD)	Copyright Index	Trademark Rights Index	Enforcement Effectiveness Index
Year				
1990	1.98	1.51	1.91	0.67
1995	2.58	1.98	2.27	0.82
2000	3.05	2.33	2.63	1.25
2005	3.34	2.45	2.69	1.68
<i>N</i> =	122	105	52	52

1. Panel A, Developing Countries, Full Sample ( $N^1$ ) refers to all available scores for developing countries. For the Patent Rights Index, this includes: Algeria, Angola, Argentina, Bangladesh, Benin, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Chile, China, Chinese Taipei, Colombia, Congo, Costa Rica, Cyprus, Democratic Republic of Congo (Zaire), Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Gabon, Ghana, Grenada, Guatemala, Guyana, Haiti, Honduras, Hong Kong (China), India, Indonesia, Iran, Iraq, Ivory Coast (Cote d'Ivoire), Jamaica, Jordan, Kenya, Liberia, Lithuania, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, Somalia, South Africa, Sri Lanka, Sudan, Swaziland, Syria, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Uganda, Ukraine, Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe.
2. Panel A, Developing Countries, Sub-Sample ( $N^2$ ) refers to the sample of scores for developing countries cited at any point in the core analyses for this chapter. It includes all the countries cited in note 1, except: Burundi, Costa Rica, El Salvador, Fiji, Grenada, Guyana, Iraq, Ivory Coast (Cote d'Ivoire), Jamaica, Liberia, Myanmar, Papua New Guinea, Rwanda, Sierra Leone, Somalia, Swaziland, Trinidad and Tobago, and Uganda. These countries were excluded due to problems with data availability for certain indicators.
3. Panel A, OECD Countries, Sub-Sample ( $N^3$ ) refers to all OECD countries except Iceland and Luxembourg.
4. The Patent, Copyright and Trademark indices are based on laws on the books, whereas the enforcement effectiveness index is based on business perceptions.
5. The maximum range of scores is 0-to-5 for the indices. The Copyright, Trademark and Enforcement indices were rebased from their original range of 0-to-1.
6. Annex I.1 to the present chapter provides an overview of the Patent Rights Index and summarizes the elements of the other three Park *et al* indices. Annex 4 of Park and Lippoldt (2008) describes all, except see Appendix A of Park and Lippoldt (2005) for the Enforcement Index.
7. *Sources*: Park and Lippoldt (2008), Park (2008) and Park and Lippoldt (2005) including underlying data and the present author's supplemental calculations. NB, sub-samples were defined based on data availability.

## Patent Rights, Developing Countries and The Economic Influence of the Multilateral Trading System

*Table I.2. Correlation Coefficients: Patent Rights Index and Subjective Indicators of Institutional Conditions, 2005-2006.<sup>1</sup>*

	Subjective IPR Indicators				Other Institutions - Subjective Indicators		OECD Membership
	CEPII – Respect for Intellectual Property	CEPII – Of which, Respect for Intellectual Property such as Patents or Manufacturing Secrets	CEPII – Arrangements for Protection of Intellectual Property (local and international)	WEF Global Competitiveness Report – Indicator for Intellectual Property Protection <sup>3</sup>	CEPII – Security of Property Rights: Formal Property Rights	CEPII – Competition between Businesses: Competition Regulation Arrangements	
Series Code <sup>2</sup> (where applicable)	B603	B6030	B604	6.04	A601	B702	
Patent Rights Index – 2005	0.5964	0.5264	0.5938	0.6392	0.6229	0.7206	0.6915
Global Competitiveness Report–IPR Indicator	0.7596	0.7021	0.6771		0.7185	0.5633	0.6022

1. This table covers 67 developing and developed countries for which data points were available from three databases: the CEPII Institutional Profiles 2006 Database, the Global Competitiveness Report 2005-2006 of the World Economic Forum, and the Patent Rights Index as developed by Walter G. Park et al.
2. The CEPII series codes refer to series from the Institutional Profiles 2006 Database, available at [www.cepii.fr](http://www.cepii.fr). This database represents assessments by French economic representatives surveyed in a broad range of countries. A total of 85 countries are available. The series shown in the table are scored as follows: B603 and B6030, from 1 (low level of respect) to 4 (very high level of respect); B604, from 0 (if no such arrangements) and from 1 (low level of application) to 4 (very good level of application); A601, from 1 to 4; B702, 0 if no arrangements and, if arrangements, from 1 (not very effective) to 4 (very effective).
3. The Global Competitiveness Report Indicator for Intellectual Property Rights is drawn from the Executive Opinion Survey of the World Economic Forum covering some 10000 senior business representatives in 117 countries. The IPR indicator is scored from 1 (weak or non-existent) to 7 (equal to the world's most stringent).
4. The Patent Rights Index is scored from 0 to 4 and the data are those underlying Park and Lippoldt (2008) and Park (2008).

# Patent Rights, Developing Countries and The Economic Influence of the Multilateral Trading System

Table I.3: Long-Term Evolution of Patent Rights Index, by Component and Country Group, 1975 to 2005.

Year	OECD			High-Income Non-OECD Countries			Upper-Middle Income Non-OECD Countries			Lower-Middle Income Countries			Low-income Countries		
	Patent Rights Index Scores		Ratio of Component Change to Total	Patent Rights Index Scores		Ratio of Component Change to Total			Ratio of Component Change to Total			Ratio of Component Change to Total			Ratio of Component Change to Total
	1975	2005		1975	2005		1975	2005		1975	2005		1975	2005	
Duration-relative to 20 year term	0.85	1.00	0.07	0.88	1.00	0.07	0.78	0.99	0.11	0.72	0.97	0.15	0.76	0.90	0.12
Enforcement Provisions	0.51	0.96	0.22	0.25	0.75	0.28	0.16	0.62	0.25	0.08	0.52	0.26	0.00	0.26	0.22
Restrictions on Patent Rights	0.34	0.53	0.09	0.27	0.50	0.13	0.35	0.52	0.09	0.12	0.33	0.12	0.23	0.45	0.19
Membership in Int'l Treaties	0.25	0.96	0.34	0.13	0.65	0.29	0.07	0.61	0.29	0.08	0.55	0.28	0.11	0.50	0.34
Coverage of Patentable Subject Matter	0.37	0.94	0.28	0.36	0.80	0.24	0.26	0.73	0.26	0.22	0.54	0.19	0.31	0.45	0.12
<i>Total</i>	2.33	4.39	1.00	1.88	3.70	1.00	1.62	3.48	1.00	1.22	2.91	1.00	1.41	2.55	1.00
Absolute Change: 1975-2005		2.06			1.82			1.86			1.69			1.14	
Ratio: 2005 Total to 1975 Total		1.89			1.97			2.15			2.38			1.81	

1. See notes to Figures I.3 to I.7, for listings of the countries covered under each country group.

Table I.4: Regression of Institutional Variables on Change in the Patent Rights Index, 1990-2005.<sup>1</sup>

	(1) Full Sample	Sig nf <sup>3</sup>	(2) Full Sample	Sig nf <sup>3</sup>	(3) Develop- ing Countries	Sig nf <sup>3</sup>	(4) OECD Countries	Sig nf <sup>3</sup>
CEPII – Influence of large firms and banks (foreign); 1= strong, 0= weak	0.163976		0.189788		0.130034		0.128905	
<i>t-statistic</i>	0.894565		0.927167		0.626512		0.283587	
CEPII – Influence of large firms and banks (domestic); 1= strong, 0= weak <sup>(2)</sup>	0.862128	***	0.564824	*	0.827378	***	0.241203	
<i>t-statistic</i>	3.095789		1.853655		3.129447		0.541931	
WTO Accession, joined after 1995 (1=yes, 0=no)	0.863410	*						
<i>t-statistic</i>	1.977170							
OECD Member as of 2005 (yes= 1; no = 0)	-0.534430	***						
<i>t-statistic</i>	-2.691377							
CEPII <sup>(2)</sup> - Pressures arising through WTO membership: 0 =weak; 1=strong			-0.205336		-0.203565		-0.001468	
<i>t-statistic</i>			-0.903601		-0.843603		-0.843603	
CEPII <sup>(2)</sup> - Pressures arising through RTA membership (e.g., Euromed, Mercosur, NAFTA): 0 =weak; 1=strong			0.205875		0.223882		0.935247	*
<i>t-statistic</i>			1.048430		1.086187		1.989783	
Change in per capita GDP 1990-2005 (constant USD), in %	0.042289		0.333652		0.246050		0.515835	
<i>t-statistic</i>	0.183027		1.359109		1.116902		0.587047	
Adjusted R-squared	0.2481		0.0965		0.2592		-0.0064	
N =	62		62		44		18	

1. The regression was run controlling for change in GDP per capita.
2. The CEPII indicators are based on a qualitative assessment by French economic representatives in 85 countries. They are available from the *Institutional Profiles 2006* database. The series codes are A5002 (large foreign firms and banks), A5000 (large domestic firms and banks), A8031 (pressures arising from membership in the WTO) and A8032 (pressures arising from membership in regional trading arrangements, RTAs). The original series are scored 0 if the stakeholder has no weight and no influence and, if the stakeholder has an influence, then from 1 (very little influence, very low weight) to 4 (a huge amount of influence and weight). For purposes of this regression analysis, the series were rescored as 1 = relatively strong influence (original score 3 or 4) or 0 = relatively weak influence (original score 0, 1 or 2). For the OECD-only analysis, due to a lack of variation, the scoring for influence of domestic firms and banks in OECD countries was recalibrated as 1 = very strong influence (original score 4) or 0 = strong influence (original score 3). None of the original OECD scores for series A5000 were below 3.
3. Here, and throughout the dissertation, significance is specified in terms of values for the p statistic as follows: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% levels, respectively.

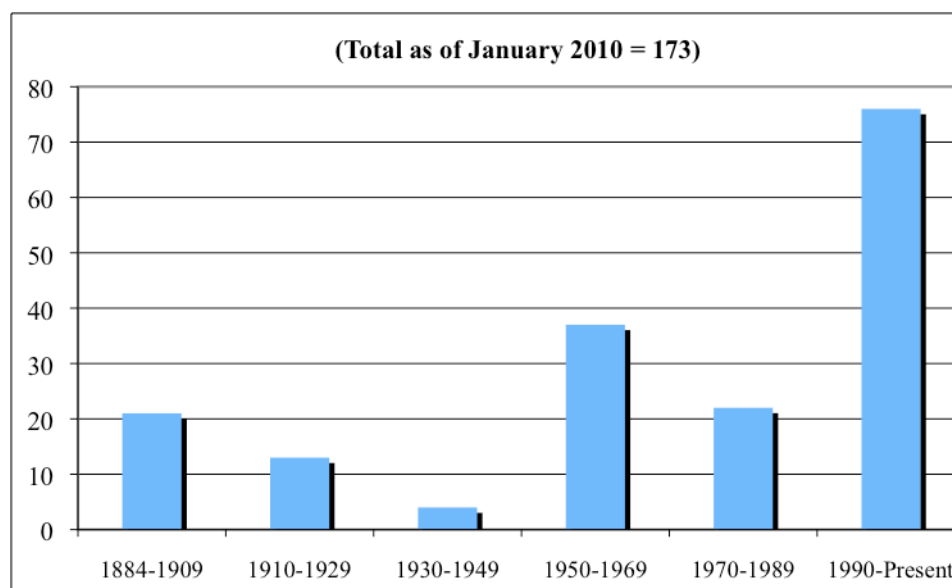
Table I.5: Regression of Institutional Variables (including IC) on Level of Patent Rights Index, 2005.

	(1) Full Sample	Signf †	(2) Full Sample	Signf †	(3) Develop- ing Countries	Signf †	(4) OECD Countries	Signf †
CEPII <sup>(2)</sup> – Influence of large firms and banks (foreign), 1= strong, 0= weak	0.140832		0.110488		0.183171		0.048028	
<i>t-statistic</i>	1.078341		0.821581		0.990747		0.473251	
CEPII <sup>(2)</sup> – Influence of large firms and banks (domestic), 1= strong, 0= weak	0.397191	**	0.369783	*	0.352344		-0.186784	*
<i>t-statistic</i>	2.020855		1.820791		1.501141		-1.808378	
CEPII <sup>(2)</sup> – Pressures arising through WTO membership: 0 =weak; 4=strong	-0.031285		-0.007953		-0.030615		-0.0579	
<i>t-statistic</i>	-0.527672		-0.131614		-0.353429		-1.2381	
CEPII <sup>(2)</sup> – Pressures arising through RTA membership (e.g., Euromed, Mercosur, NAFTA): 0 =weak; 4=strong	-0.020105		0.012429		-0.025005		-0.0137	
<i>t-statistic</i>	-0.428266		0.268924		-0.369936		-0.3657	
OECD Member in 2000 (1=yes, 0=no)	0.511520	**						
<i>t-statistic</i>	2.241187							
IV - Intangible Capital per capita, 2000 (USD) <sup>(3)</sup>	0.000003	***	0.000005	***	0.000003	**	0.000002	**
<i>t-statistic</i>	3.054149		7.393581		2.419458		2.602589	
Adjusted R <sup>2</sup>	0.6193		0.5920		0.2542		0.4692	
N=	62		62		44		18	

1. Here, and throughout the dissertation, significance is specified in terms of values for the p statistic as follows: \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% levels, respectively.
2. CEPII variables are discussed in footnote 2 of the previous table.
3. Instrumented Variable (IV). The level of intangible capital per capita is drawn from World Bank (2006). Due to endogeneity, the variable is instrumented using GDP per employee (as of 2000) from WDI On-Line. GDP per employee is highly correlated with intangible capital (correlation coefficient = 0.91), but not with the residual of the original regression (correlation coefficient = 0.12). A Durbin-Wu-Hausman test confirms the decision to use the instrument.

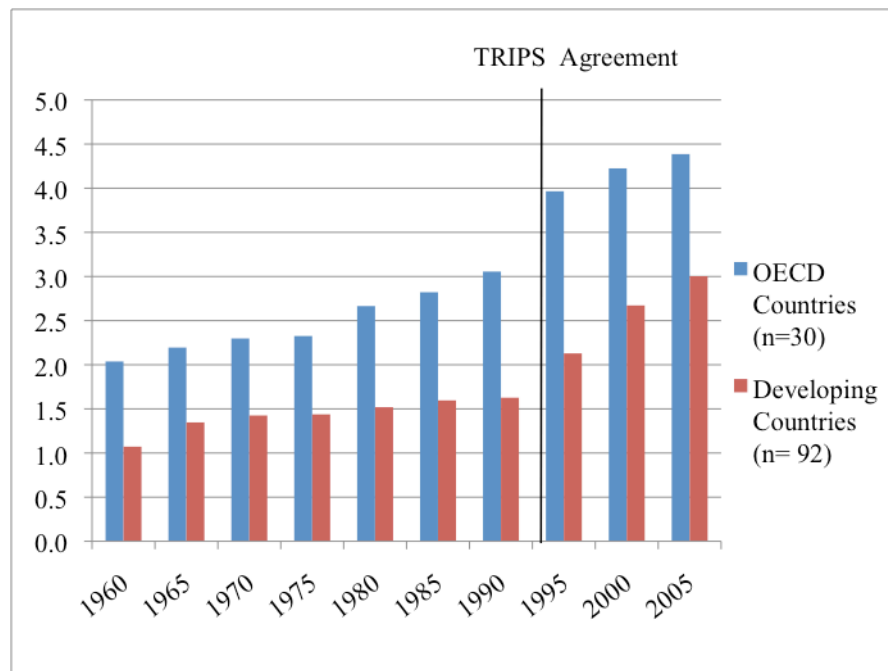
## H FIGURES

Figure I.1: Paris Convention for the Protection of Industrial Property: ratifications, by year of entry into force.



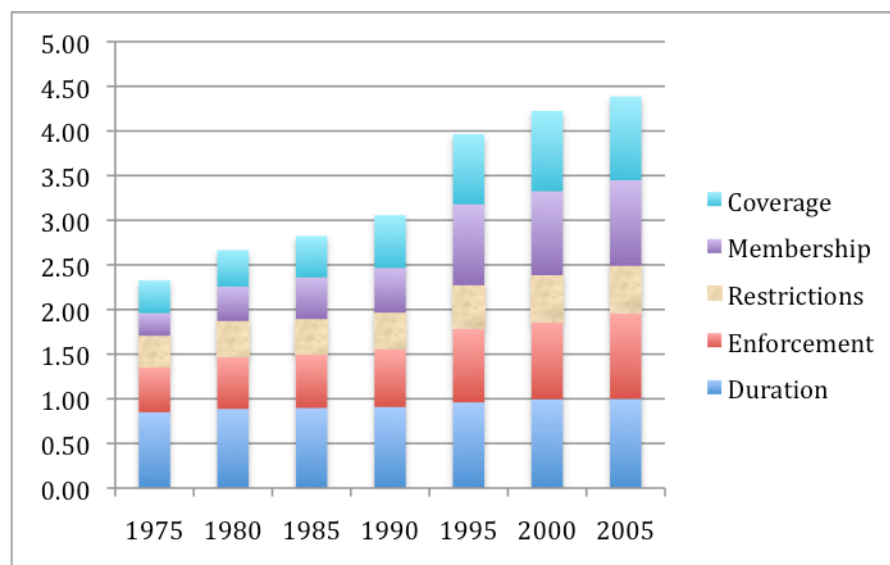
Sources: WIPO, [http://www.wipo.int/treaties/en/SearchForm.jsp?search\\_what=C](http://www.wipo.int/treaties/en/SearchForm.jsp?search_what=C) and Lippoldt (2008a).

Figure I.2: Patent Rights Index, 1960 – 2005.



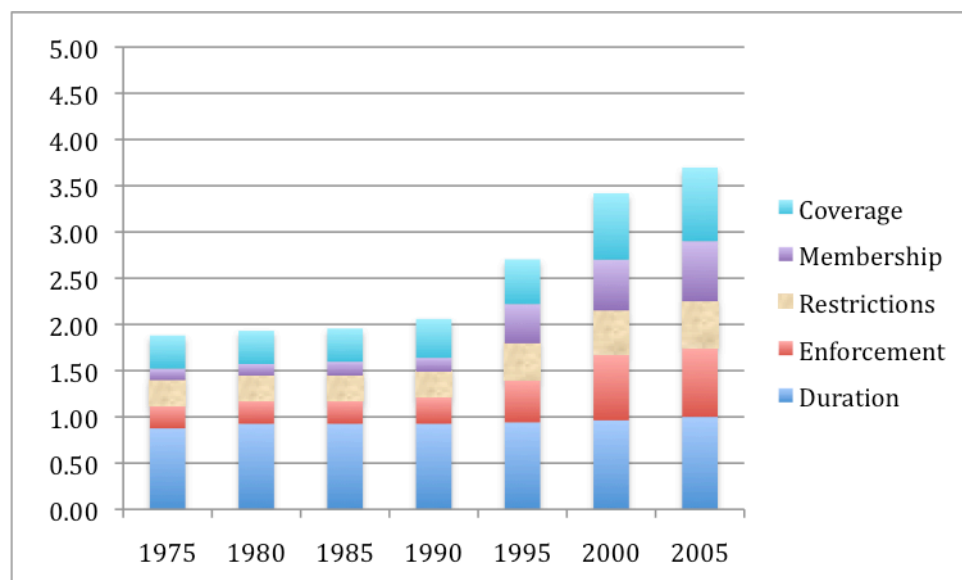
1. Based on laws on the books (0 = weak, 5 = strong).
2. Source: data underlying Park and Lippoldt (2008).

Figure I.3: Composition of the Patent Rights Index, OECD Countries, 1975 – 2005.



1. N = 30, covering all current OECD countries.
2. Note for Figures I.3 to I.7: The Patent Rights Index is based on laws on the books (0 = weak, 5 = strong); see Annex I.1 to this chapter for details.
3. Source: Patent Rights Index from Park (2008) and data underlying Park and Lippoldt (2008).

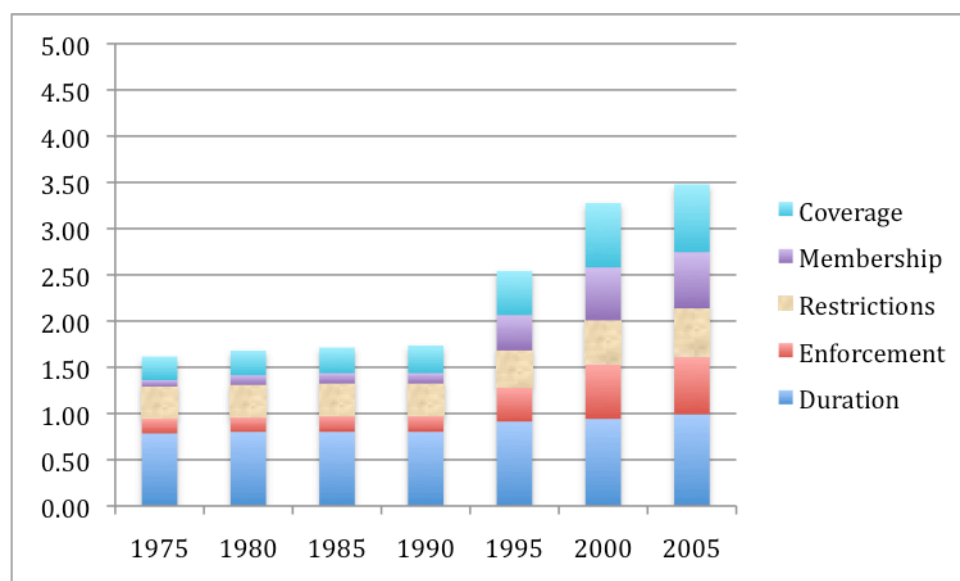
Figure I.4: Composition of the Patent Rights Index, High Income Non-OECD Countries, 1975 – 2005.



1. N = 8, including Chinese Taipei, Cyprus, Hong Kong (China), Israel, Malta, Saudi Arabia, Singapore, and Trinidad and Tobago.
2. Note: For Figures I.3 through I.7, countries are grouped according to the income classification established by the World Bank, taking into account their situation at the end of the study period.

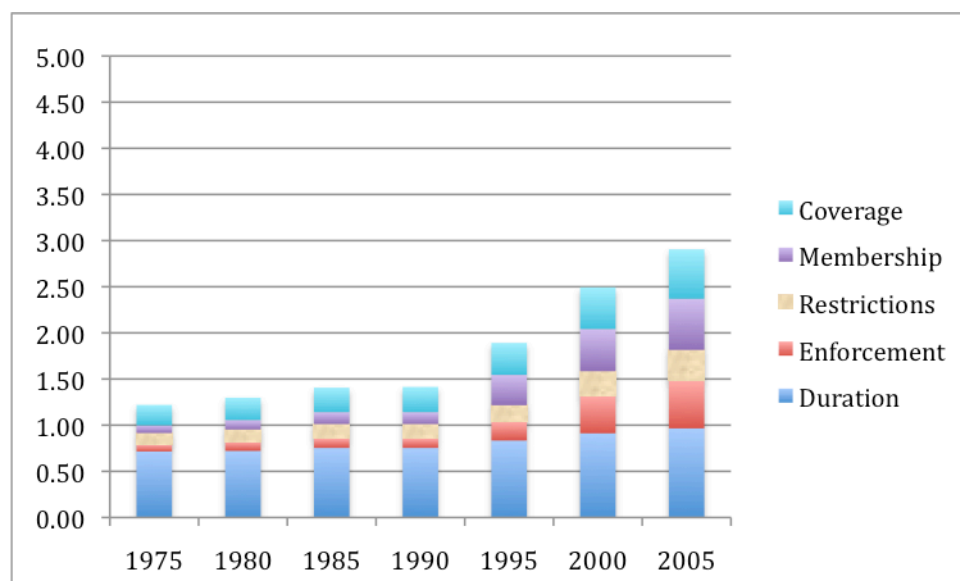


*Figure I.5: Composition of the Patent Rights Index, Upper Middle Income Non-OECD Countries, 1975 – 2005.*



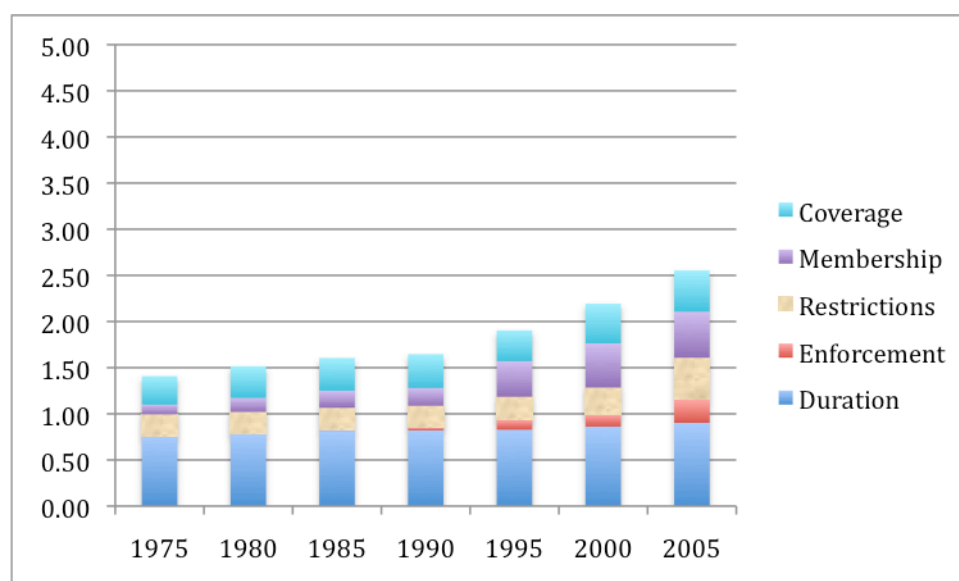
1. N = 23, including Algeria, Argentina, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Dominican Republic, Fiji, Gabon, Grenada, Jamaica, Lithuania, Malaysia, Mauritius, Panama, Peru, Romania, Russia, South Africa, Uruguay and Venezuela.

*Figure I.6: Composition of the Patent Rights Index, Lower Middle Income Non-OECD Countries, 1975 – 2005.*



1. N = 31, Angola, Bolivia, Cameroon, China, Congo, Ecuador, Egypt, El Salvador, Guatemala, Guyana, Honduras, India, Indonesia, Iran, Iraq, Ivory Coast (Cote d'Ivoire), Jordan, Morocco, Nicaragua, Nigeria, Papua New Guinea, Pakistan, Paraguay, Philippines, Sri Lanka, Sudan (an LDC, but included here due to its income level in certain years), Swaziland, Syria, Thailand, Tunisia and Ukraine.

Figure I.7: Composition of the Patent Rights Index, Low Income Countries, 1975 – 2005.



1. N = 30, including Bangladesh, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Ethiopia, Ghana, Haiti, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, Senegal, Somalia, Tanzania, Togo, Uganda, Vietnam, Zambia and Zimbabwe.

Figure I.8: WTO Accession and Strengthening of Patent Rights, 1990-2005.



1. Numbers in parentheses indicate the year of WTO accession, except for the developing country average where it indicates the number of countries in the sample.
2. Source: Based on data underlying Park and Lippoldt (2008).

## I Annex I.1

### 1. Composition of the Patent Rights Index

1)	Membership in International Treaties	<u>Signatory</u>	<u>Not Signatory</u>
	-- Paris Convention and Revisions	1/5	0
	-- Patent Cooperation Treaty	1/5	0
	-- Protection of New Varieties (UPOV78 or 91)	1/5	0
	-- Budapest Treaty (Microorganism Deposits)	1/5	0
	-- Trade-Related Intellectual Property Rights (TRIPS)	1/5	0
2)	Coverage	<u>Available</u>	<u>Not Available</u>
	-- Patentability of pharmaceuticals	1/8	0
	-- Patentability of chemicals	1/8	0
	-- Patentability of food	1/8	0
	-- Patentability of surgical products	1/8	0
	-- Patentability of microorganisms	1/8	0
	-- Patentability of utility models	1/8	0
	-- Patentability of software	1/8	0
	-- Patentability of plant & animal varieties	1/8	0
3)	Restrictions on Patent Rights	<u>Does Not Exist</u>	<u>Exists</u>
	-- "Working" Requirements	1/3	0
	-- Compulsory Licensing	1/3	0
	-- Revocation of Patents	1/3	0
4)	Enforcement	<u>Available</u>	<u>Not Available</u>
	-- Preliminary Injunctions	1/3	0
	-- Contributory Infringement	1/3	0
	-- Burden-of-Proof Reversal	1/3	0
5)	Duration of Protection	<u>Full</u>	<u>Partial</u>
		1	$0 < f < 1$

-- where  $f$  is the duration of protection as a *fraction* of 20 years from the date of application or 17 years from the date of grant (for grant-based patent systems).

Overall score for Patent Rights Index: sum of points under (1) – (5).

Source: Park and Lippoldt (2008).

## **2. Summary of the Composition of Other Indices Developed by Park et al.**

### **A. Copyright Index: Reynolds (2003) and Park (2005)**

1) Coverage: i) general (literary and artistic works), ii) performances, iii) sound recordings, iv) films, v) broadcasts, vi) *droite de suite* (shares in resale), vii) computer programmes. Scoring: i) – v) based on availability measured as a proportion of 70 year duration, vi) share as percentage of max (top censored at 5%), vii) based on availability.

2) Usage - extent of private use: i) full use or no mention of private use, ii) private study or fair dealing, iii) use but with tax on devices or media, or iv) no private use allowed.

3) Enforcement, availability of: i) criminal sanctions, ii) preliminary injunctions, iii) seizure and destruction, iv) anti-circumvention provision.

4) International treaties, membership: i) Berne Convention 1886, ii) Universal Copyright Convention 1952, iii) Rome Convention 1961, iv) Geneva Convention 1971, v) Universal Copyright Convention 1971, vi) Brussels Convention 1974.

Scoring: Originally, the index was scored as a summation of fractional points awarded for the elements 1 to 4, with the possible total score ranging from 0 to 1. As presented in Table 1 of this chapter, the index was rebased to range from 0 to 5 by multiplying the original score by 5.

### **B. Trademark Rights Index: Reynolds (2003) and Park (2005)**

1) Coverage: i) service marks, ii) certification marks, iii) collective marks, iv) colours, v) shapes (3-dimensional, packaging, etc.), vi) well-known marks.

2) Procedures, availability: i) prohibition of marks in bona fide use, ii) licensing restrictions, iii) use or lose provisions in law, iv) international exhibition protection, v) criminal penalties, vi) local lawyer requirements, vii) marks can become generic, viii) transferability of mark without business, ix) priority goes to first to use a mark.

3) International treaties, membership: i) Paris Convention 1883, ii) Madrid Agreement 1891, iii) Nice Agreement 1957, iv) Lisbon Agreement 1958, v) Vienna Agreement 1973, vi) Trademark Law Treaty 1994.

Scoring: Originally, the index was scored as a summation of fractional points awarded for the elements 1 to 3, with the possible total score ranging from 0 to 1. As presented in Table 1 of this chapter, the index was rebased to range from 0 to 5 by multiplying the original score by 5.

### C. Enforcement Effectiveness: Park and Lippoldt (2005)

This index is a qualitative measure of the effectiveness of IPR enforcement in practice. It is based on reports filed with the US Trade Representative documenting experience and perspectives in relation to enforcement in countries outside the U.S. The reports describe complaints (with all the limitations and biases such may contain), if any, about enforcement procedures and about the failure of the proper authorities to carry out the laws on the books. The failure to enforce may be due to some inability on the part of the authorities to carry out those laws or due to a conscious policy choice. Complaints about the lack of substantive laws are not incorporated here.

Scoring: The Enforcement effectiveness index is scored as follows: **0** if enforcement measures are not available or inadequate to deter abuse;  $\frac{1}{2}$  if enforcement measures are available but not effectively carried out (*e.g.* due to lag in policy implementation or resource barriers); **1** otherwise. As presented in Table 1 of this chapter, the index was rebased to range from 0 to 5 by multiplying the original score by 5.

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## **Chapter II**

### **Imports and FDI: The Influence of Patent Rights Reform in Developing Countries During the Period from 1990 to 2005**

## II Trade and FDI: The Influence of Patent Rights Reform in Developing Countries During the Period from 1990 to 2005

**Abstract:** Drawing on a broad sample countries, this chapter considers the relationship of selected international economic indicators to the patent right reforms that took place during the period from 1990 to 2005, a period of strengthening in the international intellectual property rights framework including the advent of the WTO TRIPS Agreement. The literature notes that economic theory is ambiguous on the economic implications of stronger intellectual property rights and stresses the need for empirical approaches. Using a revised methodology, this chapter builds on previous work by Park and Lippoldt (2008) in order to consider whether stronger patent rights may have been associated with increased imports and foreign direct investment. This might be the case, for example, if rights holders feel the enhanced patent protection provides improved international economic opportunities to leverage their intellectual property as well as a means to defend against patent infringement in foreign markets. The analysis points to a tendency during the study period for strengthening of patent rights to be associated with increased merchandise and services imports in developing countries, as well as increased stocks of inward FDI in developing countries and Least Developed Countries. Such flows and stocks can be important channels for technology transfer.

**JEL codes:** O24 (trade policy), O34 (intellectual property rights)

**Keywords:** Intellectual property rights, patents, economic development, trade, foreign direct investment

## **A Introduction<sup>77</sup>**

Economists are still assessing the development impacts of strengthened Intellectual Property Rights (IPRs) resulting from reforms during the past two decades as evidenced by increased adherence to key international accords, as well as increasing numbers of regional or bilateral trade agreements and unilateral changes in national law. Two recent OECD studies (Park and Lippoldt, 2005 and 2008) have considered this issue from an empirical perspective with respect to licensing, trade and foreign direct investment (FDI), and the present chapter builds on this work with particular regard to patents. At the heart of the two OECD studies are regression analyses whereby indicators for selected types of economic activity are related to indicators of the strength of particular IPRs (patents, copyright and trademarks)<sup>78</sup> controlling for other factors that influence the corresponding economic activity. The following analysis extends the previous work by considering change in key indicators of international economic performance (imports and FDI) that is associated with the component elements of a widely cited indicator of patent reform, the Patent Rights Index.

Chapter 1 considered the role of the multilateral trading system and other institutional factors in driving IPR reform in developing countries. A key element in this regard is the World Trade Organisation's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which came into effect in 1995. The TRIPS Agreement established minimum IPR standards and a framework to review and enforce these standards. In parallel with the advent of TRIPS, the World Intellectual Property Organisation (WIPO) witnessed a

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<sup>77</sup> Portions of this Chapter, as noted in the text, draw on the Patent Rights Index developed by Walter G. Park, American University, Washington, DC, and his colleagues, an indicator used here with his kind permission; the chapter also references previous analyses developed by the present author in co-operation with him. In addition, the author wishes to acknowledge, with gratitude, the advice, references and suggestions received on various aspects of the author's research from Carlos Alberto Primo Braga, Ricardo Cavazos, Patrick Messerlin, Sébastien Miroudot, Jonathan Senft, Charles Tsai and Jayashree Watal, as well as from colleagues and participants at various seminars where early elements of this work were presented including seminars organised by University of Maastricht, London School of Economics, Réseau de Recherche sur l'Innovation, Stockholm Network, Quaker United Nations Office, Free Market Foundation of Southern Africa, University of Connecticut (Storrs) and OECD. The author gratefully acknowledges the support for this research project from Ken Ash, Director, and Raed Safadi, Deputy-Director, Trade and Agriculture Directorate, OECD.

<sup>78</sup> International accords also cover other types of intellectual property such as geographical indications (concerning the origins of goods), industrial designs, layout-designs of integrated circuits and undisclosed information (trade secrets). Discussions are underway in the context of the WTO's Doha Development Agenda concerning other dimensions such as the relationship of the TRIPS Agreement to protection of traditional knowledge and folklore.

significant increase in adherence to the various international treaties that it administers. One result of these developments has been a strengthening of IPRs around the world, including in a number of developing countries where the initial protection of IPRs was weak at best.

The possible association of patent reform with change in trade and FDI flows in developing countries merits particular consideration in view of the development implications. Trade embodies technology and is an important vehicle for technology transfer. As underscored in the World Trade Report (WTO, 2003), “Empirical research has found a positive relationship between the size of trade flows and a country’s level of total factor productivity.”<sup>79</sup> As with trade, FDI constitutes an important channel for technology diffusion.<sup>80</sup> The theoretical and empirical literature, discussed in the next section, underscores the particular importance of imports and increases in the stock of FDI as facilitating the accumulation of intangible assets available to be leveraged for accelerated economic growth. In particular, certain studies indicate that in the economy patented technologies can be combined with other know-how in a manner that boosts overall productivity.

This chapter begins with a review of illustrative excerpts from the literature. It then presents the data set and previous results from the Park and Lippoldt analyses before moving to present the expanded analyses. The central concern is to examine the association of change in selected aspects of international economic performance with change in the institutions for protection of patent rights (specifically, laws on the books) during the period 1990 to 2005. This period was selected to encompass a point preceding the WTO TRIPS Agreement as well as its entry into effect and the completion of most of the transition periods associated with its implementation. As highlighted in Chapter 1, the reforms in patent rights were in part driven by international institutions and, in particular, the advent of the WTO’s TRIPS Agreement.

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<sup>79</sup> The effectiveness of trade as a vehicle for transfer and diffusion of technology depends in part on the composition of imports; the same WTO report points out that in 2000 some 30% of developing countries imports were classified as “high-tech” products, whereas only about 10% of imports by least developed countries (LDCs) fell into this category; the share for developed country imports of these products was a bit more than 20%.

<sup>80</sup> A WTO (2002) secretariat report cites four main channels for this to occur via FDI: 1) backward and forward linkages (e.g., as foreign affiliates push local suppliers to adopt new technologies or assist them to upgrade, which may benefit other local firms through spillovers); 2) demonstration effects (e.g. as local firms learn to imitate technologies or business processes); 3) competition effects (e.g., as the expanded presence of foreign firms may stimulate competing local firms to improve their technological performance); and 4) learning by doing that builds human capital (e.g., employees of the foreign affiliates acquire knowledge through formal training and informal channels, which may be subsequently shared or applied elsewhere).

A broad review of technology transfer issues can be found in Hoekman and Smarzynska (2006).

Particular emphasis is given in the present chapter to developments in developing countries, a country group that faced institutional challenges and economic uncertainties in implementing the new international standards for patent protection. The chapter highlights the tendency – with some notable variation by sector or level of development – for strengthened IPRs to be associated with increased inflows of FDI and imports, flows that can represent an important channel of technology transfer into developing countries. It concludes that IPR reform can play a useful role as one element in national development strategies, particularly where there exist notable shortfalls in IPR protection and where appropriate complementary policies are included in the strategies.

## **B Theoretical motivation and context**

Over the past two decades a rapidly expanding body of economic literature has examined and underscored the importance of trade and FDI for economic performance at global, national and firm levels. A sub-strand of the literature has also considered the relationship of international economic relations to innovation, in some cases taking into account IPRs. Much of the early work in this period focused on development of theoretical perspectives, while more recently a growing body of empirical work has arisen to complement the theoretical work. The next two sub-sections offer illustrative examples from this literature in order to provide context for the subsequent empirical analysis.

### **1 Trade, FDI and Innovation**

Grossman and Helpman (1990) provide an early (pre-TRIPS Agreement) framework for considering the relationship of trade to innovation.<sup>81</sup> They begin with a simple framework of a two-sector-two factor economy, where output by sector depends on the stock of knowledge capital multiplied by a function of land and labour. A second equation represents the positive relationship of manufacturing experience and learning-by-doing to the future stock of knowledge capital. They develop their framework by drawing on the literature – including their own contributions – and by presenting insights from their model. They note the developments in growth theory in the second half of the 1980s that recognised the possibilities for increasing returns to scale and emphasised the accumulation of knowledge

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<sup>81</sup> This framework was further elaborate in an oft-cited volume: Grossman, Gene M. and Elhanan Helpman, 1991, *Innovation and Growth in the Global Economy*, The MIT Press.

capital as a key asset that contributes to such returns in many contexts. The authors present a number of relevant features of the economic environment. They note the importance of research and development work in permitting innovators to create some degree of market power, particularly where the ensuing innovation substitutes imperfectly for existing brands (i.e., it creates a market niche). At the same time, the authors note that the existence of foreign competitors may shorten the longevity of profit opportunities provided by research and development (e.g., if these foreign firms can reverse engineer or further develop the innovative product in question). In some instances, it will be difficult for innovators to appropriate the knowledge (e.g., general forms of knowledge generated in the research process) and some of this knowledge will spill over. Thus, research generates two types of outputs, the patentable innovation and the non-appropriable contribution to the stock of knowledge capital. This has a feedback effect in that the greater the stock of public knowledge and scientific understanding, the lower the supply of additional resources required for developing a new variety. Though spillovers are found to play a critical role in making long-run growth sustainable, they are not automatic and local firms may need to invest resources in order to capture benefits.

Grossman and Helpman (1990) also point to a range of channels through which trade and trade policy may influence incentives to innovate. Their two-sector model includes one sector that is knowledge intensive and high growth. Recalling the Rybczynski Theorem, they give an example whereby an increase in the supply of the resource used in the knowledge intensive sector will speed growth, whereas the opposite occurs if the increase in supply of resources takes place in relation to the other sector. Thus, policy interventions that influence the allocation of resources can have a direct impact on growth in the acting country or partner countries. The authors find that in framing policies, much depends on the underlying comparative advantage of a country. There are a variety of pitfalls facing an activist policy. If a country subsidises research and development, but actually has an advantage in manufacturing, growth may slow as a consequence of misallocated resources. Also, policies that cause an excessive allocation of resource to knowledge creation can actually reduce welfare. If a country protects a production sector that competes for resources with a research and development activity, then the cost of research and development may increase and the allocation of resources to the activity may decline. Moreover, protection of a high-technology sector via trade policy may cause skilled labour to shift from research to manufacturing and

so retard innovation in the active country. Internationally, there is a trade off whereby a country protecting or subsidising a knowledge-intensive sector may push resources of a trading partner out of that sector and into an alternative sector where their contribution to knowledge accumulation may decline. The global welfare effect depends on where each country's comparative advantage lies and the net balance of the influences.

Seker (2009) references some of the subsequent literature before presenting an assessment of the growth performance of firms and their global engagement via trade. His study uses plant-level data drawn from the World Bank's Enterprise Surveys dating from 2002 to 2008 and covering 43 countries.<sup>82</sup> Growth is considered in relation to employment, sales, productivity and innovation (i.e., introduction of new varieties, production process improvements, internationally recognised quality certification and licensing from abroad). In comparison to purely domestic firms, he finds that globally engaged firms are larger, more productive, more capital intensive, and pay higher wages. Among exporters, those that import intermediate products are more productive and grow faster. Non-exporting firms that import intermediate products perform better than non-traders, though exporters tend to perform better still. Firms with foreign ownership grow faster but are less innovative than domestically owned firms. Moreover, Seker finds that investment in research and development significantly increases the growth rates of two-way traders and importers. In explaining these results, Seker notes that use of foreign inputs can increase firm productivity due to the access they provide to additional varieties of inputs or inputs of higher quality. Exporting increases the market size for the firm and thereby increases the potential returns on research and development. Trading can decrease the cost of implementing technological innovations and spur growth.<sup>83</sup>

Technology transfer is often cited in the literature as an important element in boosting the knowledge capital available to developing and developed countries. Maskus (2004) highlights five main channels for technology transfer through market-mediated mechanisms:

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<sup>82</sup> Each wave of the survey covers just a fraction of the 43 countries in the sample. During the timeframe from 2002 to 2008, each of the countries was covered in at least one survey wave, but also in no more than three waves. The data set does not cover 2007.

<sup>83</sup> Pavcnik (2002) considers the case of trade liberalisation and productivity in Chile using a methodology that takes into account plant closures. She finds a relationship between plant-level productivity improvements and trade liberalisation. At the aggregate level she finds productivity improvement taking place as a consequence of a shifting of resources and output from less efficient to more efficient producers.



trade in goods and services; foreign direct investment, joint ventures, cross-border movement of personnel and licensing.<sup>84</sup> While flows via each channel embody technology, he notes that at present it is not possible to determine precisely the relative magnitudes of their technology content. However, Maskus (2004, p. 10) points out that “[l]icenses typically involve the purchase of production or distribution rights (protected by some intellectual property right) and the technological information and know-how required to make effective the exercise of those rights.” Citing balance of payments data, Maskus notes that in 2001 OECD member countries earned more than USD 70 billion in royalty revenue from licensing and other types of arm’s length trade in technology (i.e., excluding intra-firm flows).

Maskus (2000, p 119ff) provides a helpful discussion in regard to FDI, noting that it embodies financial capital and technology or intangible capital. For FDI in OECD countries, financial capital is often raised locally so FDI is primarily a source of technology and intangibles. For developing countries, financing for FDI is often raised abroad; so, financial inflows play an important role in addition to the technology transfer. A variety of location advantages influence decisions to invest and produce rather than to export. These might include such factors as market size and growth, transport costs, distance to markets, labour productivity, natural resources, local demand, trade protection and protection of intellectual property rights. Given that FDI implies flows of intangibles, the choice to invest may be an indication that there are advantages for the investors in maintaining a degree of direct ownership over these intangibles. Maskus notes that North-South investment tends to be vertical, while North-North tends to be horizontal. Multinational enterprises have scale advantages in horizontal FDI, multi-plant production of similar products for various local markets and also in multiple applications of the same intellectual property internationally. This horizontal FDI may benefit from reduced transaction costs where business is conducted within a single controlling firm, a savings that stimulates investment flows and the associated intra-firm trade. With respect to vertical FDI (where there is fragmentation of production), Maskus notes that locational advantages can be especially important. For example, difficulties in writing and enforcing contracts at arms-length or in protecting intellectual property mean that the quality of institutions can be quite important in such decisions.

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<sup>84</sup> Maskus (2004) also identifies several non-market channels for international technology transfer including imitation, departure of employees, publicly available test and patent application data, and temporary migration.

Park and Lippoldt (2005) note that licensing transactions are an important means by which technology and expertise can be acquired by licensees, saving them the expense of independent research and development. At the same time, licensors not only derive fees and royalties, but may also be able to capitalize on the licensee's local reputation and knowledge. As a mode of market entry, licensing can offer firms strategic advantages under certain circumstances. Some companies (particularly small ones) may use licensing as a means to test a market before engaging in FDI or to overcome a lack of capacity to penetrate a market on their own. Also, as Park and Lippoldt note, licensing can involve relatively minimal commitment and make it easier for firms to enter and exit a market, whereas other means of entry may be less flexible (e.g., export sales may face tariff and non-tariff barriers and FDI may be costly or may face local restrictions). In addition, businesses may look to licensing as a means of earning an early return on their research and development efforts, rather than depending exclusively on internally-developed end products as the sole source of return on their investment in R&D.<sup>85</sup>

Keller (2007) provides a succinct overview of the literature on the links of trade and FDI to technology transfer, particularly via technology externalities. These are quite substantial. In the case of the United States, the implied value of technology spillovers provided to other countries are found to be an order of magnitude larger than the US technology licensing receipts. Robust evidence points to the positive influence of imports on spillovers, notably associated with capital goods trade. Available evidence also points to a positive influence of FDI on spillovers, but here the story is a bit more nuanced and dependent on high-quality firm level data. Keller cites some evidence of vertical spillovers via FDI to suppliers. He also points to broader evidence of spillovers, but notes that there is significant heterogeneity. The spillovers are stronger in relatively high-technology industries. The evidence for technology spillover effects via exporting experience (i.e., learning by doing) is mixed, though anecdotal evidence points to some technology transfer as suppliers learn from customers that impose higher product quality standards than domestic customers.

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<sup>85</sup> This point is sometimes made by representatives of multinational enterprises. For example, it was raised at the *High-Level Workshop on Intellectual Property Rights and Economic Development in China: Meeting Challenges and Opportunities Following WTO Entry*, Beijing, China, 20-21 April 2004, organised by the OECD in co-operation with the State Intellectual Property Office and the Development Research Centre of the State Council, China. The proceedings of this workshop and a related event are available on the OECD web site: [http://www.oecd.org/document/49/0,2340,en\\_2649\\_34269\\_31505201\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/49/0,2340,en_2649_34269_31505201_1_1_1_1,00.html).

Overall, the spillover effects represent increases in the available stock of knowledge and can have important potential implications for innovation and growth.

In further work, Keller (2009) points to geographic proximity as continuing to play a role in technology transfer, despite the intangible nature of knowledge. There remain transactional costs in international commerce and distance makes it harder to ensure the type of transfer that comes from face-to-face interaction. The physical presence of an affiliate plant of a multinational contributes to spillovers via imports of intermediate goods that embody innovation and through learning by the plant's local labour force, perhaps combined with labour turnover that facilitates diffusion of the acquired knowledge. He notes, however, that while imports of intermediate goods help in promoting productivity, the technology embodied in those goods may not be very accessible and the associated technology spillovers comparatively low in such cases. More generally he notes the importance of getting beyond regression techniques to establishing some indication of causality with respect to the linkages between spillovers and productivity.

## **2 IPR, Trade and FDI**

Within the larger literature on international economic relations and innovation, a number of authors have considered the role played by IPRs, particularly in light of the advent of the TRIPS Agreement. One strand of research has considered theoretical perspectives on the strengthening of IPRs and the implications for developed and developing countries. Others have considered trade or trade and FDI in combination employing more empirical approaches. This section presents an illustrative selection of their findings in order to provide further context relevant to the empirical analysis that follows.

Helpman (1993) provided an early foundation for a theoretical model – in a paper predating the TRIPS Agreement, building on his earlier work with Grossman (e.g., see Grossman and Helpman, 1990). The Helpman paper considers the strengthening of intellectual property rights and its impact on developed and developing countries (dubbed “the North” and “the South” respectively). He assesses possible welfare change decomposed into four items: terms of trade, production composition, available products and inter-temporal allocation of consumption. In an exercise with trade but not FDI, he concludes that “tighter” IPRs would result in a shift of production from the South to the North as imitation declines,

with an associated decline in demand for factors of production in the South and a worsening of terms of trade for this region. The North may win or lose, depending on whether the terms of trade gains outweigh the loss in efficiency as the allocation of production shifts from low-cost regions in the South. The initial rate of imitation in the South is a critical factor in this view because in cases where the initial rate is high then the imposition of stronger IPRs harms the allocation of production by shifting it to higher cost Northern producers and thereby affecting prices for every consumer. In cases where the initial rate of Southern imitation is low, the imposition of stronger IPRs has less of a negative impact on the allocation of production while initially boosting the pricing power of Northern firms. Nevertheless, Helpman posits that while IPRs may reduce the cost of capital associated with reduced risk, this reduction of risk may also be associated with decreased profits and eventually slowed innovation. Adding FDI flows from North to South may mitigate the effects of tighter IPRs on the South's terms of trade losses, but does not eliminate the negative welfare effect of the reallocation of manufacturing (i.e., the FDI tends to flow to unskilled-labour intensive and resource extraction industries). However, as Helpman (1993, p. 1275) notes, while such theoretical analysis is useful for identifying channels through which regions are affected and circumstances in which the effects go one way or the other, it has some limitations. Though his theoretical exercise identifies a number of central features, it does not identify all the relevant features.<sup>86</sup> Empirical analysis can serve as an important complement to follow up such preliminary insights.

More recently, Branstetter and Saggi (2009) revisit this stream of work to provide a revised and further elaborated theoretical model that delivers a more complete picture with respect to production shifts within developing countries. They begin with a brief discussion of prior literature that considered the relationship of IPR strengthening in developing countries (the South) to the rate of innovation in developed countries (the North); this earlier research included findings that the nature the relationship depends on whether production shifts from

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<sup>86</sup> Helpman's analysis has a number of constraining assumptions, which facilitate the identification of possible channels of influence and directions of affects; however, they distance his conclusions from the complex realities. For example, his simple model of FDI is based on a one-factor, one-sector framework, whereby flows are associated with wage differentials. There are a variety of determinants of FDI. Moreover, the economic impacts of FDI are greatly simplified in this analysis and important aspects may be omitted. For example, as the author notes, FDI by multinational corporations may embody technology transfer, whereby the volume of FDI may be influenced by the protection of IPRs, but this channel for potential benefits is not accounted for in the model.

one region to the other due to changes in imitation in the South or changes in North-South FDI flows. By developing a model with FDI and imitation endogenously determined, Branstetter and Saggi are able to offer new insights on the innovation-imitation relationship. They find that increased IPR protection in the South reduces incentives for Southern firms to engage in imitation (i.e., imitation becomes more costly<sup>87</sup>), which reduces risk to innovators and encourages Northern multinationals to engage in FDI. Multinational firms shift production towards the South and come to account for increasing shares of Southern production and employment. This more than offsets the decline in Southern imitation-based production. In fact, the model indicates that the South increases its share of global production. Moreover, due to production shifts to lower cost areas, labour demand and real wages in the North decline, as do prices. Southern wages rise in real terms. At the same time, the incentives increase for Northern firms to innovate, because strengthened IPR protection reduces the risk of imitation. In contrast to Helpman's finding, Northern firms enjoy improved duration of profit flows from protected innovation and broadening of international marketing possibilities, as well as less risk in FDI. Thus, FDI flows to the South are associated with increased innovation in the North.

Turning to the empirical literature, studies are tending to indicate that variation in IPR strength may influence not only the volume of FDI or trade but also the content of the flows, as well as the overall market entry strategies of firms. Time may be an important factor in this. While IPR reforms were under discussion for some years prior to the TRIPS Agreement, there was some uncertainty on the outcome of the discussions that may have limited the value to economic agents of the "signals" that reform was pending. On the other hand, once the accord was in place and the actual laws on the books began to change, the signalling effect was strengthened even before these reforms were fully implemented. Moreover, FDI – and sometimes trade – can require lengthy lead times due to the need for planning and establishment of network relations, among other requirements. Thus, the effects of IPR strengthening may take a while to become manifest and may continue to evolve over multiyear periods.

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<sup>87</sup> In any event, imitation is not costless. As Maskus (2000, p. 42) notes imitation takes time and requires investment in research and development, marketing, production facilities, and start-up costs.

Maskus (2000) reviewed findings from his own research on the issues effects of IPR reform during the previous decade, as well as a range of other studies. He notes that assessment of effects from IPR strengthening on trade is empirically difficult in that the price effects of patents (and trademarks) are embedded in the prices at which goods are traded, whereby price effects cannot be separated from other components of pricing behaviour. Moreover, there is considerable complexity in assessing IPR effects in view of the multiple channels through which they can affect international economic relations. That is, firms may decide to service markets via exports, FDI or licensing, with decisions only partly influenced by considerations of IPR strength. Moreover, Maskus points out the importance of context: IPRs create market power, and thus the market structure matters and can complicate the analysis. At the same time there is theoretical ambiguity: the strengthening of the patent regime may have an ambiguous impact on the dominant firm's decision to export. A trade-off exists between the enhanced market power generated by stronger patents and the larger effective market created by limitations on competition from local imitators. As Maskus notes, the market power effect could reduce the elasticity of demand, while the market expansion effects could induce more exports.<sup>88</sup> Maskus (2000, pp 29-30) sees a fundamental trade-off for policy-makers in setting IPR strength. On the one hand, static efficiency requires wide access for use at marginal cost (which may be quite low), while on the other, dynamic efficiency requires incentives to invest in new information for which social value exceeds development costs.

From his review of the empirical work, Maskus (2000) generally found market expansion effects dominating over market power effects, though he does cite work showing market power dominating in countries with weak imitative capacity and strong patent regimes. His broad conclusion is that weak patent rights constitute a significant barrier to manufacturing trade, particularly in IPR-sensitive goods, especially where credible imitation threats exist.<sup>89</sup> At the same time, poor countries with low imitative capacity and wealthy ones that have a

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<sup>88</sup> Maskus also observes that firms also benefit from some degree of cost reduction in export markets as need for costly deterrent activities can be reduced in light of strengthened IPR protection. Maskus and Penubarti (1995, p. 230) hypothesize that in larger countries with highly competitive local imitative firms, market expansion effect would dominate, whereas in smaller economies with limited ability to imitate the market power effect would dominate.

<sup>89</sup> Maskus (2000, pp. 111-112) notes that weak patent laws do not necessarily deprive innovative firms of all market power because local imitation is costly and takes time, though this varies by sector. Neither do strong patents generally create full monopolies on a product, because legitimate substitute products are likely to be on the market.

comparative disadvantage in developing new products and technologies are at a disadvantage and could face deterioration in terms of trade as a consequence of market power effects.

Surveys provide an indication of the importance that commercial interests place on protection of intellectual property rights in the context of FDI and trade.<sup>90</sup> For example, A. T. Kearney periodically publishes a survey of CEOs (chief executive officers), CFOs (chief financial officers) and other key decision-makers of the world's largest 1000 firms, in order to provide insights on their locational preferences and concerns, as well as investing intentions. Though there is some variation in the format of questions and the report over time, respondents often cite IPR concerns as figuring prominently in their decision-making though this factor it is not considered in isolation. For example, market scale or growth potential may dominate locational decisions. Still, as businesses strive to leverage their intellectual property in global markets, there is an increased risk of infringement that accompanies the increased value (A.T. Kearney, 2004). For example, A.T. Kearney (2007) notes that China topped the FDI Confidence Index rankings during the 5 years leading up to the report, despite the fact that threats to IPR protection were the most cited top risk to further investment there during the next five years (cited by fully ½ of the respondents). In some cases, IPR concerns in a market may not dissuade foreign firms, but rather push them to choose sourcing strategies involving FDI via a captive business rather than outsourcing. A.T. Kearney (2004) lists safeguarding intellectual property as the sixth most cited reason for not outsourcing, being named by 43% of respondents. At the same time, in the competition for investment, strong IPR protection can play a positive and decisive role in attracting investment, as respondents noted with respect to Singapore (which has relatively strong IPR protection). With respect to research and development, A.T. Kearney (2005) reports that intellectual property protection is among the three most important attributes in determining investment location decisions, being cited by ½ of respondents. (The other two most cited attributes were costs and the availability and quality of local labour for research and development.) A listing of the most critical risks to firm operations in 2004 found theft of intellectual property to be a leading emerging risk

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<sup>90</sup> Another source of information on this can be found in business submissions to government. For example, in 1984, the United States designated inadequate protection of patents, trademarks and copyright as an unfair trade practice that could result in retaliation under section 301 of the trade act of 1974. As part of this "special 301" process, the United States Government solicits public input which can be consulted. For example, see the press release "USTR Calls for Comments on Intellectual Property Protection and Enforcement" dated 12 January 2010 and available here as of 3 February 2010: <http://www.ustr.gov/about-us/press-office/press-releases/2010/january>.

(ranked 7<sup>th</sup>), being cited by 28% of respondents, but coming after more traditional concerns such as government regulation and legal decisions, country financial risk, currency and interest rate volatility, political and social disturbances, corporate governance issues, or rule of law concerns (A.T. Kearney, 2004). In sum, protection of IPR is clearly among the leading concerns for investors, even though it is not at the top for most, and while it can be decisive, it is often considered in combination with other factors shaping the business environment.

Smarzynska (2002) presents an analysis of FDI undertaken in Eastern Europe and the republics of the former Soviet Union drawing on firm-level data from a worldwide survey of companies conducted by the European Bank for Reconstruction and Development (EBRD) in 1995. She found that weak IPR regimes tended to discourage foreign investors in technology-intensive sectors that rely heavily on IPRs to protect their innovation. Moreover, in all sectors, weak IPR regimes tended to deter investors from undertaking local production and rather focus on distribution of imported products. In addition, she notes that there is some evidence that weak IPR protection may discourage investors generally (i.e., not just those in sensitive sectors). In an earlier study of intellectual property managers from 100 major U.S. firms, Mansfield (1994) and Lee and Mansfield (1996) present an empirical analysis revealing that IPRs mattered little for protecting sales and distribution outlets, but mattered importantly for protecting production and research and development (R&D) facilities. The proportion of FDI invested in production and R&D facilities was positively and significantly related to the perceived strength of IPRs. In addition, firms tended to regard strong IPRs as being more important for decisions concerning transfer of advanced technology than for FDI decisions as a whole. Such heterogeneity across types of business operation may help to explain the mixed responses in the A.T. Kearney surveys of investment decision-makers (discussed above).

In a further empirical study on FDI and IPR issues, Nunnenkamp and Spatz (2003) find that the importance of IPRs as a determinant of FDI flows varies according to the sector and host country, especially as those factors relate to the imitative capacity. They “find that host countries can not only attract more FDI, but also derive more benefits from FDI by strengthening IPR protection. R&D expenditure by US affiliates as well as the value added and exports created by them tend to rise with stronger IPR protection.” At the same time, they note that the extent of these positive effects tends to be limited and subject to the specific conditions more broadly in the sector and country concerned. As in some of the studies



discussed above, the authors find that other factors, such as market scale, often play a determinant role and may attract investment despite shortcomings in the IPR environment. Also, as more countries raise their standards for IPR protection, the harder it becomes for a country to derive particular advantage from moves to strengthen the protection afforded to rights holders. (The latter point is notable in light of the conclusion from Chapter 1 of the present dissertation that the coefficient of variation for the Patent Rights Index scores declined substantially during the period from 1990 to 2005.)

As for the technology transfer dimension of international economic flows, Branstetter *et al.* (2006) consider the response within US multilateral firms to IPR reform in 16 economies during the period from 1982 to 1999. Their analysis of firm level data “reveals that royalty payments for technology transferred to affiliates increase at the time of reforms, as do affiliate R&D expenditures and total levels of foreign patent applications.” The findings point to prospects of increased technology transfer from US firms to affiliates in countries that engaged in IPR reform. Bascavusoglu and Zuniga (2002) find that French firms are also responsive to enhanced patent protection in foreign markets in line with their commercial potential, meaning the technological capacity and market scale in the destination market. However, for low-income markets they find the implications are not significant and in the case of low technology sectors they find that strengthened patent protection may actually deter technology flows.

*Strengthened IPRs and international licensing: Park and Lippoldt (2005)*

In this early empirical study of the TRIPS era, a pre-cursor to the present Chapter, Park and Lippoldt (2005) assess the relationship between international licensing and the strengthening of IPRs during the period 1990 to 2000. Licensing was singled out for special consideration, in particular, because of its potential role in technology transfer. During the study period, licensing played an important role in the large and increasing volumes of income earned globally from commercial transactions related to technology transfer. For OECD countries at the end of the period (2001), these receipts amounted to more than USD

140.8 billion.<sup>91</sup> The summary presented below focuses in particular on the role of strengthened patent rights in relation to the evolution of licensing.

In line with the literature reviewed above, Park and Lippoldt (2005) note that theoretical reflections generally do not lend themselves *a priori* to absolute statements as to the relationship between stronger IPRs and licensing activity. Stronger IPRs may be expected to reduce the costs of reaching and enforcing contracts thereby encouraging expanded licensing activity. However, ever-stronger IPRs could eventually reach a level where they confer excess market power, thereby risk constraining licensing as rights holders boost license fees or refuse to license. Moreover, weak IPRs may prompt a defensive reaction whereby some rights holders are willing to license to local producers in order to have a local interested party to safeguard against infringement.

The prior literature pointed to some evidence of a generally positive relationship between IPR strength and licensing, subject to certain conditions and with some variation by sector (e.g., Yang and Maskus, 2001). Park and Lippoldt (2005) followed up this previous work by exploring in more detail the determinants of licensing flows, the variation in flows by level of economic development, and the relationship of licensing to FDI and exports. The principal analytical method they employ is a regression analysis designed to estimate the relationship during the 1990s between indicators for the strength of IPRs (i.e., the “Park et al.” indices for patent rights, copyright, trademark rights and enforcement effectiveness discussed in Chapter 1) and the licensing fees received by US parent firms from the use of their intellectual property in other parts of the world, while controlling for other factors (including firm-level control variables). In a complementary exercise designed to provide confirming information, Park and Lippoldt conducted an analysis using counts of technology transfer licensing deals. By using information based on numbers of transactions, they sought to gain insights concerning the volume of technology transfers (rather than just the value of those flows, which could be somewhat inflated if rights-holders exercised market power that may come from stronger IPR protection).

The regression model used by Park and Lippoldt (2005) is as follows:

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<sup>91</sup> This amount (USD 140.8 billion) refers to data for 2001 from 17 OECD Member countries concerning receipts from the sale and use of patents, licenses, trademarks, designs, know-how and closely related technical services including technical assistance) and for industrial research and development carried out abroad, among other elements. For details, see OECD (2005), pp. 53 and 71.

$$\text{Log (Licensing}_{i,n,t}) = \alpha_0 + \alpha_1 \log (Z_{1\ i,t}) + \alpha_2 \log (Z_{2\ i,t}) + \alpha_3 \log (\text{IPR}_{n,t}) \\ + \text{“Industry Dummies”} + \text{“Time Dummies”} + \text{Error}_{i,n,t}$$

where the subscript  $i$  denotes the firm,  $n$  denotes country, and  $t$  denotes time. The IPR variables are the key variables of interest, representing the strength of intellectual property rights as represented by the four “Park *et al.*” indices covering patent rights, copyright, trademarks and enforcement effectiveness (presented in Chapter 1 of this dissertation). The variables  $Z_1$  and  $Z_2$  and the dummies are control variables. The selection of specific variables was based on insights from the literature, intuition and data availability. In operationalising the various permutations of the model, the control variables “ $Z$ ” were specified as firm-level covariates (market size and the R&D intensity)<sup>92</sup> and key environmental factors (tariff levels, country risk and corruption).<sup>93</sup> Dummy variables were included to control for fixed effects with respect to industry group and time period. As is standard in such analyses, the error term accounts for factors that have not been explicitly captured by the other variables.

The data set for the regression analysis concerns a sample of US parent firms over three time periods 1992, 1995 and 1999. As this is not a balanced panel (some firms appear in some periods but not in others), the analysis is run as a pooled regression. The full sample consists of over 7 000 observations, covering 11 industries and 91 countries. The sample is based on firm-level data from two surveys of the US Bureau of Economic Analysis (BEA) providing information on royalties and licensing fees of a sample of US-based firms and firm-level control variables.<sup>94</sup>

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<sup>92</sup> As with IPR strength, each of the selected control variables “ $Z$ ” might be expected to influence the flow rate or supply of technologies. The market size facing the firm (as proxied by sales) may positively affect the flow rate as well as the supply of technologies, with bigger markets tending to provide larger incentives to develop and exploit intellectual property. In contrast, the effect of the R&D intensity of firms (i.e. their ratio of research and development expenditure to sales) may be more ambiguous. R&D intensity may positively stimulate the supply of technologies, if the intensity of R&D is associated with the extent of “fruits” from innovation. However, the R&D intensity of a firm may also lead management to be more concerned about protecting the associated intellectual property. Holding other factors constant, such firms may be less willing to license or outsource their technologies to third parties. Conversely, firms could tend to be less concerned about the misappropriation of technologies with a low intensity of R&D.

<sup>93</sup> The three environmental control variables are operationalised as mean tariff rates and indices of country risk and corruption. Tariff rates might be expected *a priori* to influence the choice of mode of market entry and, consequently, technology transfer. High tariff rates may make licensing more attractive because the border protection creates a barrier to trade in the goods that embody the intellectual property. On the other hand, both country risk and corruption might be expected *a priori* to negatively affect licensing as they may make it harder to appropriate the returns from use of the intellectual property.

<sup>94</sup> The BE-93 survey provides information on the international payments and receipts of royalties and licensing fees of US-based firms (including US parent companies as well as firms that are not multinationals).

The equation was used to test various hypotheses related to the influence of IPR strength on the ability of intellectual property holders to appropriate returns via international licensing arrangements. Presented here are the results of two of the tests of relevance for the subsequent empirical analysis presented in this Chapter. The first is an assessment of the hypothesis that the strength of IPRs influences international licensing receipts and that the extent of this influence varies by type of intellectual property right and effectiveness of IPR enforcement. The second is an assessment of the hypothesis that the strength of IPRs influences the choice of channel for international technology transfer between licensing and FDI and between licensing and export of the products that embody the technology.

In order to provide context with respect to the flows of royalties and licensing fees, Table II.1 presents the distribution of amounts received by the sample firms in 1999 from the licensing use of intellectual property. As can be seen, the bulk of these fees originate in high-income countries and from affiliated sources, an indication that the associated technology may tend to be held fairly closely by firms and the directed primarily to the developed country markets. Tables II.2 and II.3 present the results from the regression analysis with respect to the two hypotheses cited above. They focus on licensing to unaffiliated sources, which may be more sensitive to variation in IPR strength than affiliated licensing because there is potentially less control of the intellectual property after it is transferred to the licensee. In other words, IPR strength may be one factor that could potentially have an influence on the flow of such intellectual property to various markets including in developing countries.

From glance at Table II.2, it is clear that the coefficients for the strength of patent rights are consistently significant in relation to variation in royalty and licensing revenue, though the explanatory power of the regression is relatively limited. (The adjusted  $R^2$  scores are relatively modest, which may not be surprising in such a cross-sectional analysis). As can be observed from column (1), a 1% strengthening of the Patent Rights Index is associated with a 0.65% increase in the receipts of *unaffiliated* licensing fees. The coefficient is larger with respect to wealthier countries, perhaps because of their greater imitative capacity (i.e., such

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The payments and receipts are broken down by source of income (e.g., from broadcasting, franchises, books). The firm-level control variables come from the BEA's BE-10 survey database providing information on US parent and affiliate financial and operating characteristics. A concordance between the BE-93 and BE-10 data was established and provided by C. Fritz Foley, Harvard Business School, for which Park and Lippoldt express their kind thanks. The data employed here are from the benchmark survey years: 1989, 1994, and 1999. The 1989 values are used to correspond with the licensing data in 1992 (earliest year in BE-10), the 1994 values for licensing in 1995, and 1999 values for licensing in 1999.

imitative capacity might dissuade some rights holders from licensing in more developed countries with comparatively weak patent protection). For each of the other IPR indices, the significance is less consistent; there is one instance for each where the corresponding coefficient is not significant. For the Trademark and Enforcement Effectiveness indices, even where they are significant this significance is weaker than for the Patent Rights Index. Notably, for the Copyright and Trademark indices, where significant, they tend to be negative (in 3 of 4 instances). One possible explanation is that rights holders may exploit their pricing power where protection is greater and that this results in smaller licensing volumes.<sup>95</sup> Among the control variables, considering the findings from the literature review above, it is not surprising to find significant coefficients for research and development intensity.

This exercise affirms the first hypothesis of an association of IPR strength with international royalty and licensing revenues, and also that patent rights are the most strongly associated form of intellectual property protection for unaffiliated licensing.<sup>96</sup> Moreover, as Park and Lippoldt (2005) note, the statutory level of protection is an important explanatory factor even after controlling for a measure of enforcement effectiveness (which itself is a statistically significant determinant of licensing in two specifications of the equation, albeit only modestly so). Thus, reform of “laws on the books” has an important effect independent of the current state of the implementation; it can establish the possibility for legal recourse in cases of abuse and may signal the future direction of policy. Maskus (1990) and Park and

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<sup>95</sup> Park and Lippoldt (2005) suggest possible explanations of the generally weak results for the variables concerning copyright, trademark rights and enforcement effectiveness. For copyright, they note that stronger copyright may enable US parent firms to exercise stronger market power in the developing markets, which would increase the return for each license while having a negative effect on overall licensing in those markets. For trademark rights, they note that stronger protection for symbols and names may enable firms to enjoy greater market power in all markets. While stronger patent rights may lead to further innovation, stronger trademark rights may tend to allow for a stronger exercising of existing rights. In less developed markets, the index of enforcement effectiveness does not appear as an important influence on licensing, but this is likely due to the situation in most of the countries in this sub-sample which tend to score low on enforcement effectiveness and thus there is not much variability.

<sup>96</sup> In further specifications of the model, presented in Park and Lippoldt (2005), the effects of IPRs strength on licensing are found to vary by industry group. Patent rights are found to be significant in the services, electrical and electronic, and transportation industries, but not in the machinery and wholesale trade industries. Copyrights are significant for the licensing of books, trademarks, franchising and broadcasting. Enforcement effectiveness is particularly significant for licensing in the chemicals, electrical and electronic, and services industries.

Lippoldt (2003) have noted that signalling with respect to strengthened IPR protection may positively influence the behaviour of rights holders with respect to trade and investment.<sup>97</sup>

Table II.3 presents a re-specification of the model by Park and Lippoldt in order to consider whether change in IPR strength at the margin affects licensing relative to other channels of technology transfer, such as FDI and exports. The dependent variable is the log of the ratio of unaffiliated licensing to either FDI (Panel I) or exports (Panel II). For the purposes of this exercise, “FDI” refers to investment in physical plant and equipment (net of accumulated depreciation) and “exports” refers to US parent firm exports to unaffiliated parties.

The results tend to confirm the second hypothesis presented above, namely that the strength of IPRs influences the choice of channel for international technology transfer between licensing and FDI and between licensing and export of the products that embody the technology, whereby the strength of patent rights tends to play a more significant role than the other indicators of IPR strength. In this assessment, the explanatory power of the model is stronger than in the previous one (i.e., the  $R^2$  is much larger). The results in Panel I point to a tendency for licensing to dominate over FDI where patent rights are stronger, in both developed and less developed markets. This is in line with the discussion in the literature review above, which suggested that firms tend to prefer to retain direct control over intellectual assets in environments where IPRs are weaker.<sup>98</sup> The coefficients for the other IPR indicators are relatively weak, though it is notable that enforcement effectiveness does seem to have some complementary and positive effect on licensing, albeit only in some specifications and even then the significance and size of the coefficient tends to be more modest than the coefficient for patent rights.

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<sup>97</sup> Additional country-level control variables are included in the equation to control for country risk, corruption, and trade restrictiveness (via the mean tariff rate). The tariff variable turns out not to be a significant factor, while country risk and corruption are significant at the 1% level. The results indicate that corruption negatively contributes to licensing, and that lower country risk contributes positively to licensing. The sign for country risk is positive because a higher value of the index is associated with a lower country risk.

<sup>98</sup> Maskus *et al.* (2004) provide some complementary information on the relationship of strengthened IPRs to FDI and licensing. They note that there is evidence to support the notion that stronger IPRs would reduce contracting costs and encourage a shift from FDI towards licensing. However, they find that the “standard prediction holds only in sectors with rapid innovation rates, which presumably are higher-technology industries.” In lower-technology industries, they find it more likely that stronger patents would induce firms to shift toward greater use of FDI and lesser use of licensing.” This is because in lower-technology industries a strengthening of patent rights would reduce the risk of imitation thereby encouraging FDI, whereas presumably the demand for access to new technology via licensing is less pressing in those industries.

Also notable in Table II.3 are the coefficients for research and development intensity, whereby a higher R&D intensity is found to favour FDI. This would seem to confirm further findings from the literature review above. Namely, when R&D intensity is high, FDI may be the preferred mode of technology transfer for internalisation reasons; that is, the investment in research and development puts more at risk than would otherwise be the case, and the risk of imitation and copying may be higher when the firm licenses to unaffiliated third parties than when the firm controls its own production abroad. An increase in market size (i.e., sales) also favours FDI relative to unaffiliated licensing, perhaps because there are economies of scale from such investment. Panel II examines the effect of IPRs on the ratio of licensing to exports. Here, an increase in patent strength is found to favour licensing over exporting in poorer markets, but it is not statistically significant in the regression focused on richer markets.

Park and Lippoldt (2005) then use a second analytical approach to confirm their findings. They drew on the Securities Data Corporation database on *Joint Ventures and Strategic Alliances* to focus on counts of international licensing transactions where firms in a developed country licensed intellectual property to firms in 28 developing or emerging economies (e.g., Korea, Singapore or Brazil). The analysis examined the relationship of change in patent regimes in these countries to changes in the numbers of licensing deals they experienced during the period 1989 to 2002. Considering the change in licensing transactions between two periods (1989-to-1994 versus 1997-to-2002), the authors find that the developing countries that least strengthened their patent regimes experienced a small overall reduction in the count of licensing deals (Table II.4). In contrast, developing countries that most strengthened their patent regimes experienced a notable increase in the number of deals over the same time period. The analysis points to a positive correlation between changes in numbers of licensing deals and changes in patent regimes. As this is based on counts rather than values, the authors noted that this may provide an indication that increased IPR strength is contributing to an environment conducive to more technology transfer transactions and not simply increasing the flow of royalties to developing country licensors. In sum, the conclusions of this exercise seem to be consistent with the findings of the previous regression analyses.

### **3 Motivation**

While the foregoing theoretical studies offer important insights on the possible role and functioning of innovation and intellectual property in the international economy, they also underscore the complexity. Conclusive findings remain elusive on the overall implications of a strengthening of protection for patent rights, though there are indications of the role and importance of patent rights for technology transfer. Still, there are trade-offs among the various effects and the balance is difficult to determine on an *a priori* basis.<sup>99</sup> For example, Maskus (2000, p. 33-34) notes that countries importing goods and technologies subject to IPRs may face several costs associated with stronger IPR protection, including higher prices for imports, potential competitive abuses in the exploitation of IPRs, employment losses in imitative and copying industries, and restricted access to international technologies. (To his list one could add the cost of implementing and maintaining the IPR system.) At the same time, stronger IPR protection generates potential domestic benefits such as increases in domestic innovation (possibly better suited to local needs than foreign innovation), incentives for trade and inward FDI, and reductions in the costs of writing and monitoring contracts for technology licenses.

Business decisions to invest and trade are complex and based on a variety of considerations, with higher-level considerations sometimes trumping lower level concerns.<sup>100</sup> While an effective IPR regime may not be sufficient in-and-of itself to attract FDI or trade, it may well contribute to market entry decisions including the choice of entry channel. Moreover, in some cases an inadequate IPR regime can indeed be a deal-breaker to a firm with IPR-intensive technologies. As IPR standards improve in countries around the world, some firms have come to require a basic level of protection and they have a choice of markets that now deliver such protection (enabling them to better avoid unduly risky markets). At the same time, as global IPR standards increase and converge, the competitive advantage that provision of basic IPR protection affords to a given host country may shrink. Moreover, some firms have the option of alternative means to protect technologies. For example, it may be that a strategy of trade secrecy can adequately protect a firm's intellectual property in some cases,

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<sup>99</sup> See Primo Braga and Fink (1998a) for a discussion of some of the challenges facing developing countries. In addition, Lessig (1999) discusses challenges specifically related to patents and innovation.

<sup>100</sup> Primo Braga and Fink (1998b) comment that the choice of whether and where to invest depends on locational advantages of the home and foreign markets and the profitability of internalising production or selling or licensing the technology to another firm that is active in the market. The extent of protection for intellectual property rights can constitute an important locational advantage.



even in the face of some weakness in the local IPR system. In some cases, factors such as market scale (i.e., access to a large market) or strategic positioning may prove to be dominant factors motivating investment or trade, whereby firms choose enter the market and simply manage the IPR risk. Such factors, for example, may help to account for the large number of pharmaceutical FDI projects in China (which has had a mixed performance on IPR enforcement since its entry into the WTO in 2001).<sup>101</sup>

This situation underscores the importance of empirical work to clarify the relationships between strengthened IPRs and indicators of international economic performance. Maskus (2000, p 113) states it thusly, “To summarize, theoretical models do not clearly predict the impacts of variable patent rights on trade volumes. Much depends on local market demand, the efficiency of imitative production, and the structure of trade barriers. Also important are the reactions of imperfectly competitive firms. Thus, a clear picture can emerge only from empirical studies.” In the next section, we turn to consider in more detail the relationship between the strengthening of patent rights (including the individual components) and economic performance at the national level.

Patent rights are presented as a central matter of the empirical analysis in view of their intimate relationship to technology; by definition, they embody technology in that they concern inventions that are novel, useful, and materially applicable. To the extent they promote innovation or technology transfer, factors that encourage access to patented technology (e.g., via trade or FDI) or innovation that generates patents may be of interest for policy-makers striving to boost growth. Output per capita must rise as part of the development process and for that to happen the quality of technology must be improved in terms of its application in economic processes that engage factors of production (land, labour and capital). The following assessment looks into the question of the strengthening of patent rights as it effects the trade and FDI channels for access to products and processes that to varying extents contain protected intellectual property.

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<sup>101</sup> For example, among the top 10 locations for pharmaceutical FDI projects during January 2002 to February 2005, China ranked second with 44 projects. The US ranked first with 52 FDI projects in the sector. Other countries ranked as follows: India (30), Ireland (29), Spain (27), Canada (27), UK (23), Singapore (23), Brazil (22) and Germany (18) (“Pharma pulls in \$15bn”, 12 April 2005, available as of 15 September 2006 at: [www.fdimagazine.com](http://www.fdimagazine.com)).

## **C Data**

The time period for the following empirical analysis covers the years from 1990 to 2005. The principal dependent variables are foreign direct investment, merchandise imports and services imports. These are drawn, respectively, from the UNCTAD *Foreign Direct Investment Database*, the WTO *Statistics Database*, and the UNCTAD *Handbook of Statistics*. Details are given in Annex II.2 of this chapter of the dissertation. The principal independent variable is the Patent Rights Index, originally developed by Juan Ginarte and Walter Park (1997) and subsequently updated and further developed by Walter Park (2008b), with the revision being first applied in Park and Lippoldt (2008). The Patent Rights Index is presented in detail in the first chapter of this dissertation. A variety of control variables are employed in the various analyses and these are drawn from a range of sources presented in Annex II.2 to this chapter. The principal dependent and independent variables and the control variables are largely drawn from a database developed for the study conducted by Park and Lippoldt (2008), though supplemented with some additional data. This includes, in particular, the addition of population data from the World Bank's *World Development Indicators* and trade volume and value series drawn from the WTO *Statistics Database*.

## **D Empirical Assessment**

The empirical assessment is built on a series of regression analyses that consider the relationship of change in the patent rights index (or its components) to certain indicators of economic performance of relevance for technology transfer, in particular imports and foreign direct investment. The assessment starts from the earlier paper by Park and Lippoldt (2008), building upon this foundation using a revised methodology and supplementing the findings with a new test of the tangible impacts on trade and an assessment of the components of patent rights.

### **1 International Trade, FDI and Strengthened Patent Rights: methods and results**

The heart of the new empirical analysis in this chapter builds upon the work of Park and Lippoldt (2008), which considered the relationship of strengthened IPRs to technology

transfer and local innovation.<sup>102</sup> The present analysis applies a different methodology<sup>103</sup>, however, and considers a more targeted set of hypotheses. Lippoldt (2009) presents a preliminary assessment using this revised approach, though focussing only on the high-income countries.

From the discussion in the literature review above, we know that technology transfer constitutes an important means for developing countries to increase their stock of knowledge capital and productivity. Imports and inward FDI are cited in the literature as being important channels for technology transfer to take place. At the same time, the strengthening of patent rights – in particular in the context of implementation of the TRIPS Agreement<sup>104</sup> – has aroused controversy and fears of conferring excess market power upon rights holders with the potential to constrain flows of technology embodied in traded goods and services. In light of these considerations, the objective of the present analyses is to consider whether there have been substantial changes in developing countries in the flow of imports and stock of inward FDI, changes that may be associated with the strengthening of patent rights during the period of TRIPS implementation (considering that most of the transition requirements ended by 2005). In particular, the analysis considers the two following hypotheses:

- Hypothesis 1: The strengthening of patent rights during the period from 1990 to 2005 was positively associated with change in the flow of imports (both merchandise and services), including with respect to developing countries.
- Hypothesis 2: The strengthening of patent rights during the period from 1990 to 2005 was positively associated with change in the volume of foreign direct investment, including with respect to developing countries.

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<sup>102</sup> Park and Lippoldt (2008) is itself the development of an earlier paper by the same team (Park and Lippoldt, 2003). The earlier paper employed a slightly different approach, had a narrower scope (e.g., it did not cover services), used previous versions of the Park *et al* indices, and covered the timeframe 1990 to 2000.

<sup>103</sup> Ricardo Cavazos, OECD, advised the author in the development of this new approach and facilitated its implementation via Stata programming.

<sup>104</sup> Along with the TRIPS Agreement, the international community also included an accord on FDI in the final act of the Uruguay Round. While the following assessment of patent rights and FDI may be influenced by some unmeasured effects arising as a consequence of the WTO Agreement on Trade-Related Investment Measures, it should be noted that the agreement had a different implementation timeline and was relatively limited in scope (i.e., its scope covered primarily local performance and trade balancing requirements). Therefore, its effects are not likely to be collinear with those of the patent reforms.

In order to test the two hypotheses, a regression analysis was conducted using a panel estimator (ordinary least squares) and random effects.<sup>105</sup> In order to take advantage of the panel information in the data, the data set was augmented through definition of an identifier for each unit and time period. As the source of heteroskedasticity is unknown, the model included provision of an error term to take the heteroskedasticity into account.<sup>106</sup> This delivers robust standard errors, which improves inference in comparison with the previous study.<sup>107</sup> However, it should be underscored that this type of analysis does not explicitly measure causality.

The *model* was specified as follows:  $\ln y_{it} = \alpha + \beta \ln x_{it} + \gamma \ln z_{it} + e_{it}$ ,

where

$y$  is the *dependent variable*,

$x$  the *Patent Rights Index score*,

$z$  *control variable(s)*,\*

and

$e$  the *error term*.

$\ln$  denotes the *natural logarithm*.

(\* Note that  $z$  may consist of time-invariant variables.)

The subscripts refer to the values of  $y$ ,  $x$ , and  $z$  for country  $i$  at time  $t$ , where  $i = 1, \dots, N$  and  $t = 1, \dots, T$ . The symbols  $(\alpha, \beta, \gamma)$  represent the *coefficients* indicating the association between an independent variables and the explanatory variable  $y$ , holding other factors constant. As both the dependent and independent variables are in log units, the parameter is in *percentage*

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<sup>105</sup> Use of fixed effects was not an option because three of the control variables included in the database were time-invariant indicators (Doing Business rank, physical property rights and IPR Survey). These data prevent the use of fixed effects with the panel estimator because of collinearity between the fixed effects and the time-invariant variables.

<sup>106</sup> Park and Lippoldt (2008) took a different approach. They assumed that the heteroskedasticity was probably associated with variation in the size of countries. This enabled them to employ a feasible generalised least squares approach, which can lead to more efficient estimates than an ordinary least squares approach, subject to the assumption being valid. However, given the uncertainty in the source of heteroskedasticity, the author opted to employ an ordinary least squares approach for the present assessment. Comparisons of the two approaches confirm a better fit from the ordinary least squares method, thereby improving the ability to draw inferences from the results.

<sup>107</sup> A comparison of the Park and Lippoldt (2008) results with those in the present analysis reveals changes in the sign and magnitude of the parameter estimates, as well as in the magnitude of the standard errors. Notably, several large parameter estimates from the original study were attenuated. In the most striking example, which concerned the developed country sample, the change in inward FDI associated with a 1% change in the Patent Rights Index was 11.2% in the earlier study and 6.6% in the new study.

*units* (e.g., if  $\beta = 2$ , a 1% increase in  $x$  is associated with a 2% increase in  $y$ , holding  $z$  constant).<sup>108</sup>

The data are drawn from the database underlying Park and Lippoldt (2008), with some adjustments (e.g., to facilitate the exploitation of the panel aspects of the data). The sample of 122 countries is presented by country grouping in Annex II.1, with assignments based on each country's situation as of 1990. The sample consists of an *unbalanced panel*, in the sense that there is some variation in the number of observations per country due to missing data for some variables in certain countries or time periods. There are a maximum of 4 observations for each country (1990, 1995, 2000 and 2005). Depending on the iteration of the model, the dependent variable is designated to be either the inward stock of FDI, merchandise imports or services imports. The independent variable of interest is the Patent Rights Index (see Chapter 1 of this dissertation for a detailed discussion of this indicator). The control variables include real gross domestic product (GDP) per capita, freedom to trade internationally, Doing Business rank, legal effectiveness, physical property rights, governance, and IPR survey reporting (reflecting executive opinions of the overall effective stringency of the IPR system in the country at hand). The selection of indicators took into account a combination of considerations including discussion in the relevant literature, availability and coverage of the time period and countries. Annex II.2 presents the sources and definitions for these variables.

Sample statistics are presented in Table II.5, showing averages by country group for the main dependent variables (FDI, merchandise and services imports) and the Patent Rights Index. The three dependent variables are shown in the table on a per capita basis in order to facilitate comparisons. The gaps between the groups are quite striking for these three variables, highlighting the modest average per capita flows of imports and stocks of FDI in the developing countries; nonetheless, these flows and stocks are potentially important transit

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<sup>108</sup> The objective of the regression essentially remains the same as in the previous study. As Park and Lippoldt (2008) note, this “is to estimate values of the coefficients  $\alpha$ ,  $\beta$ , and  $\gamma$  that best fit the data, as well as to estimate the standard errors of  $\alpha$ ,  $\beta$ , and  $\gamma$ . The smaller the standard errors relative to the coefficient estimates, the greater the statistical significance of the coefficient estimates. For a normal distribution, if the ratio of the coefficient estimate to its standard error exceeds 1.645, the coefficient estimate is considered *statistically significant at the 10% level*, meaning that the null hypothesis that the coefficient is zero (*i.e.* the associated variable has no effect on the dependent variable) can be rejected with 90% confidence. If the ratio of the coefficient estimate to its standard error exceeds 1.96, the coefficient estimate is considered *statistically significant at the 5% level* (meaning that the null hypothesis of a zero effect can be rejected with 95% confidence), and if the ratio exceeds 2.576, the coefficient estimate is considered *statistically significant at the 1% level* (and the null hypothesis of no effect can be rejected with 99% confidence).”

channels for inward transfers of technology from abroad. The ratios between the scores of the three groups are smaller with respect to the Patent Rights Index and are decreasing. As mentioned in Chapter 1, the coefficient of variation declined during the study period – particularly between the developed and developing country groups (groups 1 and 2), though there remains some significant diversity in individual country scores for various index components.

Tables II.6, II.7 and II.8 present, respectively, the results for the regression analyses of the determinants of FDI, merchandise trade and services trade. As can be seen, the coefficients for the patent rights indicator are relatively consistently significant and positive, with the exception of imports of merchandise and services into LDCs. The exception for LDCs may be due to the limited imitative capacity of these countries (i.e., patent rights are less at risk) or the pattern of imports (e.g., comparatively little intellectual property may be embedded in the imports due to the structure of the flows, for example if they have low average technology intensity). Inward FDI stocks appear to be particularly associated with the patent rights index, with relatively high statistical significant and relatively large coefficients. For developing countries, for example, a 1% increase in the patent rights index is associated with about a 1.3% increase in the stock of inward FDI.<sup>109</sup> For developed and developing countries, the flows of imports are also associated, though with lower significance and smaller coefficients. The indicators of this relationship are stronger for merchandise imports than for services.

With the exception of *Real GDP per capita* and *legal effectiveness*, the control variables have a weak or rather inconsistent outcome in the analysis. The linkages of the FDI stocks and import flows to GDP are not unexpected. However, the results for legal effectiveness are more problematic. The negative coefficients could be due to gaps between the institutional set up (covered by the indicator) and enforcement in practice or perhaps it is due to the composition of this indicator (e.g., it includes subjective elements), which substantially marks down a number of relatively strong economic performers for certain elements such as judicial independence or impartiality (e.g., Czech Republic or Korea).

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<sup>109</sup> Park and Lippoldt (2008) point out that while a portion of such FDI could be for the establishment of plants whose main purpose is sales and distribution or manufacturing, rather than research, “[t]he fact that multinational firm investments are sensitive to patent rights, holding other factors constant, suggests that there are valuable intangible assets at stake, whether they are for production, research, or sales.”

Similarly, there are some unexpected significant negative scores in individual cases with respect to other indicators that include subjective elements, including the indicators for *freedom to trade internationally* and *physical property rights* (which has implausibly large negative scores). In the case of these control variables, it may be that there is simply not much variation (these two variables are held constant across time) and that the coefficients for these indicators are vulnerable to some distortion when the sample size is small in the regression iterations concerning the various country groups. Alternatively, it may be that the indicator for patent rights is related and when they are entered in the regression with the patent rights indicator, it tends to dominate and pick up some of their effects, which would also affect the coefficients for the control variables.

Table II.9 presents some illustrative sectoral detail for merchandise imports into developing countries and LDCs. The comparison points to generally significant results for the patent rights indicator, though with some variation across the significant scores and the coefficient for one sector not being significant. In the case of the chemical sector, it may be that patent rights are of relatively low importance for imports but of higher importance for FDI associated with manufacturing (i.e., it may be more important to firms in the sector to protect via patents the manufacturing processes than the products themselves; on the other hand, trademark protection could be quite important for such products when traded internationally).<sup>110</sup>

Table II.10 presents some illustrative sectoral detail for some technology-related services imports of developing countries and LDCs. For each of these three sectors, the coefficient for the patent rights index is significant at the 1% level and relatively large. For communications and computer services, this may be due to responsiveness to threat of imitation. Patent protection may be important in this regard, because it may be used to protect proprietary technologies associated with delivery of the service, as well as protection of the processes associated with the service in countries that extend such protection. The positive association of patent rights and royalties (often associated with technology licensing), is in line with the discussion of Park and Lippoldt (2005), whereby IPRs in general -- and patent rights in particular -- can play an important role in reducing transaction costs such as with respect to contracting and enforcement.

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<sup>110</sup> For a discussion of product versus process innovation in the chemicals sector, see Kiriya (2010).

Summing up the results of this regression analysis, the exercise provides substantial but partial support for both hypotheses. In the case of developing countries, the coefficients for the patent rights indicator are significant and positive with respect to the stock of inward FDI and the flows of merchandise imports and services imports during the time period covered by the study (Figure II.1). In the case of LDCs, however, only the hypothesis with respect to inward FDI finds support. Across the merged sample for developing countries and LDCs, there are a number of technology-intensive sectors presented on an illustrative basis, highlighting the positive and significant relationship of these flows to patent rights.<sup>111</sup>

## **2 Supplementary Assessments**

This section presents two supplementary assessments to the main exercise presented above. First, there are lingering concerns that patent reform may result in increased valuation of imports to developing countries and LDCs without a corresponding increase in tangible benefits (Maskus, 2008). In order to provide a simple consideration of this issue at an aggregate level, the author conducted a simple comparison of import value and volume flows using regression analysis. Secondly, the patent rights index is decomposed and change in its main components is considered in relation to import values using the same dataset as for the first supplementary exercise. This exercise is done using the same dataset (as the volume and value comparison) and a simple regression equation in order to facilitate consideration of the relationship of each component to the change in merchandise imports.

The objective of this exercise is to test the following hypothesis:

- Hypothesis 3: That the change in import volumes exhibits a positive and statistically significant relationship to the strengthening of patent rights during the period 1990 to 2005, and that this relationship is of the same order of magnitude as for import values, including for developing countries.

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<sup>111</sup> Maskus (2000, p. 116) presents a scenario whereby he considers the alternative channels for market entry available to firms. He sees exports as likely to be the primary mode of supply when transport cost and tariffs are low in comparison to the costs of FDI and licensing. FDI will dominate where trade and transport costs are high, local productivity is high relative to wages, construction costs are low, the size of the market is large and the research and development and marketing intensity of the product is substantial. (FDI exists because firms with ownership advantage prefer to exploit this content through internal organisation.) Licensing may be seen as insecure and therefore less likely where the technology is complex or products highly differentiated. Where IPRs stronger, licensing may be relatively more efficient and therefore more utilised.



Again, the time period for the study covers 1990 to 2005, with a maximum of four observations for each country (1990, 1995, 2000 and 2005). The import indicators are drawn from the WTO *Statistics Database* on-line. The independent variable of interest is again the Patent Rights Index. The control variables include GDP per capita (lagged one period to address possible endogeneity issues) and country fixed effects. The data set covers a sample of 23 developed and developing (middle and low income) countries, assigned to one the two groups depending on their status in 1990. The selection was based on data availability and diversity (i.e., covering high, medium and low income countries). The principal variables (imports, patent rights and GDP) were all included as natural logarithms in order to facilitate interpretation. The result is an unbalanced panel in that a few countries are not covered in every time period. The pooled regression analysis was conducted using an ordinary least squares approach, first with import volumes and then import values as the dependent variables.<sup>112</sup> The exercise was conducted for the full sample and then jointly for the medium and low-income countries.

The results of this assessment are presented in Table II.11. In each iteration of the regression, the coefficient for the patent rights indicator is positive and significant; all four are of similar magnitude. For the full sample, the volume indicator is even larger than the value indicator though this difference is not statistically significant (i.e., taking into account the standard errors, there is overlap). The adjusted  $R^2$  is notably lower for the full sample iteration in the volume regression, though still moderately high for this type of regression. The implication is that for the time period, economic conditions and range of patent rights strengthening undertaken, the import volumes exhibited a relationship to patent rights that is similar to that of import values. Import values did not change in a fashion much different from import volumes at the aggregate level. It may be that the aggregation masks substantial structural change in imports and in specific sectors the value and volume changes could vary

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<sup>112</sup> The equations were specified as follows:

$$\text{Import Value}_{i,t} = a + b_1x_{i,t} + b_2z_{i,t} + v_i + e_{i,t}$$

$$\text{Import Volume}_{i,t} = a + b_1x_{i,t} + b_2z_{i,t} + v_i + e_{i,t}$$

Each import value and volume observation refers to the WTO import value index score for economy (i) at time (t). The variable (x) refers to the Patent Rights Index score and the variable (z) refers to the GDP per capita. The variable (v) concerns the dummy for country fixed effects and (e) is the residual. The variables except for country dummies were entered as natural logarithms.

substantially (e.g., see the discussion in Maskus et al., 2004, on micro-economic implications of strengthened patent rights). Nevertheless, from this simple test at the aggregate level, there is no evidence of a wide divergence in the experience with import values and volumes, including for developing countries. Moreover, aggregate import volumes and values both tended to increase in association with the increase in patent rights. The outcome of this simple test does not contradict the hypothesis, though it also does not provide decisive conclusions.

In a further supplementary assessment, the simplified database and regression equation were used to assess the relationship between the value of merchandise imports or the stock of inward FDI and each of the five components of the patent rights index, controlling for GDP per capita and country fixed effects (Tables II.12 and II.13).<sup>113</sup> This supplementary assessment was run for a sample of medium and low-income countries (listed in the tables).

The results for merchandise imports (Table II.12) provide an interesting indication of the relative importance of change in the five components in terms of their association of changes in the value of merchandise imports. In particular, the strengthening of enforcement provisions was positively and significantly associated with change in merchandise imports, though the coefficient is fairly small; a change of 1% in this element of the patent rights index was associated with a change of just 0.05% in import values. The enforcement law index component includes three dimensions: the availability of preliminary injunctions, ability to prosecute contributory infringement, and the reversal of the burden of proof, e.g., in the case of process patent cases. One possibility for the significance of this variable is that preliminary injunctions can be particularly important in removing violating imports from commerce. Coefficients for the index components for duration of patent protection and legal restrictions on patent rights components were also of the same order of magnitude and significant, but their statistical significance is weaker than was the case for enforcement law. Here, it should be noted that the results presented in Table II.12 are not a test of causality nor are they an

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<sup>113</sup> The equations were specified as follows:

$$\text{Merchandise Imports (Value)}_{i,t} = a + b_1x_{i,t} + b_2z_{i,t} + v_i + e_{i,t}$$

$$\text{Foreign Direct Investment (Stock)}_{i,t} = a + b_1x_{i,t} + b_2z_{i,t} + v_i + e_{i,t}$$

Merchandise import values refer to the WTO import value index score for economy (i) at time (t). FDI refers to the stock of inward FDI (from the UNCTAD World Investment Report) for economy (i) at time (t). The variable (x) refers to the Patent Rights Index score (or the score of the individual component of the Patent Rights Index) and the variable (z) refers to the GDP per capita. The variable (v) concerns the dummy for country fixed effects and (e) is the residual. The variables except for country dummies were entered as natural logarithms.

indication that the components without a significant coefficient are unimportant (it may be that there was simply less change during the study period).

The results for FDI (Table II.13) provide an indication of the relative importance of change in the five components in terms of their association of changes in the value of the inward stock of FDI. Three of the coefficients are significant. As in the case of merchandise imports, the coefficients for duration and enforcement provisions are also significant with respect to the inward stock of FDI, though the size of the coefficients is larger. The coefficient for Membership in International Treaties turns positive and is actually the largest for any of the coefficients with respect to FDI. A change of 1% in this element of the patent rights index was associated with a change of 0.1% in inward FDI. The other two coefficients are not statistically significant. The intuition here is that foreign investors making long-term commitments are looking for assurances and the membership in international treaties provides some possible recourse in the case an agreement is not respected (though in the case of the TRIPS Agreement, for example, private parties do not have standing and any complaints would need to go via a member government as part of a more general concern). Similarly, the provisions for duration and enforcement (including reversal of the burden of proof) may provide a long-term indication of the availability of the protection for patented products and processes that are associated with FDI; this can be especially important for manufacturing investments or research and development. Here again, as with Table II.12, the results are not a test of causality nor are they an indication that the components without a significant coefficient are unimportant (it may be that there was simply less change during the study period).

In sum, the two supplementary assessments, though oversimplified, provide an indication of two potentially important issues of interest to developing countries. First, while further confirming work is required to look at the evolution of prices for specific products taking into account changes quality and other factors not covered by the present data set, it is notable that the first exercise failed to find support at the aggregate level for the notion of a possible divergence in the volume and value of imports. In fact, import volume and value were similarly positively associated with change in the Patent Rights Index. Secondly, the supplementary analysis confirms tendency for a positive – though modest association – between specific components of the patent rights index and merchandise imports or FDI,

subject to the specific conditions in place during the study period (i.e., this does not indicate that all strengthening of these components will always elicit a similar response).<sup>114</sup>

## E Conclusions

A growing body of economic literature considers the relationship between the strength of IPR protection and various aspects of economic performance. This Chapter presented selected highlights from this literature focusing on IPRs, development and international economic linkages, before moving to consider empirically a particular dimension of this relationship: namely, the chapter examined empirically the association of patent rights reforms during the period 1990 to 2005 with change in indicators of merchandise and services imports and stocks of inward FDI. This period is significant because it encompasses the advent of the TRIPS Agreement and the completion of most of the transition periods it provided for developing countries.

The Chapter notes the complexity of assessing responses to the strengthening of patent rights, complexity which arises in part from the market entry options available to firms holding patents. For example, they may trade in goods, deliver services (including licensing) or invest directly via wholly owned entities or joint ventures. Flows via each of these modes may increase in response to stronger IPRs under certain circumstances, but firms may also switch their mode of supply in a given market, for example by moving from exporting to producing locally through affiliates or licensing. In such cases, trade may actually decline or expand more slowly than might otherwise be the case. Where protection of intellectual property is relatively effective and contracts enforceable, firms may opt for licensing and transfer of technology to unaffiliated partners, such as in cases where there are other risks that may dissuade direct investment (e.g., currency risk) or cases where the licensor lacks the capacity to operate in the market. Further complicating this picture are the cases where firms

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<sup>114</sup> This caveat is important because, as Maskus (2008) notes, one cannot assume from such analyses that the coefficient for the IPR reflects the underlying relationship between the variables across the full range of possibilities. The assumption of a monotonic relationship “believes the complexity of IPR strengthening”, which reduces licensing costs and supports commercialisation of products while raising transaction costs in complex technologies, i.e., points not readily captured in a single parameter. There can be variable impacts of change in each dimension of the strengthening (e.g., eligibility requirements, scope or opposition procedures) by country and sector. In the same volume, Park (2008a) notes that innovation incentives and productivities may be non-monotonic and subject to development thresholds and feedback effects in relation to IPR strengthening.

agree to license as a defensive measure despite a weak IPR environment in a particular market.

In practice, it appears that market entry decisions – including mode of entry -- are influenced by a variety of factors (e.g., protection of IPRs, labour costs, available human capital, market size, risk of imitation, and factors complementary to the IPR system such as the quality of legal institutions and infrastructure). Thus, the full influence of intellectual property reform on trade and FDI is ultimately subject to the environment in which the enterprises operate and the importance to the rights holders of IPR issues in relation to other non-IPR factors. As a consequence, it is clear that patent rights reform alone will not suffice to close the technology gap between developed and developing nations. In order to obtain an indication of the importance of patent reform, the empirical assessment in the present chapter aims to cut through some of the complexity by considering at an aggregate level the net association of the recent patent reforms with selected aspects of economic performance.

Are stronger patent associated positively with merchandise imports, services imports and FDI in developing countries and LDCs? The empirical assessment in this chapter found that at the aggregate level the answer tends to be yes for developing countries, but for LDCs it only tends to be the case for the stock of inward FDI. This appears to be consistent with issues raised in the literature review with respect to rights-holder concerns about imitative capacity and risk of IPR abuse in destination markets. Stronger patent rights protection means that rights-holders are better able to appropriate benefits from their intellectual property, selling into the more advanced markets where effective demand for innovative technology might be stronger (i.e., these countries have relatively greater resources to purchase intellectual-property intensive products or processes and a relatively high capacity to absorb or employ them) as well as the imitative capacity.

Thus, relatively strong patent protection may have provided a means of promoting technology transfer under the conditions prevailing during the study period. This effect appears to be stronger with respect to FDI than for imports of merchandise or services. In other words, the strengthened patent rights may have served not only the defensive interests of rights-holders in protecting their intellectual property from abuse, but also delivered a

positive aspect in terms of effectively opening markets to increased commercial deployment of intellectual assets.

In the case of LDCs, the tendency for a positive relationship between patent rights and economic indicators is particularly manifest with respect to the stock of inward FDI. While LDCs had opportunities to delay implementation of TRIPS Agreement minimum standards due to the availability of transition periods, those that reformed aspects of their patent rights system of particular interest to rights holders may have tended to benefit through higher levels of FDI. As we have seen, this may be due to the associated improvements in the ability of rights-holders to defend their innovations from abuse, such as by challenging those that wrongfully employ patented processes. For some firms, apparently, the ability to protect such processes is an important market consideration.

The regression analysis as specified in this study does not demonstrate causality, but it does highlight statistically significant relationships between variables that appear to explain a portion of the variation in important economic indicators. The results do not imply that stronger protection for patents (or other IPRs) will be monotonically associated with increases in merchandise or services imports or FDI; nor do they imply that there will necessarily be technology transfer benefits. Patent protection, accounting for only a portion of the variation in the flows, is not a “silver bullet” development solution. Nevertheless, appropriate IPR standards do appear to contribute to an environment conducive to the growth of these flows.

A general policy implication of the analysis with respect to developing economies is that patent reform should be assessed as one potential part of a broad strategy for promoting economic development. In view of the increasing globalisation of markets and the establishment of international standards for IPR protection, competitive pressures are challenging growth-oriented developing countries and LDCs to address basic shortcomings in their national IPR regimes. Conformity with the minimum global IPR standards may become, in effect, a prerequisite for countries wishing to access and exploit the full range of global technologies and know-how.

Technological progress is a fundamental condition for economic development (e.g., Jones, 2004 or Warsh, 2006, also referenced in Lippoldt, 2006). To the extent that technology is embodied in imported goods and services (including licences) and FDI, developing countries may have tended to benefit from a positive technology transfer effect as a

consequence of the strengthening of patent rights during the period from 1990 to 2005. The present chapter has found evidence of a positive association of the patent reforms with certain of these international economic indicators. The next chapter in this dissertation considers certain aspects of domestic innovation, which constitute a second avenue for possible technological progress. In particular, the discussion provides an empirical examination of the relationship of patent rights to certain aspects of innovation performance in developing countries during the period of patent reform from 1990 to 2005.

## F Tables

*Table II.1: Royalty and licensing fees received from abroad by U.S. parent firms.*

	Annual value of fees for 1999 (billions, USD)	Percentage share from affiliated sources	Percentage share from unaffiliated sources
All countries	33.4	72.6%	27.4%
Nations with per capita GDP > USD 18,000	26.7	74.5%	25.5%
Nations with per capita GDP < USD 18,000	6.7	64.8%	35.2%

1. *Source:* Park and Lippoldt (2005).



Table II.2: Intellectual property rights: royalty &amp; licensing fees from unaffiliated sources, firm level.

	(1)	(2)	(3)
		GDP per capita > USD 18 000	GDP per capita < USD 18 000
Constant	-8.739*** (1.516)	0.902 (0.663)	1.551*** (0.330)
Log (Patent Rights)	0.647*** (0.170)	1.560*** (0.349)	0.359*** (0.095)
Log (Copyrights)	0.162 (0.157)	0.948*** (0.232)	-0.450*** (0.126)
Log (Trademark Rights)	-0.029 (0.111)	-0.360* (0.190)	-0.197** (0.091)
Enforcement Effectiveness	0.250* (0.137)	0.363** (0.162)	0.177 (0.137)
Log (Firm R&D Intensity)	0.026*** (0.006)	0.026*** (0.008)	0.013** (0.007)
Log (Firm Sales)	0.254*** (0.016)	0.235*** (0.019)	0.260*** (0.018)
Log (Tariff Rate)	0.079 (0.058)		
Log (Country Risk Index)	2.66*** (0.363)		
Log (Corruption Index)	-0.545*** (0.108)		
Industry Group Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Adjusted R-squared	0.13	0.10	0.16
Number of Observations	5280	3773	3246

1. Dollar amounts here or in the underlying data are denominated in real 1995 US dollars.
2. The dependent variable, licensing, denotes the royalty and licensing fees received by US parent firms from unaffiliated sources. The unit of analysis is the U.S. parent firm. Firm R&D Intensity is the ratio of the parent firm's R&D expenditure to its sales.
3. The model is estimated over three time periods: 1992, 1995, and 1999.
4. Standard errors are in parentheses and italicised. \*\*\*, \*\* and \* denote significance at the 1%, 5%, and 10% levels, respectively.
5. Data sources: firm-level data - Bureau of Economic Analysis, U.S. Department of Commerce, Cross Border Trade Database (BE-93 Survey) and U.S. Direct Investment Position and Related Balance of Payments Flows (BE-10 Survey); GDP per capita and GDP deflator (1995=100) - World Bank Development Indicators 2001, CDROM; Tariff Rate - Gwartney and Lawson (2001).
6. Corruption Perceptions Index: Transparency International ([www.transparency.org](http://www.transparency.org)).
7. Country Risk: International Country Risk Guide ([www.countrydata.com](http://www.countrydata.com)).
8. Based on Table II.2, Park and Lippoldt (2005); see that article for full notes and sources.

Table II.3: IPRs and US royalty and licensing fees relative to trade and foreign direct investment.

	I. Dependent variable: Log (US outward licensing/US FDI)			II. Dependent variable: Log (US outward licensing/US Exports)		
	All countries	GDP per capita > USD 18 000	GDP per capita < USD 18 000	All countries	GDP per capita > USD 18 000	GDP per capita < USD 18 000
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	5.58*** (0.31)	1.44*** (0.74)	5.24*** (0.39)	7.91*** (0.66)	5.93*** (1.49)	9.01*** (0.89)
Log (Patent Rights)	0.42*** (0.11)	1.45*** (0.39)	0.40** (0.11)	0.61** (0.23)	1.21 (0.79)	0.57** (0.26)
Log (Copyright)	0.16 (0.13)	0.89*** (0.26)	-0.31** (0.15)	0.38 (0.28)	0.75 (0.52)	0.06 (0.34)
Log (Trademark Rights)	-0.15 (0.097)	-0.31 (0.21)	-0.23** (0.11)	-0.36* (0.20)	-0.25 (0.42)	-0.54** (0.24)
Enforcement Effectiveness	0.41*** (0.091)	0.39** (0.18)	0.13 (0.16)	0.32* (0.19)	0.32 (0.36)	-0.003 (0.36)
Log (Firm R&D Intensity)	-0.012** (0.006)	-0.015* (0.009)	-0.014* (0.008)	-0.37*** (0.012)	-0.36*** (0.018)	-0.40*** (0.017)
Log (Firm Sales)	-0.80*** (0.016)	-0.81*** (0.022)	-0.79*** (0.021)	-0.56*** (0.033)	-0.53*** (0.045)	-0.61*** (0.049)
Industry Group Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.34	0.33	0.36	0.41	0.38	0.45
Number of Observations	7019	3773	3246	6801	3684	3117

1. FDI refers to expenditures on plant and equipment abroad and Exports to the export of goods and services to unaffiliated parties (both in real 1995 US dollars).
2. Standard errors are in parentheses.
3. Also, see Table II.2 notes. *Source*: Park and Lippoldt (2005), Table 5.

*Table II.4: Patent reform and high-tech licensing transactions into developing countries.*

Strengthening of Patent Regime	Number of Licensing Transactions		
	<i>1989-1994</i>	<i>1997-2002</i>	<i>Change:</i>
Low	55	53	-2
Medium	24	26	2
High	33	61	28

1. Each row in the table shows the levels and changes over time in the volume of licensing transactions between developing nation licensees and developed nation licensors, as experienced by the developing nations with the specified degree of patent reform. The change in the volume of transactions is for the developing nations in the reform group as a whole.

2. The strengthening of patent regime refers to the change in the index of patent rights of the recipient (licensee) nation. The strengthening of patent rights is considered low if the index grew by less than 7% over the period 1989-2002, and medium if the index grew by more than 7% but by less than 20% over the same period.

3. All deals are “high-tech” licensing transactions (involving computer equipment & software, communications including telecommunications, biotechnology or electronics).

4. *Source:* Park and Lippoldt (2005).

Table II.5: Sample Statistics: Economic Indicators (in constant 2000 USD) and Patent Rights Index Scores.

Country group	FDI, inward stock, per capita				Merchandise Imports, per capita				Services Imports Per Capita				Patent Rights Index (Group Average)			
	1990	1995	2000	2005	1990	1995	2000	2005	1990	1995	2000	2005	1990	1995	2000	2005
Developed (Group 1)	2102.7	2543.7	4351.1	3997.6	4545.3	5233.2	6661.0	6908.5	3997.6	4545.3	5233.2	6661.0	3.35	4.02	4.33	4.39
N=25	23	23	23	25	25	25	25	25	25	25	25	25	25	25	25	25
Developing (Group 2)	115.8	176.8	391.3	262.7	418.1	456.8	705.7	540.5	262.7	418.1	456.8	705.7	1.70	2.40	2.97	3.31
N=70	64	67	68	64	69	69	69	70	64	69	69	69	63	69	70	70
LDC (Group 3)	23.7	28.3	52.9	53.6	54.9	56.9	88.4	83.5	53.6	54.9	56.9	88.4	1.87	1.92	2.07	2.45
N=27	25	26	27	27	27	27	27	27	27	27	27	27	23	25	27	27

1. Sources: FDI – UNCTAD *Foreign Direct Investment Database*; Merchandise Imports – WTO *Statistics Database* Time Series; Services Imports – UNCTAD, *Handbook of Statistics On-Line*. The aggregate data for all three were drawn from the database underlying Park and Lippoldt (2008), with per capita figures calculated using population from the World Bank *World Development Indicators* On-Line. The Patent Rights Index scores are drawn from the same database, see Chapter 1 of this dissertation for additional information.
2. The regression analyses presented below were run using aggregate data by country and not per capita. The amounts are presented here on a per capita basis in order to facilitate comparisons between the groups.
3. The range of possible scores for the Patent Rights Index is from 0 to 5, with higher scores representing more stringent protection of patents as indicated by laws on the books.

*Table II.6: Inward FDI and Patent Rights, by Level of Economic Development.*

Dependent Variable:	Inward FDI Stock (in real 2000 U.S. dollars)			
	Full Sample	Developed Countries (Group 1)	Developing Countries (Group 2), excluding LDCs	Least Developed Countries (Group 3)
Constant	-2.611 (2.199)	5.647 (7.894)	-0.552 (3.554)	-30.96** (13.02)
Patent Rights Index	1.375*** (0.215)	6.583*** (2.332)	1.293*** (0.208)	1.463** (0.470)
Real GDP per capita	0.968*** (0.157)	1.365** (0.581)	0.655*** (0.269)	3.362*** (0.563)
Freedom to Trade Internationally	1.030** (0.512)	-1.583 (1.594)	0.477 (0.729)	1.523*** (0.261)
Doing Business Rank	0.359* (0.234)	-0.136 (0.211)	0.508* (0.341)	2.964 (1.891)
IPR Survey	0.537 (1.146)	8.952 (5.912)	1.439 (1.298)	-4.037 (3.697)
Legal Effectiveness (e.g., impartial courts)	-0.719** (0.331)	-0.312 (1.288)	-0.692* (0.439)	-0.617*** (0.125)
Physical Property Rights	-0.283 (1.357)	-15.65* (9.391)	-0.406 (1.577)	4.418 (4.863)
Governance	0.225 (0.211)	-0.364 (0.330)	0.621** (0.236)	0.466 (0.341)
Number of Observations	263	67	163	33
Number of Countries	91	23	56	12
R <sup>2</sup>	0.582	0.470	0.319	0.547

1. All variables are in natural logarithmic units, except for Governance.
2. See Annex II.2 for variable definitions and data sources.
3. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
4. Annex II.1 for the detailed listing of countries by group.
5. Estimation is by OLS panel estimator with random effects.

*Table II.7: Merchandise Imports and Patent Rights, by Level of Economic Development.*

Dependent Variable:	Merchandise Imports (in real 2000 U.S. dollars)			
	Full Sample	Developed Countries (Group 1)	Developing Countries (Group 2), excluding LDCs	Least Developed Countries (Group 3)
Constant	11.30*** (2.056)	28.20*** (9.045)	9.811*** (2.824)	15.55** (7.172)
Patent Rights Index	0.320*** (0.0904)	1.274** (0.521)	0.317*** (0.100)	0.392 (0.387)
Real GDP per capita	1.271*** (0.105)	1.156*** (0.263)	1.173*** (0.149)	1.845*** (0.205)
Freedom to Trade Internationally	0.0237 (0.154)	-1.114*** (0.341)	0.288 (0.174)	-0.351 (0.218)
Doing Business Rank	0.489*** (0.216)	0.131 (0.290)	0.609** (0.284)	-0.984 (1.168)
IPR Survey	-0.405 (1.192)	11.97** (6.136)	1.579 (1.470)	-0.811 (1.790)
Legal Effectiveness (e.g., impartial courts)	-0.473*** (0.0775)	-0.855** (0.307)	-0.480*** (0.102)	-0.329** (0.143)
Physical Property Rights	0.702 (1.398)	-18.35** (10.07)	-0.0378 (1.732)	1.247 (2.586)
Governance	0.111* (0.0538)	-0.0644 (0.105)	0.169** (0.0635)	0.115 (0.209)
Number of Observations	266	69	164	33
Number of Countries	91	23	56	12
R <sup>2</sup>	0.537	0.315	0.201	0.769

1. All variables are in natural logarithmic units, except for Governance.
2. See Annex II.2 for variable definitions and data sources.
3. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
4. Annex II.1 for the detailed listing of countries by group.
5. Estimation is by OLS panel estimator with random effects.

*Table II.8: Services Imports and Patent Rights, by Level of Economic Development.*

Dependent Variable:	Services Imports (in real 2000 U.S. dollars)			
	Full Sample	Developed Countries (Group 1)	Developing Countries (Group 2), excluding LDCs	Least Developed Countries (Group 3)
Constant	-1.634 (2.129)	3.928 (8.398)	-3.540 (3.241)	6.231 (8.944)
Patent Rights Index	0.180** (0.0849)	1.825* (1.136)	0.189** (0.0855)	0.201 (0.984)
Real GDP per capita	1.067*** (0.140)	1.591*** (0.392)	0.863*** (0.187)	1.562*** (0.338)
Freedom to Trade Internationally	-0.278 (0.277)	-1.010 (0.779)	0.625* (0.316)	-1.249*** (0.331)
Doing Business Rank	0.369* (0.199)	0.0803 (0.246)	0.583** (0.299)	-1.271 (1.635)
IPR Survey	1.098 (1.312)	5.974 (5.380)	2.773* (1.662)	1.548 (3.158)
Legal Effectiveness (e.g., impartial courts)	-0.207 (0.175)	-1.161** (0.512)	-0.144 (0.214)	-0.0792 (0.360)
Physical Property Rights	-0.49 (1.600)	-10.16 (8.134)	-1.413 (2.083)	-1.767 (3.571)
Governance	0.00972 (0.0893)	0.0261 (0.115)	0.164* (0.0814)	-0.481 (0.337)
Number of Observations	248	67	153	28
Number of Countries	89	23	54	12
R <sup>2</sup>	0.544	0.347	0.172	0.603

1. All variables are in natural logarithmic units, except for Governance.
2. See Annex II.2 for variable definitions and data sources.
3. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
4. See Annex II.1 for the detailed listing of countries by group.
5. Estimation is by OLS panel estimator with random effects.
6. The covered categories of services are transport, travel, communications, construction, insurance, financial services, computer and information services, royalties and license fees, other business services, personal, cultural and recreational services, and government services.

*Table II.9: Developing Country and LDC Merchandise Imports and Patent Rights, by Commodity Group.*

Dependent Variable:	Merchandise Imports (in real 2000 U.S. dollars)				
	(1) Pharma- ceuticals	(2) Office Telecom	(3) Chemicals	(4) Optics	(5) Electronics
Constant	10.18*** (1.685)	7.863*** (2.380)	5.657* (2.817)	7.850*** (2.237)	8.605*** (2.516)
Patent Rights Index	0.504*** (0.129)	0.840*** (0.177)	-0.0414 (0.170)	0.296** (0.118)	0.622*** (0.168)
Real GDP per capita	1.115*** (0.130)	1.278*** (0.165)	1.259*** (0.142)	1.275*** (0.133)	1.238*** (0.152)
Freedom to Trade Internationally	-0.706 (0.540)	0.686** (0.330)	-0.181 (0.233)	-0.186 (0.300)	0.572* (0.368)
Doing Business Rank	0.384** (0.164)	0.372 (0.262)	0.494* (0.277)	0.336* (0.223)	0.394* (0.262)
IPR Survey	0.485 (1.023)	-0.129 (1.374)	2.707* (1.722)	1.201 (1.123)	0.488 (1.246)
Legal Effectiveness (e.g., impartial courts)	-0.887*** (0.343)	-0.667*** (0.246)	-0.258 (0.285)	-0.305* (0.184)	-0.406** (0.173)
Physical Property Rights	0.599 (1.046)	0.187 (1.553)	-0.656 (1.998)	-0.545 (1.385)	-0.490 (1.454)
Governance	-0.0303 (0.188)	0.313*** (0.108)	-0.246 (0.160)	-0.00801 (0.110)	0.182 (0.137)
Number of Observations	177	241	232	232	232
Number of Countries	83	89	88	88	88
R <sup>2</sup>	0.557	0.574	0.496	0.592	0.551

1. All variables are in natural logarithmic units, except for Governance.
2. See Annex II.2 for variable definitions and data sources.
3. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
4. See Annex II.1 for the detailed listing of countries by group.
5. Estimation is by OLS panel estimator with random effects.
6. NB, process patents are particularly important with respect to the chemicals sector, whereas product patents tend to be particularly important for the other sectors.



*Table II.10: Developing Country and LDC Services Imports and Patent Rights, by Commodity Group.*

Dependent Variable:	Service Imports (in real 2000 U.S. dollars)		
	Communications (1)	Computer services (2)	Royalties (3)
Constant	-4.539* (2.702)	-14.30*** (4.161)	-9.238*** (3.045)
Patent Rights Index	1.308*** (0.445)	2.756*** (0.691)	1.081*** (0.367)
Real GDP per capita	0.502*** (0.190)	0.900*** (0.292)	1.120*** (0.256)
Freedom to Trade Internationally	1.216 (0.772)	2.237 (1.785)	1.624* (1.033)
Doing Business Rank	0.0706 (0.189)	0.597* (0.283)	0.241 (0.294)
IPR Survey	2.242* (1.359)	2.376 (1.815)	3.802* (2.166)
Legal Effectiveness (e.g., impartial courts)	0.0106 (0.48)	-0.564 (0.523)	0.213 (0.567)
Physical Property Rights	-1.538 (1.506)	-0.912 (2.629)	-3.983 (2.581)
Governance	0.127 (0.270)	-0.0179 (0.529)	-0.113 (0.304)
Number of Observations	203	144	197
Number of Countries	81	65	79
R <sup>2</sup>	0.624	0.588	0.551

1. All variables are in natural logarithmic units, except for Governance.
2. See Annex II.2 for variable definitions and data sources.
3. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
4. See Annex II.1 for the detailed listing of countries by group.
5. Estimation is by OLS panel estimator with random effects.

Table II.11: Strengthening of Patent Rights and Change in Import Volumes and Values.

	Import Volume			Import Value		
	Full Sample		Medium and Low Income Countries	Full Sample		Medium and Low Income Countries
Constant	-3.376 *** (0.850)		0.756 (0.975)	7.758 *** (0.693)		8.062 *** (0.888)
Patent Rights Index	0.341 *** (0.109)		0.299 ** (0.129)	0.327 *** (0.089)		0.347 *** (0.118)
GDP Per Capita (lagged 1 period)	1.205 *** (0.198)		0.756 ** (0.293)	0.901 *** (0.162)		0.730 ** (0.267)
Country Fixed Effects	Yes		Yes	Yes		Yes
Observations	88		40	88		40
Economies Covered	23		11	23		11
Adjusted R <sup>2</sup>	0.55		0.95	0.98		0.93

1. Sources: Import volume and value data from WTO *Statistics Database* on-line; Patent Rights Index and GDP per capita sources described in Annex II.2 of the present paper, drawn from Park and Lippoldt (2008) database.
2. All variables in natural logarithmic units.
3. Analysis conducted using ordinary least squares regression with country fixed effects.
4. Income group designation is based on the World Bank classification as of 1990.
5. Period covered is from 1990 to 2005, though panel is unbalanced (not all countries are represented in every year).
6. Country coverage: 1) middle and low income - Bulgaria, India, Indonesia, Jordan, Korea, Pakistan, Philippines, South Africa, Sri Lanka, Thailand, Turkey; 2) high income - Australia, Canada, Hong Kong, Iceland, Israel, Japan, New Zealand, Norway, Singapore, Switzerland, Chinese Taipei, United States.
7. Standard errors shown in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.

Table II.12: *Strengthening of Patent Rights and Change in Developing Country Import Values, by Patent Rights Index Component.*

Dependent Variable:			Merchandise Imports (in real 2000 U.S. dollars)									
Patent Rights Index Component:	Total		Duration		Enforcement Provisions		Legal Restrictions on Rights		Membership - International Treaties		Coverage: Patentability of Subject Matter	
Constant	8.062 *** (0.888)		7.222 *** (0.887)		7.745 *** (0.844)		7.863 *** (0.976)		7.675 *** (1.056)		7.177 *** (1.027)	
Coefficient for the Corresponding Patent Right Component	0.347 *** (0.118)		0.050 * (0.028)		0.048 *** (0.016)		0.054 * (0.027)		0.042 (0.032)		0.026 (0.055)	
GDP Per Capita	0.730 ** (0.267)		1.021 *** (0.259)		0.880 *** (0.246)		0.867 *** (0.278)		0.891 *** (0.308)		1.035 *** (0.299)	
Country Fixed Effects	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	40		40		40		40		40		40	
Country Count	11		11		11		11		11		11	
Adjusted R2	0.9333		0.9214		0.9339		0.9231		0.09169		0.9125	

1. Sources: Import value data from WTO *Statistics Database* on-line. Patent Rights Index and GDP per capita sources described in Annex II.2 of the present paper, drawn from Park and Lippoldt (2008) database.
2. All variables in natural logarithmic units.
3. Analysis conducted using ordinary least squares regression with country fixed effects.
4. Period covered is from 1990 to 2005, though panel is unbalanced (not all countries are represented in every year).
5. Country coverage: a sample of middle and low income countries - Bulgaria, India, Indonesia, Jordan, Korea, Pakistan, Philippines, South Africa, Sri Lanka, Thailand, Turkey. Income group designation is based on the World Bank classification as of 1990. Selection based on data availability and consistency with the exercise in the previous table.
6. Standard errors shown in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the  $p < 0.01$ ,  $p < 0.05$  and  $p < 0.1$  levels, respectively.

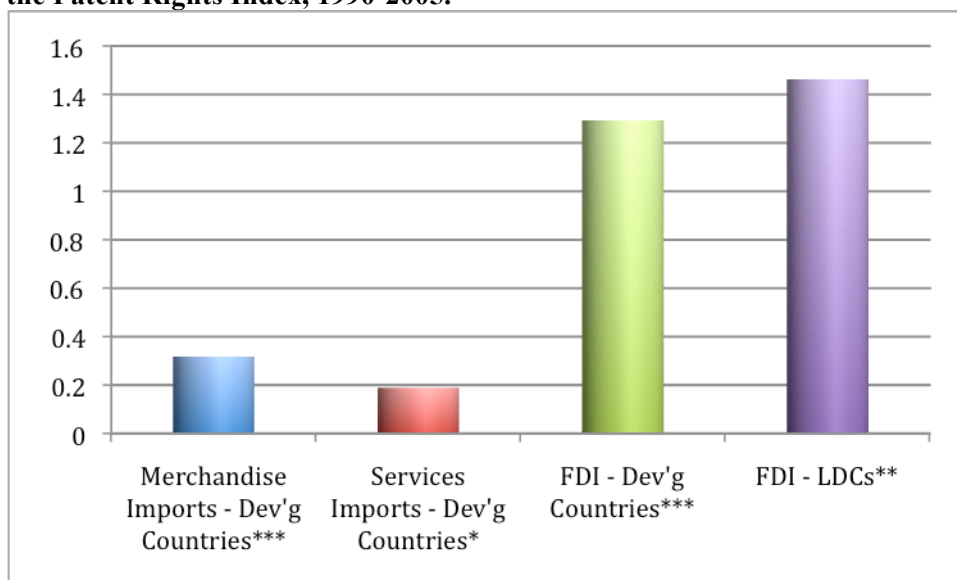
*Table II.13: Strengthening of Patent Rights and Change in Developing Country Inward Stock of FDI, by Patent Rights Index Component.*

Dependent Variable:		Inward FDI (in real 2000 U.S. dollars)					
Patent Rights Index Component:	Total	Duration	Enforcement Provisions	Legal Restrictions on Rights	Membership - International Treaties	Coverage: Patentability of Subject Matter	
Constant	-1.266 (1.459)	-2.564 * (1.398)	-1.968 (1.441)	-2.528 (1.714)	-1.185 (1.654)	-2.978 *	
Coefficient for the Corresponding Patent Right Component	0.591 *** (0.193)	0.111 ** (0.044)	0.071 ** (0.027)	0.037 (0.047)	0.114 ** (0.051)	0.020 (0.091)	
GDP Per Capita	1.561 *** (0.438)	2.018 *** (0.409)	1.862 *** (0.420)	2.030 *** (0.489)	1.622 *** (0.482)	2.139 *** (0.497)	
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	40	40	40	40	40	40	
Country Count	11	11	11	11	11	11	
Adjusted R2	0.8899	0.8805	0.8821	0.8550	0.8754	0.8521	

1. Sources: FDI data from the UNCTAD *Handbook of Statistics* on-line. Patent Rights Index and GDP per capita sources described in Annex II.2 of the present paper, drawn from Park and Lippoldt (2008) database.
2. All variables in natural logarithmic units.
3. Analysis conducted using ordinary least squares regression with country fixed effects.
4. Period covered is from 1990 to 2005, though panel is unbalanced (not all countries are represented in every year).
5. Country coverage: a sample of middle and low income countries - Bulgaria, India, Indonesia, Jordan, Korea, Pakistan, Philippines, South Africa, Sri Lanka, Thailand, Turkey. Income group designation is based on the World Bank classification as of 1990. Selection based on data availability and consistency with the exercise in the previous table.
6. Standard errors shown in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the  $p < 0.01$ ,  $p < 0.05$  and  $p < 0.1$  levels, respectively.

## G Figures

**Figure II.1: Change in economic indicators associated with 1% change in the Patent Rights Index, 1990-2005.**



1. Statistical significant is indicated as follows: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .
2. The values shown are the coefficients from panel regression analyses (OLS) where the variables are in natural logarithmic units. The variable of interest is specified as the dependent variable and the patent rights index as an independent variable; controls are included for other potential influences including real GDP per capita, Freedom to Trade Internationally (Fraser Institute), business regulatory environment (World Bank, Doing Business), IPR effectiveness (as opposed to laws on the books), legal effectiveness, physical property rights and governance.
3. For full sources and notes, see Tables II.6, II.7 and II.8.

## H Annex II.1. Country Coverage, by Group

<b><u>Group 1:</u></b> <b><u>Developed Countries</u></b> <b><u>(N=25)</u></b>	<b><u>Group 2:</u></b> <b><u>Developing Countries (N=70)</u></b>	<b><u>Group 3:</u></b> <b><u>Least Developed (N=27)</u></b>
Australia	Algeria	Korea
Austria	Argentina	Lithuania
Belgium	Bolivia	Malaysia
Canada	Botswana	Mauritius
Denmark	Brazil	Mexico
Finland	Bulgaria	Morocco
France	Cameroon	Nicaragua
Germany	Chile	Nigeria
Greece	China	Pakistan
Iceland	Colombia	Panama
Ireland	Congo	Papua New Guinea
Israel	Costa Rica	Paraguay
Italy	Cyprus (Republic of)	Peru
Japan	Czech Republic	Philippines
Luxembourg	Dominican Republic	Poland
Malta	Ecuador	Romania
Netherlands	Egypt	Russian Federation
New Zealand	El Salvador	Saudi Arabia
Norway	Fiji	Singapore
Portugal	Gabon	Slovak Rep.
Spain	Ghana	Somalia
Sweden	Grenada	South Africa
Switzerland	Guatemala	Sri Lanka
United Kingdom	Guyana	Swaziland
United States	Honduras	Syria
	Hong Kong	Chinese Taipei
	Hungary	Thailand
	India	Trinidad & Tobago
	Indonesia	Tunisia
	Iran	Turkey
	Iraq	Ukraine
	Ivory Coast	Uruguay
	Jamaica	Venezuela
	Jordan	Vietnam
	Kenya	Zimbabwe

## I Annex II.2. Variables and Data Sources

### A. Dependent Variables

1. Inward Foreign Direct Investment (FDI) Stock. Source: United Nations Conference on Trade and Development (UNCTAD) Foreign Direct Investment Database (FDI-online).  
<http://stats.unctad.org/fdi>
2. Merchandise Trade. Source: World Trade Organization (WTO), *Statistics Database, Time-series on Merchandise and Commercial Services Trade*, Subject Selection: Total Merchandise Trade.  
<http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx?Language=E>
3. Merchandise Trade by Sector. Sources:
  - Imports of Pharmaceuticals and Office and Telecom Equipment are from the WTO, *Statistics Database, Time-series on Merchandise and Commercial Services Trade*, Subject Selection: Merchandise Trade by Commodity:  
<http://stat.wto.org/StatisticalProgram/WSDBStatProgramHome.aspx?Language=E>.
  - Imports of Chemicals (Organic plus Inorganic), Electrical and Electronic Products, and Optics and Precision Equipment are from the United Nations *Comtrade Database*, Metadata and Reference: Commodity List: <http://comtrade.un.org/db/mr/rfCommoditiesList.aspx>. Harmonized System Codes for these sectors are 28 (Inorganic chemicals), 29 (Organic Chemicals), 85 (Electricals and Electronics), 88 (Aircraft, Spacecraft), and 90 (Optics etc.).
4. International Trade in Services. Source: UNCTAD *Handbook of Statistics On-line*.  
<http://stats.unctad.org/handbook>. Report Folder V, Table 5.1. The services covered comprise 11 principal services categories according to the concepts and definitions of the IMF Balance of Payments Manual (BPM5, 1993). The 11 principal BPM5 services categories are transport, travel, communications, construction, insurance, financial services, computer and information services, royalties and license fees, other business services, personal, cultural and recreational services, and government services n.i.e.
5. International Trade in Services by Sector. Source: UNCTAD *Handbook of Statistics On-line*.  
<http://stats.unctad.org/handbook>. Report Folder V, Table 5.2. The services coverage is the same as for International Trade in Services.

### B. Explanatory Variables

1. Patent Rights Index. Source: Ginarte and Park (1997) and Park (2008b).
2. IPR Survey. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 7.09), 2004-5 (Table 6.04), 2005-6 (Table 6.04), and 2006-7 (Table 9.07)*, Oxford University Press. This variable measures Business Executive opinions on the stringency of intellectual property protection (1 = is weak or nonexistent, ... , 7 = is equal to the world's most stringent).
3. Physical Property Rights. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 3.11), 2004-5 (Table 6.03), 2005-6 (Table 6.03), and 2006-7 (Table 1.01)*, Oxford University Press. This variable measures Business Executive opinions on how well private property is protected,

including financial assets (1 = are poorly defined and not protected by law, ... , 7 = are clearly defined and well-protected by law).

4. Index of Legal Effectiveness. This variable is a composite score of judicial independence, impartial courts, security of property rights (tangible and intellectual), and integrity of the legal system. Source: Economic Freedom Network (EFN), 2006 Dataset:

<http://www.freetheworld.com/release.html>.

5. Index of Freedom to Trade Internationally. This variable is a composite score of minimal taxes or interference with trade (including tariffs and non-tariff barriers to trade), minimal capital controls and foreign ownership restrictions. Source: Economic Freedom Network (EFN), 2006 Dataset:

<http://www.freetheworld.com/release.html>.

6. Real GDP per capita (in real 2000 U.S. dollars). Source: World Bank, *World Development Indicators (WDI)* 2007, CD-Rom.

7. Doing Business Rank. This variable measures the ease of doing business (for example, the number of procedures required in starting a business, dealing with licenses, employing workers, registering property, getting credit, protecting investors, enforcing contracts, paying taxes, trading across borders, and closing down a business). Countries are ranked in ascending order (1=easiest place to do business, 2=next easiest, etc.) Source: World Bank Group

<http://www.doingbusiness.org/CustomQuery>.

8. Governance. Source: World Bank: <http://info.worldbank.org/governance/wgi2007>.

There are six dimensions of governance: Voice and Accountability (VA), Political Stability (PS), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), and Control of Corruption (CC). For purposes of this study, the six measures are averaged: Governance Index = (VA + PS + GE + RQ + RL + CC)/6.

9. U.S. Price Index (GDP Deflator). Source: Economic Report of the President, <http://www.gpoaccess.gov/eop/download.html>.



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## **Chapter III**

# **Indicators of Innovation: The Influence of Patent Rights Reform in Developing Countries During the Period from 1990 to 2005**

### III Indicators of Innovation: The Influence of Patent Rights Reform in Developing Countries During the Period from 1990 to 2005

**Abstract:** Drawing on a broad sample of developing and OECD countries, this chapter considers the hypothesis that international intellectual property rights reforms influenced the evolution of certain aggregate innovation-related indicators during the period from 1990 to 2005 (i.e., the period of the advent and implementation of the WTO TRIPS Agreement). After reviewing key points from relevant literature, the text moves to present an empirical analysis that considers a range of innovation-related indicators that could be associated with changes in innovation performance. The analysis finds that for a broad sample of developed and developing countries there is a significant association of change in these innovation-related indicators with change in the level of patent rights protection.

**JEL codes:** O24 (trade policy), O34 (intellectual property rights)

**Keywords:** Intellectual property rights, development, innovation



## A Introduction<sup>115</sup>

Intangible assets are at the heart of modern economies, whereby the creation and leveraging of “dematerialised content” – intangible streams of data, images and symbols – are playing expanding roles in economic activity (Goldfinger, 1997). Innovation constitutes a primary means of developing these assets. Patents are an important output of many of these innovation processes and a valuable intellectual asset. Consequently, it is of interest and relevance to consider the role that intellectual property rights protection, and in particular patent rights protection, may have in the evolution of the stock of these assets and the innovative processes that contribute to their development.

In a qualitative assessment of the emerging intangible economy as of 1997, Goldfinger (1997) cited three key trends that were already evident: 1) the changing profile of employment and output structure (with the shift from manufacturing and agriculture to the by-then dominant services sector), 2) globalisation (with international trade expanding more rapidly than output and increased mobility of the populations, specifically with respect to travel and tourism), and 3) information technology spreading to become ubiquitous. Reports from observers and practitioners of innovation continue to emphasise the on-going evolution of innovation processes, which are changing in terms of both their manner of operation and their speed of operation. Prahalad and Krishnan (2008), for example, point to the emergence of co-creation as a driving force in innovation, closely associated with the phenomena of globalisation and individualised customer experience.<sup>116</sup> Similarly, at recent workshops on innovation organised by the OECD, discussion has highlighted a dynamic process of change

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<sup>115</sup> Portions of this document, as noted in the text, draw on the Patent Rights Index developed by Walter G. Park, American University, Washington, DC, and his colleagues, an indicator used here with his kind permission; the chapter also references previous analyses developed by the present author in co-operation with him. In addition, the author wishes to acknowledge, with gratitude, the advice, references and suggestions received on various aspects of the author’s research from Carlos Alberto Primo Braga, Ricardo Cavazos, Patrick Messerlin, Sébastien Miroudot, Jonathan Senft, Charles Tsai and Jayashree Watal, as well as from colleagues and participants at various seminars where early elements of this work were presented (including seminars organised by University of Maastricht, London School of Economics, Réseau de Recherche sur l’Innovation, Stockholm Network, Quaker United Nations Office, Free Market Foundation of Southern Africa, University of Connecticut (Storrs) and OECD). The author gratefully acknowledges the support for this research project from Ken Ash, Director, and Raed Safadi, Deputy-Director, Trade and Agriculture Directorate, OECD.

<sup>116</sup> Prahalad and Krishnan (2008) argue that to succeed in the new age of innovation, “firms must partner with individual customers to co-create customized experiences”. They point to several firms that have understood and capitalised upon the co-creation model (*e.g.* Starbucks, Facebook, ING and Google).

in the nature and pace of innovation processes in comparison to the less globalised and less economically liberal, pre-Internet period leading up to the 1990s.<sup>117</sup>

The exploitation of intellectual assets can yield a high return on investments, in part, because of the intangible nature of these assets which may imply a low marginal cost of production (e.g., in the case of digital products). This intangible nature means that deployment of the assets is generally non-exclusive, non-rivalrous and readily scalable. For example, a business that has developed a software product may wish to license this product repeatedly for simultaneous use by multiple owners or licensees. The creation of value from such assets is not certain, however, and is highly contingent on the management capabilities and business strategies (Lippoldt *et al.*, 2008). This can be particularly challenging for small businesses, which may lack resources to develop and exploit important opportunities associated with their assets.

This chapter considers the relationship between selected aspects of the evolution in intellectual assets, innovation processes, and the strengthening of patent rights protection with particular regard to developing countries during the period from 1990 to 2005. In view of the micro-economic complexity and theoretical ambiguity concerning the impacts of strengthened patent rights, the analysis focuses on empirical assessment at an aggregate level in order to obtain insights with respect to possible overall relationships between key variables and economic performance during the study period. The discussion builds on the presentation of intellectual property rights (IPRs) protection from Chapter 1 of this dissertation and the presentation of the literature on international economic relations, IPR protection and innovation from Chapter 2. The narrative in the present chapter begins with a discussion of the nature of innovation and intangible assets, with reference to the role of IPRs and the incentives for innovation. This is followed by the presentation of the data and the empirical assessment, then a conclusion highlighting the possible policy relevance of the results.

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<sup>117</sup> For example, during 2007-08 the OECD Committee on Industry, Innovation and Entrepreneurship supported a series of three workshops held in Copenhagen, London and Trento (Italy). These workshops considered different aspects of contemporary innovation, primarily in the business sector. For more information see the web sites:

[www.oecd.org/sti/innovation/entrepreneurship](http://www.oecd.org/sti/innovation/entrepreneurship);  
[www.oecd.org/sti/innovation/hiddeninnovation](http://www.oecd.org/sti/innovation/hiddeninnovation);  
[www.oecd.org/sti/innovation/partnerships](http://www.oecd.org/sti/innovation/partnerships).

## **B Theory and Motivation**

Solow (1956) delivered a major contribution to the theory of economic growth, providing a neoclassical elaboration that described the relationships of capital and labour to output, but with technology given as an exogenous factor (though he did consider, p. 85, a means of inclusion of exogenously-determined neutral technological change in the model). Many observers (e.g., Warsh, 2006) credit Paul Romer with leadership in subsequently developing a broader view that more accurately reflects important economic realities including technological change and accumulation of intangible assets (non-rival inputs).

Romer (1990) presents an essentially neoclassical model of growth with explicit provision for endogenous technological change. He begins with three premises. First, he states that technological change (improvement) lies at the heart of economic growth, because they enable enhanced exploitation of a given pool of raw materials. Technological change provides the incentive for continued capital accumulation and together they account for much of the increase in productivity. Second, Romer states that “technological change arises in large part because of intentional actions taken by people who respond to market incentives.” Third, he posits that technology is non-rivalrous and that once developed it can be employed repeatedly and simultaneously with no additional cost. The model considers final output as a function of four primary inputs: human capital (a product of formal education and on-the-job training), labour, capital and non-rival inputs (knowledge).<sup>118</sup> Romer notes that developing human capital, such as the ability to add, remains costly to produce in that there are non-negligible costs to train each additional person. At the same time, once produced, knowledge goods such as a design have a trivial replication cost. Moreover, knowledge is only incompletely excludable in that there are limitations in the ability of the originator or owner to appropriate it; there are spillovers that benefit others. He gives the specific example of a patented new technology, whereby the innovator gains the right to produce a product and exclude others, but whose patent application is public and can contribute to learning by other potential innovators. An implication of this is that research may be undersupplied with human capital, because the returns to research will not reflect the full market value of the research (i.e., there are positive external effects).<sup>119</sup> As the important implication of the model, Romer

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<sup>118</sup> Thus, there are intangibles on both the left and right hand side of the equation, including both the non-rival inputs (like know-how) and technology on the right and the intangible outputs (like software) on the left.

<sup>119</sup> In this example of a patented innovation, the risk of less than full returns refers to a case where the research was successful. It should be noted that at the outset there is a further basic risk that any given research

notes that human capital proves to be central to growth. Integration into an economy with a large number of people is not the central concern for growth, but rather integration into an economy with an abundant supply of human capital. In this context, openness can offer a means to improve growth by providing access to larger pools of human capital, whereas a closed economy will suffer lagging growth due to limitations on the supply of human capital.<sup>120</sup>

The development of such theoretical insights does not resolve the challenges posed for empirical work by the emergence of the intangible economy. Goldfinger (1997) underscores a range of practical, conceptual and measurement issues that arise from the associated economic changes. A primary issue is the challenge of tracking service sector activity, which is heterogeneous, changing and difficult to measure. He considers the intangible economy from three perspectives: a demand perspective consisting of intangible artefacts in final output for consumption (e.g., entertainment), a supply perspective of intangible assets used by firms to establish and maintain their competitive position (e.g., brand, human capital and intellectual property), and a system perspective consisting of a “logic of dematerialisation” driven by abundance (due to the non-rivalrous nature of products), risk (high development costs but low marginal cost), interpenetration across sectors (e.g., software and hardware), market complexity (e.g., distinction between buyers and sellers is less clear, such as with user-provided inputs or third party payment via advertising) and indeterminacy of optimal business strategies (due to volatility in demand and competition). Goldfinger concludes that addressing the measurement challenges of intangibles will require recognition of the centrality of intangibles to modern economic activity, designing a statistical system that is able to handle open-ended change and diversity, and development of a system that can deal with change over time and identification of inflection points.

While innovation appears closely related to the development of intellectual assets, it has also proven difficult to describe in definitive terms; the definition of innovation has evolved over time in response to the changing realities in the real economy. The current edition of the *Oslo Manual* (OECD-EC, 2005) defines an innovation as, “The implementation of a new or

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project may fail to yield successful results. The environment for dealing with such risk of failure (e.g., credit conditions or bankruptcy law) may also affect whether research is appropriately supplied in an economy.

<sup>120</sup> Such access to human capital through openness may come through face-to-face contacts (e.g., short term travel or longer term migration), but it may also come via information and communication technologies (e.g., such as video conferencing or distance learning) or embedded in products such as electronic equipment (e.g., software), among other possibilities.

significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.” Thus, according to this definition, innovation can be in line with traditional popular ideas of technological developments in products or processes. But, it can also appear as non-technological developments (sometimes technology enabled) in organisation (*e.g.* in the workplace or in the manner in which firms interact with the outside world), marketing (*e.g.* design, packaging or manner of promotion), or repurposing of existing products (*e.g.*, Pfizer redirected work on sildenafil citrate from unpromising trials as a potential heart medication to a new application related to male impotence, resulting in the product marketed as Viagra).

In line with Goldfinger’s supply perspective concerning the intangible economy (mentioned above), the accelerating pace and changing nature of innovation appear to be associated with an increasing weight for intangible assets in the economy (*e.g.*, Lippoldt *et al.*, 2008). As Bismuth (2006, p. 9) notes, there is no globally agreed definition for this asset class (sometimes also referred to as intellectual assets or intellectual capital). However, among the various definitions that she reviews, most include three core characteristics: “i) they are sources of probable future economic profits; ii) lack physical substance; and iii) to some extent, they can be, retained and traded by a firm.” Concretely, she notes the various definitions tend to include such elements as research and development (R&D) and intellectual property (including patents), but often go beyond to include broader concepts as human resources and capabilities, organisational competencies (databases, technology, routines and culture) and “relational” capital including organisational designs and processes, and customer and supplier networks. A further characteristic of these assets is that they generally deliver value from their application in specific contexts and this yields material results (*e.g.*, patents are blueprints used to produce products with tangible effects).<sup>121</sup>

In view of the challenges in assessing the stock of such assets, as a first analytical step some economists have begun to focus on the flow of investments into development of such assets. A growing body of research aims to consider such investment at the national level via adjustments and additions to national accounts data in order to better reflect the flows. The

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<sup>121</sup> Once consequence of the lack of a clear definition for intangible assets is that they are not fully included in generally accepted accounting principles or corporate reporting, which complicates the economic assessment of their importance. In some countries, investments in some intangible assets such as software with expected usable life-spans of greater than one year may be included in balance sheets and amortised; “goodwill” as well may be included in the case of acquisitions when the acquired firm is purchased for more than the market value (the difference being assumed to be due to intangibles).

scale of this investment is substantial and rising in countries for which roughly-comparable time series estimates are available (Figure III.1). Recent-year estimates are available for some OECD economies and fall in the range of 8 to 12% of gross domestic product.<sup>122</sup> Corrado, Hulton and Sichel (2006) have pioneered this line of work, developing estimates of business investment in intangible assets in the United States over the past 55 years. They find that this investment grew from less than 6% to about 14% of business output, while the comparable investment in tangible assets declined from about 12% to less than 10%, albeit with some fluctuation along the way. Drawing on various studies from the literature, Barnes and McClure (2009) present a comparison from a range of OECD countries, whereby they highlight significant long-term growth of investment in intangibles as a share of output over recent decades despite some levelling off of the trend following the recession early in the current century. To date, none of these studies cover non-OECD countries.

The allocation of investment in intangible assets by category varies substantially across the advanced economies for which there are estimates. Figures III.2 and III.3 provide an illustration of the composition of investments in business intangible assets for the United States and Netherlands. The various categories can be seen in the figures, whereby the United States is distinguished by its sizeable investment in organisational structure (which might include, e.g., management consulting fees) and the Netherlands by its sizeable investment in brand equity (principally via advertising).<sup>123</sup>

An OECD stocktaking of work on intellectual assets and value creation (Lippoldt *et al.*, 2008) reviewed macro, regional and firm level aspects of the issue, noting various indications of the importance of intellectual assets to value creation, economic growth and competitiveness in a modern economy. The authors note, “Effective development and deployment of intellectual assets can fuel value creation both in terms of expansion of the stock of wealth and in the generation of current value through new or improved products and processes.” In this regard, it is important at all levels for decision makers to be aware of these intangibles and to monitor their progress. By making this an explicit priority, these assets can be better managed and leveraged. The OECD study further states that “Failure to correctly

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<sup>122</sup> In the absence of official statistics on the composition of intangible assets, the comparison in the Figure is based on point-in-time estimates from the literature.

<sup>123</sup> The Figures presenting the composition of intangible assets in the United States and Netherlands should be compared with caution. As there are not official indicators for this comparison, the data are drawn from estimates available in the literature.

assess intellectual assets can lead to misallocation of resources and other inappropriate decisions by managers, policy makers and others.”

Various recent research mandates given to the OECD secretariat by member countries provide an indication of governments’ recognition that innovation and intangible assets are important to their economies and potentially to addressing such global challenges as climate change or sustainable energy. The OECD study on intellectual assets and value creation mentioned above was an early part of this agenda. The current core OECD initiative in this regard is a project called the Innovation Strategy, which aims to assess innovation from a broad range of perspectives and deliver guidance and resources for policy-makers aiming to stimulate growth.<sup>124</sup> Other on-going OECD initiatives are focussed more narrowly on IPRs, including such issues as IPRs and economic development or counterfeiting and IPR piracy.<sup>125</sup>

## C Data

In order to cover developing countries, the empirical analysis (below) draws on the study *Where is the Wealth of Nations: Measuring Capital for the 21<sup>st</sup> Century* (World Bank, 2006)<sup>126</sup>, which includes estimates of the stock of intangible capital for 120 developing and OECD countries for the year 2000. The World Bank indicator uses a different definition of

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<sup>124</sup> The official OECD project description states, “The analytical challenge of the OECD Innovation Strategy is to better understand how innovation works in a global market for science and technology. The goal is to help policy makers improve framework conditions for innovation and trigger a virtuous circle driving growth.” Source: The dedicated web site for this OECD initiative found here (10 February 2010): <http://www.oecd.org/innovation/strategy>.

<sup>125</sup> On IPRs and economic development, see for example Park and Lippoldt (2005 and 2008); these references are discussed at some length in Chapter 2 of the present dissertation.

With respect to counterfeiting and piracy, one recent OECD study (2008) examined the international trade in tangible (physical) counterfeit and pirated products, estimating the volume of this trade in 2005 at USD250 billion. While this is a small proportion of overall trade, it is nonetheless large in absolute terms and the signalling effects of this abuse may have disproportionate negative effects on potential innovators in sectors where such abuse is most common. Moreover, the aforementioned estimate does not take into account products produced and consumed domestically or digital products distributed via the Internet. The OECD notes that if such products were included, the total magnitude of abuse could be several hundred billion USD more. Particularly disturbing is the discussion in the OECD report noting that supply lines for legitimate products in some areas have been infiltrated, a development that raises health and safety issues among other concerns.

A further OECD study (2009) examined piracy of digital products. This is a particularly challenging area for control of IPR abuse. The illicit market for digital products is hard to tackle because of the easy potential availability of infringing products (e.g. via the Internet) and the potential low cost of producing such products. Moreover, consumers may not be aware or concerned about the legitimacy of the products in that the quality can be good or acceptable. Also, such products may offer some advantages in that they are available in advance or in areas where the product is not otherwise sold and may avoid limitations brought on by digital rights management devices.

<sup>126</sup> The author of the present dissertation wishes to express his thanks to Jonathan Senft, OECD, for pointing out this study to him.

intangibles than the one employed in the studies based on the Corrado, Hulton and Sichel methodology. (NB, in order to avoid confusing these two definitions in the following empirical assessment, the term “intangible capital” is used exclusively to refer to the World Bank definition for this asset class.) The World Bank study develops an estimate for intangible capital as a residual between the estimated wealth of a country and an estimate for the value of tangible assets.

In order to calculate the intangible capital stocks, the World Bank team estimates produced capital (equipment, machinery, structures and urban land) and natural capital (agricultural land, sub-soil assets, forest resources and opportunity cost of protected areas). Total wealth is then calculated using the estimated net present value of an assumed future stream of consumption over 25 years (about one generation). To complete this calculation, certain assumptions are made across all countries for the time preference of consumption and the elasticity of utility for consumption. The future stream of consumption takes into account the actual average for the years 1998 to 2000 and assumes a constant rate of growth. Intangible capital is the difference between total wealth and the combination of produced and natural capital. The World Bank analysis implicitly considers sustainable consumption as the state where savings offset the depletion of natural resources, so it is possible to have a negative value for the intangible capital residual. Overall, further regression estimates by the World Bank team find that on average over 1/2 of the variation in the intangible capital can be accounted for by rule of law factors (governance, institutions), over 1/3 by schooling (years) and under 1/10 by foreign remittances.<sup>127</sup> Figure III.4 provides an indication of the pattern of dispersion in the World Bank intangible capital data. The figure plots a scatter chart of the per capita stocks of intangible capital in comparison to per capita GDP. As can be seen from the trend line, there is a positive correlation between the two variables.

The empirical analysis (below) next draws on estimates from the literature for intangible assets. For OECD countries, a first round of analysis aims to obtain a dynamic perspective by drawing on various studies employing the methodology developed by Corrado, Hulton and Sichel (2005 and 2006). These studies estimate the flow of investment in intangible assets by adjusting and combining selected components of the national accounts and other elements within the definition of these assets but not covered in the current national accounts framework (defined to include the categories are shown in Figures III.2 and III.3).

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<sup>127</sup> For a full discussion of the derivation of these estimates see World Bank (2006), pp 91-99.



For several countries these estimates are available over time, providing an indication of the evolution of investment in intangible assets as a share of GDP. There are no estimates of this type available for developing countries at this time.

These two types of intangibles estimates are considered in relation to the Patent Rights Index. That index was originally developed by Park and Ginarte (1997) and subsequently elaborated by Park and Wagh (2002) and Park (2008). A more complete description is provided in Chapter 1 of this dissertation.

Further analyses in the next section also consider the relationship of patent rights to innovation indicators, including R&D expenditure (UNESCO and OECD data) and patent applications (WIPO data). The sources and definitions for the variables used in these further analyses are described in Annex III.2 to this chapter. The dependent and explanatory variables in these further analyses were drawn from the database underlying Park and Lippoldt (2008), with one exception. The number of researchers per 1000 employed is included as a control variable in certain iterations in order to better isolate the extent of the association of the patent rights indicator with the dependent variable of interest. The observations are drawn from the OECD Science and Technology Indicators database.<sup>128</sup>

## **D Empirical Assessment**

From the literature review above (e.g., Romer, 1990, and Goldfinger, 1997, also Jones, 2004, cited in Chapter 2), we have indications that intangible assets – particularly those that embody technology or production-related knowledge – are important elements in delivering growth in a modern economy. The fact that they are non-rivalrous and only partly excludable mean that these assets can contribute to growth in a manner leading to increasing returns to scale (i.e., there are often high fixed costs, but very low marginal costs). Patent activity can be one manifestation of progress in this regard, delivering a new or improved recipe for making or doing something with tangible effect – a recipe that is novel, non-obvious and useful. Consequently, it may be that the strength of patent rights during the period 1990 to 2005 had an association with the situation of intangible assets (either the level or the change).

We know from Romer (1990) that economic incentives play a role in motivating R&D activity. Consequently, it may be that the increased stringency of patent rights associated with

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<sup>128</sup> This data series is available on-line from OECD iLibrary, and was accessed on 10 February at this location: <http://www.oecdilibrary.org/oecd/>.

the advent and implementation of the WTO TRIPS Agreement motivated increased efforts with respect to R&D (e.g., by strengthening some characteristics of the rights associated with the period of market exclusivity provided to the inventor or rights holder). R&D processes are important channels for the development of intangible assets, with patents being in many cases a major output of the research process.

In the following empirical assessment, we will consider three hypotheses in turn, taking into account the availability of data:

H1: That the strength of patent rights<sup>129</sup> in the year 2000 was positively associated with the stock of intangible capital, controlling for human capital, and that this association was also present with respect to developing countries.<sup>130</sup>

H2: That the flow of investment in intangible assets was positively associated with the strength of patent rights in the countries for which there were available time series or cross-sectional data.

H3: That the strengthening of patent rights during the period from 1990 to 2005 was positively associated with expenditure on R&D and the incidence of patenting, controlling for a variety of other potential influences.

Each hypothesis is tested in a separate regression assessment, described in the following subsections. It should be underscored that the objective of this type of analysis is to consider the association between the variables of interest and not to determine causality.

## 1 Intangible capital and the strength of patent rights

The first assessment presented here considers the association of the strength of patent rights with intangible capital and is conducted using ordinary least square regression (Table III.1). The dependent variable is intangible capital (World Bank definition) considered from two different perspectives, as the per capita stock of intangible capital (Panel I) and the share of intangible capital in total wealth (Panel II).<sup>131, 132</sup> The latter measure gives an indication of

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<sup>129</sup> It should be recalled that the Patent Rights Index is based on laws on the books and does not refer specifically to application of the laws in practise. Thus, the analysis is referring to a particular aspect of the strength of patent rights.

<sup>130</sup> The choice of the year 2000 is due to data availability.

<sup>131</sup> Data on total wealth are from World Bank (2006). For the derivation of total wealth, see pp. 144ff.

<sup>132</sup> The equations were specified as follows:

$$\text{Intangible Capital Per Capita}_i = a + b_1x_i + b_2z_i + e_i$$

the intensity of intellectual capital in the economy. All variables were included in the regression as natural logarithms.

The full sample for this exercise includes a broad mix of OECD and developing countries.<sup>133</sup> This is a cross-sectional analysis with a sample covering just the year 2000. An attempt was made to control for human capital in view of its importance to intangible capital accumulation and in particular via research (Romer, 1990); this may help to better isolate the extent of the association of patent rights with the accumulation of this intangible capital. Thus, for certain iterations of the analysis (numbers 2, 3, 5 and 6), a variable for researchers per 1000 employed persons was included. Due to the limited data availability, this greatly reduced the sample sizes for these iterations.

The results indicate a generally significant relationship between the strength of patent rights and both the per capita stock of intangible capital and the intangible capital intensity. The relationship is much stronger with respect to the stock in terms of the size of the coefficients and the  $R^2$  scores.<sup>134</sup> While stronger patent rights also tend to be associated with stronger intangible capital intensity, the coefficient for the developing country iteration (5) is not statistically significant. (The small sample size may be a factor in this outcome.) Moreover, the coefficient for patent rights in the full sample iteration (panel II, iteration 4) is relatively small as is the  $R^2$  value. The control variable for human capital in research was generally not significant and where significant (6) had an unexpected sign (perhaps due to some anomalies in the sample). Overall, the results tend to provide qualified support for the first hypothesis above concerning the positive association of stronger patent rights with intangible capital, albeit with the exception of intangible capital intensity for the sample of developing countries.

In order to visualise the relationship more clearly, Figure III.5 provides a scatter plot of the stock of intangible capital per capita in comparison to the strength of patent rights. The result is quite interesting in that the stocks of intangible capital tend to be clustered at 50,000 USD or less for values of the Patent Rights Index of 3 or less, but from scores of about 3.5 or

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$$\text{Intangible Capital as \% Total Wealth}_i = a + b_1x_i + b_2z_i + e_i$$

The variable (x) refers to the Patent Rights Index score and the variable (z) refers to Researchers per 1000 Employed Persons; (e) is the residual. The explanatory variables were entered as natural logarithms. The year of reference is 2000.

<sup>133</sup> These countries are listed in the notes to Table III.1.

<sup>134</sup> Whereby the  $R^2$  score, of course, provides an indication of the amount of variation in the dependent variable explained by the equation.

more the pattern of dispersion shifts rapidly upward. This may be an indication of a sort of threshold as foreshadowed in the literature review (e.g., Maskus, 2008). For example, one possibility could be that patent rights only begin to provide relatively more effective incentives for development of intangibles assets once a certain number of element are present (as reflected in the scores of the various index components).

## 2 Intangible assets and the strength of patent rights

The second assessment considers the strength of patent rights in relation to investment in intangible assets as a percentage of GDP in OECD countries for which data were available. This is done in two ways: 1) “vertically” across time for four OECD countries<sup>135</sup> during the period 1975 to 2005 and 2) “horizontally” for one point in time (2006) for 16 OECD countries.<sup>136</sup> The assessment controls for human capital via the same proxy indicator as in the previous exercise (researchers per 1000 employed persons). Intangible assets are defined here based on the Corrado, Hulten and Sichel (2005, 2006) methodology. The regression analysis was conducted using an ordinary least squares approach, with the variables entered as natural logarithms. In the case of the “vertical” assessment over time, the regression was conducted with country fixed affects.<sup>137</sup>

Such an assessment of investment in intangible assets has only recently become possible, due to new contributions to the literature over the last five years. Although the sample does not include any developing countries, it is nonetheless included here because it may offer some insight in the dynamics of the relationship between the two variables of interest.

Table III.2 presents the results for both the “vertical” (Panel I) and the “horizontal” (Panel II) approaches. The results indicate a statistically significant association between the

<sup>135</sup> The countries covered include Finland, Japan, Netherlands and the United States.

<sup>136</sup> The countries covered include Australia, Austria, Canada (2005), Czech Republic, Denmark, Finland, France, Germany, Italy, Japan (2005), Portugal (2005), Slovak Republic, Spain, Sweden, United Kingdom and the United States.

<sup>137</sup> The equation was specified as follows:

$$\text{Investment in Intangible Assets as \% GDP}_{i,t} = a + b_1x_{i,t} + b_2z_{i,t} + v_i + e_{i,t}$$

The variable (x) refers to the Patent Rights Index score and the variable (z) refers to Researchers Per 1000 Employed Persons; (e) is the residual. The variable (v) refers to country fixed effects dummies. The variables were entered as natural logarithms, except for the country fixed effects dummies.

strength of patent rights and investment in intangible assets, with fairly high  $R^2$  scores.<sup>138</sup> This lends support to the second hypothesis cited above. While this relationship may not hold under other circumstances and conditions, it provides an interesting point of departure for further policy analysis with respect to developing countries and, especially, the relatively advanced developing countries considering means of participating more deeply in the intangible economy. A useful first step in this regard would be completion of Corrado, Hulten and Sichel-type studies for a sample of developing countries.

### 3 Innovation Performance and Patent Rights

In order to test the hypothesis concerning a positive association of patent rights with selected innovation-related indicators, a further regression analysis was developed. This assessment builds on work presented in Park and Lippoldt (2008), though it is implemented with a somewhat different regression analysis method. In particular, the new regression analysis was conducted using a panel estimator (ordinary least squares) and random effects.<sup>139</sup> In order to take advantage of the panel information in the data, the data set was augmented through definition of an identifier for each unit and time period. As the source of heteroskedasticity is unknown, the model included provision of an error term to take the heteroskedasticity into account.<sup>140</sup> This delivers robust standard errors, which improves inference in comparison with the previous study.<sup>141</sup>

The *model* was specified as follows:  $\ln y_{it} = \alpha + \beta \ln x_{it} + \gamma \ln z_{it} + e_{it}$ ,

where

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<sup>138</sup> In the case of the “vertical” approach (Table III.2, Panel I), the coefficient for the control variable was not significant, whereas for the “horizontal” approach it was significant.

<sup>139</sup> Use of fixed effects was not an option because three of the control variables included in the database as time invariant indicators (Doing Business rank, physical property rights and IPR Survey). These data prevent the use of fixed effects with the panel estimator because of collinearity between the fixed effects and the time-invariant variables.

<sup>140</sup> Park and Lippoldt (2008) took a different approach. They assumed that the heteroskedasticity was probably associated with variation in the size of countries. This enabled them to employ a feasible generalised least squares approach, which can lead to more efficient estimates than an ordinary least squares approach, subject to the assumption being valid. However, given the uncertainty in the source of heteroskedasticity, the author opted to employ an ordinary least squares approach for the present assessment. Comparisons of the two approaches confirm a better fit from the ordinary least squares method, thereby improving the ability to draw inferences from the results.

<sup>141</sup> A comparison of the Park and Lippoldt (2008) results with those in the present analysis reveals changes in the sign and magnitude of the parameter estimates, as well as in the magnitude of the standard errors. Notably, several large parameter estimates from the original study were attenuated. In the most striking example, which concerned the developed country sample, the change in inward FDI associated with a 1% change in the Patent Rights Index was 11.2% in the earlier study and 6.6% in the new study.

$y$  is the *dependent variable*,

$x$  the *Patent Rights Index score*,

$z$  *control variable(s)*,\*

and

$e$  the *error term*.

$\ln$  denotes the *natural logarithm*.

(\* Note that  $z$  may consist of time-invariant variables.)

The subscripts refer to the values of  $y$ ,  $x$ , and  $z$  for country  $i$  at time  $t$ , where  $i = 1, \dots, N$  and  $t = 1, \dots, T$ . The symbols  $(\alpha, \beta, \gamma)$  represent the *coefficients* indicating the association between an independent variables and the explanatory variable  $y$ , holding other factors constant. As both the dependent and independent variables are in log units, the parameter is in *percentage units* (e.g., if  $\beta = 2$ , a 1% increase in  $x$  is associated with a 2% increase in  $y$ , holding  $z$  constant).<sup>142</sup>

The data are drawn from the database underlying Park and Lippoldt (2008), with some adjustments (e.g., to facilitate the exploitation of the panel aspects of the data). The sample of 93 developing countries and Least Developed Countries (LDCs) is presented by country grouping in Annex III.1, with assignments based on each country's situation as of 1990. The sample consists of an *unbalanced panel*, in the sense that there is some variation in the number of observations per country due to missing data for some variables in certain countries or time periods. Not every country is covered in each analysis. There are a maximum of 4 observations for each country (1990, 1995, 2000 and 2005).

Depending on the iteration of the model, the dependent variable is designated to be either R&D intensity (R&D as a percentage of GDP), patent applications by residents, or patent applications by non-residents. The independent variable of interest is the Patent Rights Index. In order to better isolate the situation of patent rights, a variety of control variables are employed. International economic flows are considered via the variables for inward FDI

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<sup>142</sup> The objective of the regression essentially remains the same as in the previous study. As Park and Lippoldt (2008) note, this “is to estimate values of the coefficients  $\alpha$ ,  $\beta$ , and  $\gamma$  that best fit the data, as well as to estimate the standard errors of  $\alpha$ ,  $\beta$ , and  $\gamma$ . The smaller the standard errors relative to the coefficient estimates, the greater the statistical significance of the coefficient estimates. For a normal distribution, if the ratio of the coefficient estimate to its standard error exceeds 1.645, the coefficient estimate is considered *statistically significant at the 10% level*, meaning that the null hypothesis that the coefficient is zero (*i.e.* the associated variable has no effect on the dependent variable) can be rejected with 90% confidence. If the ratio of the coefficient estimate to its standard error exceeds 1.96, the coefficient estimate is considered *statistically significant at the 5% level* (meaning that the null hypothesis of a zero effect can be rejected with 95% confidence), and if the ratio exceeds 2.576, the coefficient estimate is considered *statistically significant at the 1% level* (and the null hypothesis of no effect can be rejected with 99% confidence).”

stock, merchandise imports, and services imports; these are known channels of technology transfer (as discussed in Chapter 2). Two research-specific variables are included, namely indicators of business executive opinions of the quality of research institutions and the extent of effective university-industry research collaboration. Controls are also included for the business environment (the World Bank Doing Business indicator) and governance (a composite based on World Bank Governance indicator components), as well as business opinions of IPR practices (IPR Survey), physical property rights protection and legal effectiveness. The selection of indicators took into account a combination of considerations including discussion in the relevant literature (on factors influencing innovation) and availability of relevant data series for the time period and countries covered. Annex III.2 presents the sources and definitions for these variables.

Sample statistics are presented in Table III.3, showing averages for the developing and LDC country group by year for the main dependent variables (resident and non-resident patent applications and R&D expenditure as a percentage of GDP) and the Patent Rights Index. The averages are generally not comparable across years or variables due to variation in the country coverage.

Tables III.4, III.5 and III.6 present, respectively, the results for the regression analyses designed to consider the association of the Patent Rights Index to the selected innovation-related indicators. In the first of these tables, the relationship to R&D Intensity is presented. Expenditure on R&D is one important input to innovation processes, as noted in the literature review above. As can be seen from Table III.4, across the four iterations of the regression equation the Patent Rights Index was consistently statistically significant at the 1% level. Most of the control variables were not, with the exception of imports of merchandise and services when entered in the analysis one at a time. Surprisingly, the inward stock of FDI was not associated, though it may be that specific types of FDI would be more clearly associated (e.g., manufacturing or research FDI). The data set does not permit this type of distinction. In the iteration of the regression with all the control variables, legal effectiveness is also significant, though only at the 10% level. Across the four iterations of the regression, the coefficients indicate that a one percent change in the Patent Rights Index was associated with a change in R&D Intensity ranging from about 0.40% to 0.48%.

Table III.5 presents the association of the strength of patent rights protection with patenting by residents in developing countries and LDCs during the period 1990 to 2005.

Again, four iterations are presented, introducing alternately the control variables for FDI, merchandise imports and services imports, as well as a fourth iteration with all of the controls. Across all four iterations one can note that the coefficients for patent rights protection are significant, though the size and significance are diminished when merchandise imports are included in the equation. One possible explanation may be that due to the positive association of patent rights with imports of intellectual property intensive merchandise, the patent rights variable is picking up some of the merchandise imports effect when merchandise imports are not explicitly included in the equation. As anticipated from the discussion of the literature above and in Chapter 2, influences from abroad may play a role in domestic innovative processes via various technology transfer channels.<sup>143</sup> In addition to merchandise imports, the coefficients for the FDI stock and services import variables are also significant and fairly large when entered individually into the equation. They are not significant in the fourth equation when all control variables are entered simultaneously. As might be expected from the discussion in the literature on the role of research and on the importance of human capital, the variable for the quality of research institutions is also significant. Finally, several “environmental” indicators are also significant including Doing Business and Governance, and in two iterations Legal Effectiveness. This is likely associated with the incentives for innovation, whereby conditions that contribute to improve returns and reduce uncertainty may motivate additional innovators to strive for patented innovation. Throughout all four iterations, the explanatory power of the equation is relatively high, with  $R^2$  scores of 0.69 or more.

The introduction of a patented product or process to a market can contribute to technology transfer. Prior to such market entry, whether through FDI or imports, the rights holders often apply for a patent locally in order to protect their innovations from abuse (recall that patents are granted on a country-by-country basis by national authorities). Table III.6 considers the relationship of the strength of patent rights to the volume of non-resident patent applications in developing countries and LDCs. Here, the coefficient for the patent rights variable is even more consistently significant at the 1% level and larger than in the regression for patenting by residents. The volume of patent applications is also clearly associated with international economic flows including inward FDI, merchandise imports and services imports. Two environmental variables also have significant coefficients, namely the Doing

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<sup>143</sup> E.g., also see Maskus, 2004.



Business and Governance variables. This may reflect the importance that foreign rights holders place on factors that reduce uncertainty as they enter new markets. The  $R^2$  scores are higher for this set of regressions than those for the resident patent application regressions, underscoring the explanatory power of the significant variables in this equation with respect to non-residential patenting.

Overall, the sets of regressions presented in Tables III.4, III.5 and III.6 underscore a strong and positive association of patent rights with domestic innovation activity, including inputs (R&D), domestic innovation outputs (residential patents) and technology transfer (non-resident patents). Support is found for the third hypothesis cited above. The tables also point to the importance of openness to investment and imports as a potential complement to patent rights in these processes. In the case of patent applications, certain environmental variables also appear as potential complements to patent rights.

## **E Conclusions**

While some developing countries may initially emphasise extensive growth, aiming to boost employment in the formal sector, eventually economic development also tends to become a story about intensification and increasing output per employee. As can be seen from the theoretical models of Solow (1956) or Romer (1990), this requires finding ways to combine labour and capital with inputs in a manner that delivers greater utility. Technological progress – innovation and diffusion of innovation – contributes to this effort by providing recipes and tools for such improvements in productivity. In a given market, subject to some constraints, both technology and the quality of inputs for production can be improved. The literature cites examples of pathways for this to take place, such as via openness to technology transferred from abroad, investment in research to improve technology, or improved education and training to build the stock of human capital. The literature also notes that there are possibilities for feedback effects whereby, for example, openness to FDI may lead to improved availability of proprietary technology as well as spillovers; this expands and advances the pool of technology available for the next domestic research effort to further improve technology.

The results of the present exercise are consistent with these theoretical insights, complementing them by providing empirical support based on the experience in developing countries during the period from 1990 to 2005. For the sampled countries, the analysis indicates a tendency for the strength of patent rights to be positively associated with the stock

of intangible capital as of 2000, and with the flow of investment in intangible assets, expenditure on R&D, and incidence of patenting during the period 1990 to 2005. Generally, the relationships were statistically significant for the group of developing countries in the sample. While the analyses of investment in intangible assets covered only 16 advanced OECD countries, they provide an interesting indication of the association of the evolution of such investment with strengthening of patent rights (including for four of these countries on a long-term basis). This insight that may be of relevance to the advanced developing countries as well, though it remains to be confirmed empirically once the relevant data become available.

Overall, the positive relationship of the Patent Rights Index with these economic indicators provides an indication that laws on the books do appear to matter to investors and other economic agents. The strength of patent rights in law may provide a signalling effect and help to reduce uncertainty, which may in turn affect incentives to innovate domestically or to transfer technology from abroad. As we have seen from the literature, this is important because of the power of innovation to boost productivity. Moreover, the development of intangible assets – being non-rivalrous, non-excludable and available for replication at low marginal cost – has potential for significant returns as these assets are leveraged in global markets.

It is notable that a variety of control variables are significant in the various regression assessments. This provides an indication that, while they are a statistically significant factor, patent rights should not be considered in isolation. Rather, based on this empirical assessment, patent rights appear to constitute one element in a menu of policies that may be usefully considered as part of economic development strategies with respect to innovation, technology transfer and investment in intangibles.

## F Tables

Table III.1: *Intangible Capital and the Strength of Patent Rights, 2000.*

	I. Dependent variable: Log (Intangible Capital Per Capita)			II. Dependent variable: Log (Intangible Capital as % Total Wealth)		
	All Countries in Sample (1)	Developing Countries (selected) (2)	Sub-set of Countries in Sample (3)	All Countries in Sample (4)	Developing Countries (selected) (5)	Sub-set of Countries in Sample (6)
Constant	2.480 *** (0.186)	-2.885 (2.667)	-1.030 (0.915)	-0.308 *** (0.056)	-2.311 (1.313)	-1.809 *** (0.347)
Log (Patent Rights)	4.049 *** (0.361)	12.897 * (4.741)	9.677 *** (1.598)	0.256 ** (0.110)	3.727 (2.334)	2.848 *** (0.606)
Log (Researchers Per 1000 Employed)		-0.169 (0.431)	0.253 (0.219)		-0.358 (0.212)	-0.181 ** (0.083)
Adjusted R-squared	0.6124	0.4899	0.7328	0.0532	0.2507	0.4250
Number of Countries (obs.)	80	7	30	80	7	30

1. Samples, Full: Argentina, Australia, Austria, Bangladesh, Belgium-Luxembourg, Benin, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Denmark, Dominican Republic, Ecuador, Egypt, Ethiopia, Finland, France, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kenya, Korea, Madagascar, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Portugal, Romania, Russia, South Africa, Senegal, Singapore, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Togo, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, Zambia and Zimbabwe; Developing (non-OECD or OECD medium income): Argentina, China, Mexico, Romania, Russia, Singapore, Turkey; Sub-set (defined based on data availability): Argentina, Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Romania, Russian Federation, Singapore, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
2. Standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the  $p < 0.01$ ,  $p < 0.05$  and  $p < 0.1$  levels, respectively.
3. *Sources*: World Bank (2006), OECD (2010), Main Science and Technology Indicators database, on-line, Park and Lippoldt (2008).

Table III.2: The Association of Intangible Assets to Patent Rights, OECD countries.

	<b>I. 4 High Income OECD Countries, 1975-2005</b>		<b>II. 16 High-Income OECD Countries, 2006</b>	
<b>Dependent variable:</b>	Log (Investment in Intangible Assets as % GDP) <sup>1, 2, 3, 4</sup>	Signif <sup>7</sup>	Log (Investment in Intangible Assets as % GDP) <sup>5, 6</sup>	Signif <sup>7</sup>
Constant	-1.6850	***	-1.5579	**
Standard error	0.1525		0.7020	
Log (Patent Rights Index)	0.8506	**	3.1781	**
Standard error	0.3791		1.1332	
Log (Researchers Per 1000 Employed)	0.0848		0.4090	***
Standard error	0.1523		0.1294	
Country Fixed Effects	Yes		No	
Adjusted R-squared	0.6954		0.6536	
Number of Observations	19		16	

1. Countries and years covered: Finland (1980, 1990, 2000, 2005), Japan (1980, 1985, 1990, 1995, 2000), Netherlands (1987, 1995, 2000, 2005), and United States (1975, 1985, 1995, 2000).
2. For certain years, data on researchers per 1000 employed persons were not available. In those cases, the closest (in time) available observation was used.
3. For the United States, the observation for intangible assets shown as 2000 actually represents 2000-2003. For Japan the observations shown as 1980, 1985, 1990, 1995 and 2000 actually represent, respectively 1980-84, 1985-89, 1990-94, 1995-99, and 2000-05.
4. Sources: United States: Corrado *et al.* (2009, p. 671) and BEA (2008, Table 1), author's calculations; Japan: Fukao *et al.* (2008, Table 4, p. 22); Netherlands: van Rooijen-Horsten *et al.* (2008, p. 35); and Finland: Jalava *et al.* (2007, p. 10). Patent Rights Index: Park (2008). Researchers: OECD, 2010, Main Science and Technology Indicators database, on-line.
5. The countries covered include Australia, Austria, Canada (2005), Czech Republic, Denmark, Finland, France, Germany, Italy, Japan (2005), Portugal (2005), Slovak Republic, Spain, Sweden, United Kingdom, United States
6. Sources: Intangible assets from OECD on-line cited as SOURCE OECD, data on intangible investment are based on COINVEST [www.coinvest.org.uk] and national estimates by researchers; GDP: OECD, Annual National Accounts Database, March 2010; Patent Rights Index: Park (2008); researchers: OECD, 2010, Main Science and Technology Indicators database, on-line.
7. Standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.

*Table III.3: Sample Statistics: Innovation Indicators and Patent Rights Index, Average Scores.*

	1990	1995	2000	2005
Patenting, By Residents	608	1793	3150	17596
<i>N</i> =	50	62	55	32
Patenting, By Non-Residents	1110	1269	4077	24184
<i>N</i> =	46	72	60	33
R&D as % GDP	0.51	0.56	0.56	0.66
<i>N</i> =	26	43	56	53
Patent Rights Index	1.74	2.29	2.76	3.12
<i>N</i> =	84	91	93	93

1. *Sources:* See Annex III.2.
2. The sample statistics are for all available country observations for the variable and year indicated. As can be seen, there is significant variability in country data availability.
3. The maximum number of observations per variable for a given year is 93 (i.e., the sample covers 93 countries).
4. The range of possible scores for the Patent Rights Index is from 0 to 5, with higher scores representing more stringent protection of patents as indicated by laws on the books.

Table III.4: The relationship of patent rights to national R&D Intensity (as a share of GDP), Broad Sample of Developing Countries and LDCs, 1990 to 2005.

Dependent Variable:	R&D as a percentage of GDP			
	(1)	(2)	(3)	(4)
Control Variable:	Inward FDI	Merchandise Imports	Services Imports	All
Constant	-6.063*** (1.107)	-8.705*** (1.346)	-6.257*** (1.088)	-9.315*** (2.046)
Patents Rights Index	0.482*** (0.147)	0.395*** (0.125)	0.446*** (0.142)	0.470*** (0.145)
Inward FDI Stock	0.0243 (0.0279)			-0.0484 (0.0439)
Merchandise Imports		0.156*** (0.0581)		0.193 (0.122)
Service Imports			0.124*** (0.0480)	0.0174 (0.0973)
Quality of Research Institutions	1.637 (1.036)	1.475 (1.050)	1.429 (1.033)	1.414 (1.037)
University-Industry Collaboration	1.480 (0.981)	0.969 (0.963)	1.224 (0.986)	0.967 (0.958)
Doing Business	0.109 (0.0824)	0.0744 (0.0876)	0.0883 (0.0841)	0.0796 (0.0858)
IPR Survey	1.591 (1.546)	1.365 (1.481)	1.150 (1.447)	1.187 (1.419)
Physical Property Rights	-1.519 (1.539)	-1.271 (1.464)	-1.153 (1.450)	-1.190 (1.415)
Legal Effectiveness	0.180 (0.174)	0.279 (0.178)	0.237 (0.184)	0.335* (0.198)
Governance	0.0345 (0.0914)	0.0147 (0.0897)	0.0566 (0.0954)	0.0462 (0.0885)
Observations	198	200	194	194
Number of Countries	73	73	72	72
R-squared	0.716	0.719	0.727	0.729

1. All variables are in natural logarithmic units, except for Governance. See Annex III.2 for variable definitions and data sources.
2. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the  $p < 0.01$ ,  $p < 0.05$  and  $p < 0.1$  levels, respectively.
3. Annex III.1 for the detailed listing of countries by group.
4. Estimation is by OLS panel estimator with random effects.
5. Source: Data underlying Park and Lippoldt (2008), but with a revised method applied here.
6. Throughout the analyses in this chapter, the covered categories of services include transport, travel, communications, construction, insurance, financial services, computer and information services, royalties and license fees, other business services, personal, cultural and recreational services, and government services.

*Table III.5: The Relationship of Patent Rights to Patent Applications by Residents, Broad Sample of Developing Countries and LDCs, 1990 to 2005.*

Dependent Variable:	Patent Applications by Residents			
	(1)	(2)	(3)	(4)
Control Variable:	Inward FDI	Merchandise Imports	Services Imports	All
Constant	-10.97*** (2.984)	-28.88*** (3.782)	-10.41*** (2.951)	-27.03*** (6.687)
Patents Rights Index	1.248** (0.521)	0.845* (0.440)	1.293*** (0.497)	0.909* (0.467)
Inward FDI Stock	0.504*** (0.143)			0.0328 (0.0953)
Merchandise Imports		1.233*** (0.198)		1.046*** (0.393)
Service Imports			1.145*** (0.166)	0.202 (0.335)
Quality of Research Institutions	6.825*** (2.211)	4.408** (2.027)	4.416** (2.015)	4.747** (2.057)
University-Industry Collaboration	-0.115 (2.251)	-3.270 (2.204)	-1.916 (2.149)	-3.445 (2.329)
Doing Business	0.993*** (0.320)	0.772** (0.348)	0.859*** (0.317)	0.824** (0.341)
IPR Survey	0.0647 (1.810)	1.383 (1.692)	0.0220 (2.259)	1.312 (2.175)
Physical Property Rights	-2.113 (1.932)	-2.928* (1.769)	-2.235 (2.617)	-2.890 (2.563)
Legal Effectiveness	0.466 (0.786)	1.173** (0.557)	0.785 (0.663)	1.226* (0.638)
Governance	1.019*** (0.322)	1.019*** (0.322)	1.134*** (0.294)	0.993*** (0.325)
Observations	176	178	166	166
Number of Countries	75	75	71	71
R-squared	0.689	0.748	0.765	0.755

1. All variables are in natural logarithmic units, except for Governance. See Annex III.2 for variable definitions and data sources.
2. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
3. Annex III.1 for the detailed listing of countries by group.
4. Estimation is by OLS panel estimator with random effects.
5. Source: Data underlying Park and Lippoldt (2008), but with a revised method applied here.

*Table III.6: The Relationship of Patent Rights to Patent Applications by Non-Residents, Broad Sample of Developing Countries and LDCs, 1990 to 2005.*

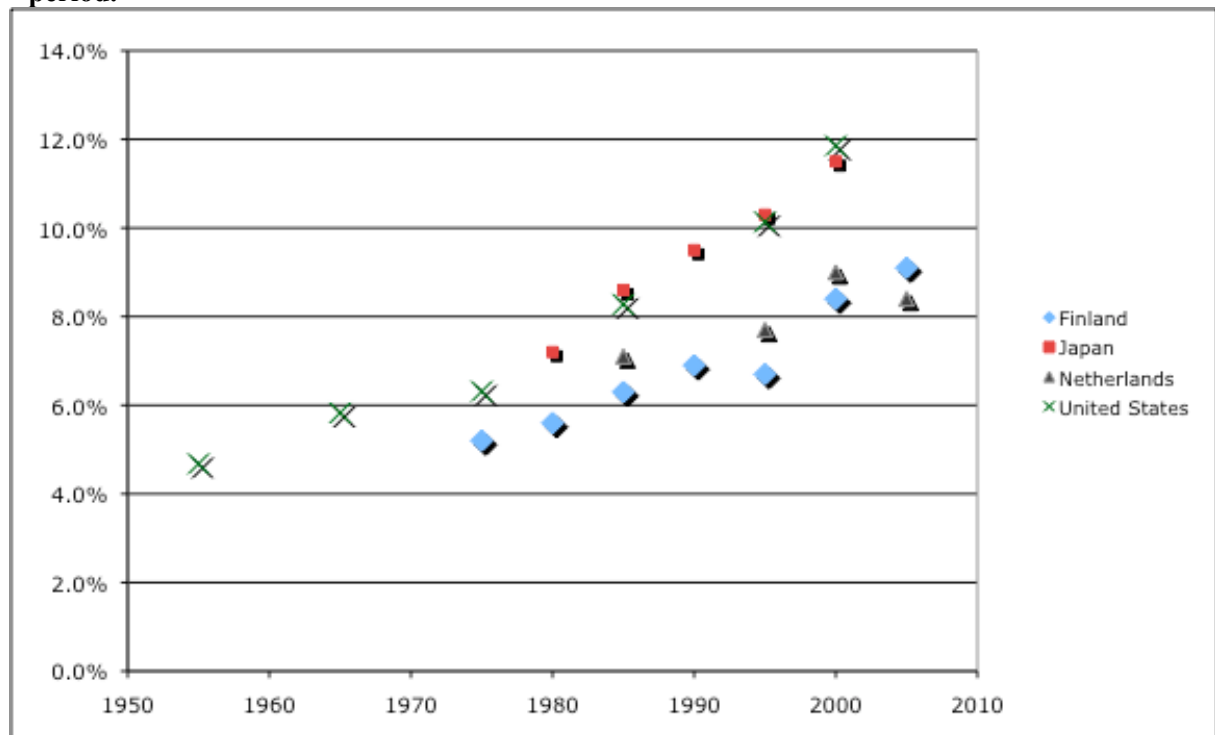
Dependent Variable:		Patent Applications by Non-Residents			
Control Variable:		(1)	(2)	(3)	(4)
		Inward FDI	Merchandise Imports	Services Imports	All
Constant		-3.588* (1.905)	-19.01*** (2.264)	-2.881 (2.063)	-9.317* (5.650)
Patents Rights Index		1.370*** (0.425)	1.390*** (0.389)	1.568*** (0.368)	1.161*** (0.320)
Inward FDI Stock		0.721*** (0.0959)			0.382*** (0.146)
Merchandise Imports			1.051*** (0.0908)		0.375 (0.326)
Service Imports				1.111*** (0.0961)	0.357 (0.311)
Quality of Research Institutions		1.791 (1.450)	0.436 (1.260)	0.0656 (1.302)	1.199 (1.329)
University-Industry Collaboration		-0.296 (1.515)	-1.473 (1.471)	-1.413 (1.575)	-2.232 (1.617)
Doing Business		0.572*** (0.168)	0.516*** (0.180)	0.496*** (0.163)	0.506*** (0.167)
IPR Survey		-0.587 (1.097)	0.165 (1.334)	-0.585 (1.889)	-0.366 (1.698)
Physical Property Rights		-0.980 (1.038)	-1.650 (1.329)	-0.467 (2.023)	-0.723 (1.796)
Legal Effectiveness		0.232 (0.684)	0.644 (0.627)	-0.00962 (0.617)	0.203 (0.611)
Governance		1.023*** (0.331)	1.105*** (0.393)	1.169*** (0.375)	1.064*** (0.373)
Observations		192	194	181	181
Number of countries		81	81	78	78
R-squared		0.771	0.792	0.789	0.798

1. All variables are in natural logarithmic units, except for Governance. See Annex III.2 for variable definitions and data sources.
2. Robust standard errors are in parentheses. \*\*\*, \*\*, \* indicate statistical significance at the p<0.01, p<0.05 and p<0.1 levels, respectively.
3. Annex III.1 for the detailed listing of countries by group.
4. Estimation is by OLS panel estimator with random effects.
5. Source: Data underlying Park and Lippoldt (2008), but with a revised method applied here.



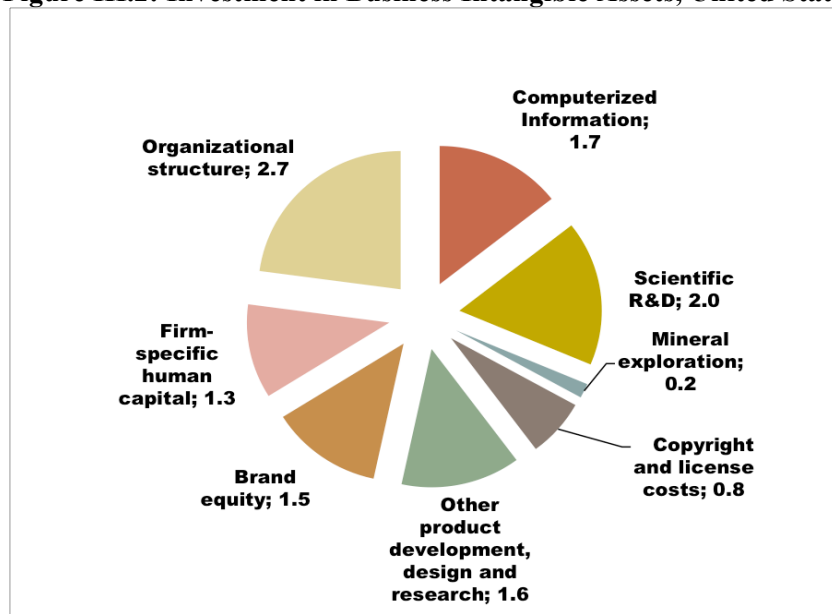
## G Figures

**Figure III.1: Investment (Flows) Over Time in Business Intangible Assets, as % GDP for each period.**



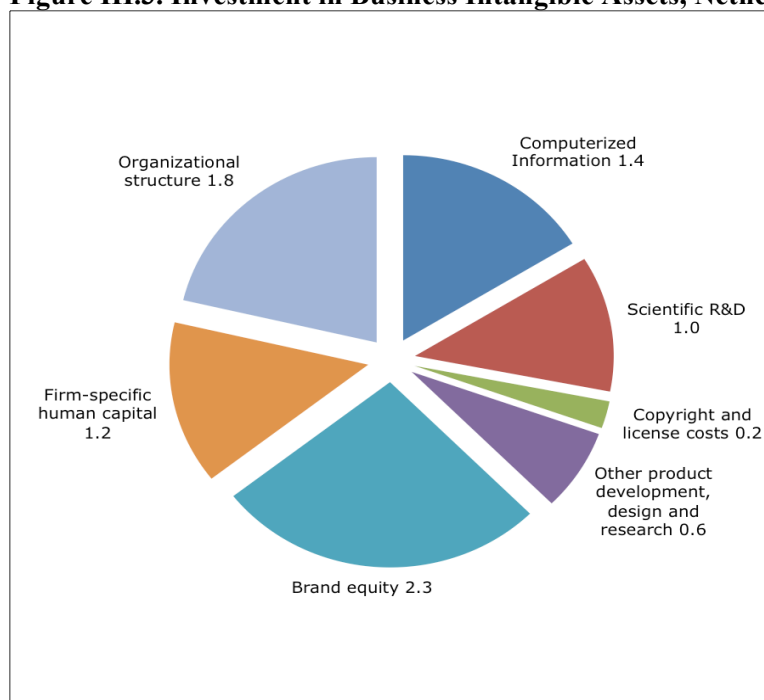
1. Sources: US: Corrado *et al.* (2009, p. 671) and BEA (2008, Table 1), author's calculations; Japan: Fukao *et al.* (2008, Table 4, p. 22); Netherlands: van Rooijen-Horsten *et al.* (2008, p. 35); and Finland: Jalava *et al.* (2007, p. 10).
2. For the United States, the observation shown as 2000 actually represents 2000-2003. For Japan the observations shown as 1980, 1985, 1990, 1995 and 2000 actually represent, respectively 1980-84, 1985-89, 1990-94, 1995-99, and 2000-05.

**Figure III.2: Investment in Business Intangible Assets, United States, 1998-2000; as % GDP.**



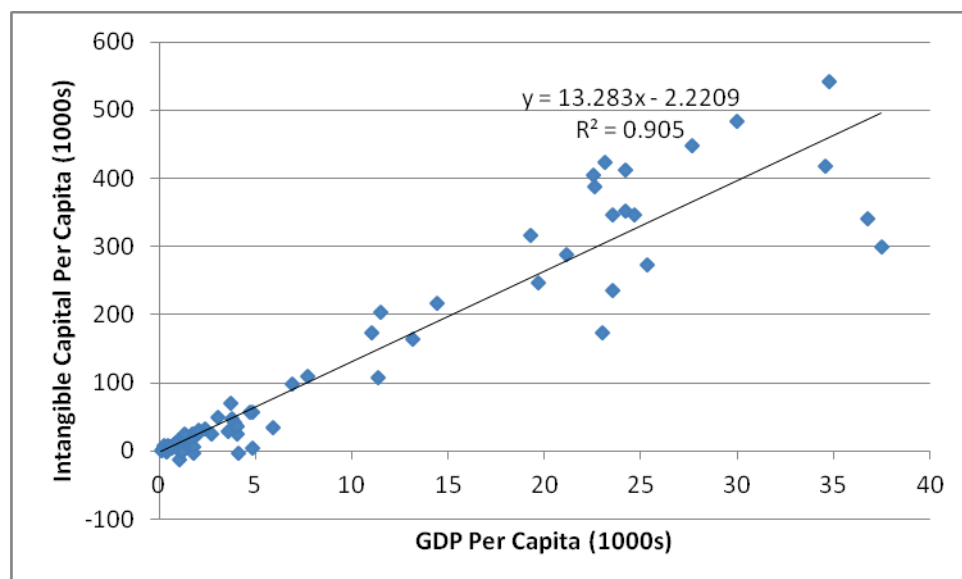
1. Source: Corrado *et al.* (2005, 2006).
2. Corrado *et al.* (2009) present more recent data, but with less detail.

**Figure III.3. Investment in Business Intangible Assets, Netherlands, 2005, as %GDP.**



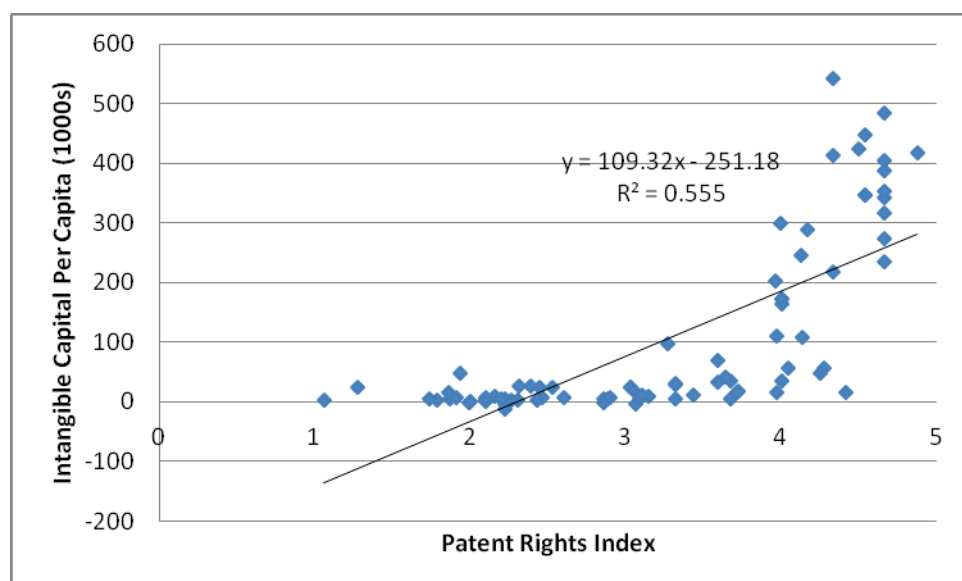
1. Source: van Rooijen-Holsten *et al.* (2008).
2. The business intangible investment in mineral exploration amounted to 0.0 in the case of the Netherlands in 2005.

**Figure III.4: Comparison of Intangible Capital and GDP, 2000, in USD.**



1. Sources: World Bank, 2010, *World Development Indicators* On-Line, and World Bank (2006).
2. Based on full sample of 80 countries listed in Table III.1.

**Figure III.5: Comparison of Intangible Capital (USD) and Patent Rights Index Score, 2000.**



1. Sources: World Bank (2006) and Park (2008).
2. Based on full sample of 80 countries listed in Table III.1.

## H Annex III.1. Country Coverage, Tables III.3 to III.6

<b>Developing Countries (N=68)</b>		<b>Least Developed (N=25)</b>
Algeria	Korea	Bangladesh
Argentina	Lithuania	Benin
Bolivia	Malaysia	Burkina Faso
Botswana	Mauritius	Burundi
Brazil	Mexico	Central African Republic
Bulgaria	Morocco	Chad
		Democratic Republic of
Cameroon	Nicaragua	Congo (Zaire)
Chile	Nigeria	Ethiopia
China	Pakistan	Haiti
Colombia	Panama	Madagascar
Congo	Paraguay	Malawi
Costa Rica	Peru	Mali
Cyprus (Republic of)	Philippines	Mauritania
Czech Republic	Poland	Mozambique
Ecuador	Romania	Myanmar
Egypt	Russian Federation	Nepal
El Salvador	Saudi Arabia	Niger
Fiji	Singapore	Rwanda
Gabon	Slovak Rep.	Senegal
Ghana	Somalia	Sierra Leone
Grenada	South Africa	Sudan
Guatemala	Sri Lanka	Tanzania
Guyana	Swaziland	Togo
Honduras	Syria	Uganda
Hong Kong, China	Chinese Taipei	Zambia
Hungary	Thailand	
India	Trinidad & Tobago	
Indonesia	Tunisia	
Iran	Turkey	
Iraq	Ukraine	
Ivory Coast	Uruguay	
Jamaica	Venezuela	
Jordan	Vietnam	
Kenya	Zimbabwe	

1. This list presents the countries covered in the database, though not all countries are covered in each exercise due to lack of data availability.
2. Country characterisations are based on their situation as of 1990.

## **I Annex III.2. Variables and Data Sources: Tables III.3 to III.6**

### **A. Dependent Variables**

#### **1. Research and Development (R&D). Sources:**

- United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, Data Center, Custom Tables, Science and Technology. [http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=136&IF\\_Language=eng&BR\\_Topic=0](http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=136&IF_Language=eng&BR_Topic=0)
- Organization for Economic Cooperation and Development, SourceOECD, Science and Technology Database, *Main Science and Technology Indicators*, Vol. 2006, Rel. 02. [www.sourceoecd.org](http://www.sourceoecd.org).

#### **2. Patent Applications (by Residents and Non-residents). Source: World Intellectual Property Organization (WIPO), *Industrial Property Statistics*, Table 1, various issues.**

### **B. Explanatory Variables**

1. Patent Rights Index. Sources: Ginarte and Park (1997), Park and Wagh (2002) and Park (2008).
2. Inward Foreign Direct Investment (FDI) Stock. Source: United Nations Conference on Trade and Development (UNCTAD) Foreign Direct Investment Database (FDI-online). <http://stats.unctad.org/fdi>
3. Merchandise Imports. Source: World Trade Organization (WTO), *Statistics Database, Time-series on Merchandise and Commercial Services Trade*, Subject Selection: Total Merchandise Trade. <http://stat.wto.org/StatisticalProgram/WSDbStatProgramSeries.aspx?Language=E>
4. Services Imports. Source: UNCTAD *Handbook of Statistics On-line*. <http://stats.unctad.org/handbook>. Report Folder V, Table 5.1. 1. The covered categories of services include transport, travel, communications, construction, insurance, financial services, computer and information services, royalties and license fees, other business services, personal, cultural and recreational services, and government services.
5. Quality of Research Institutions. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 7.04), 2004-5 (Table 3.05), 2005-6 (Table 3.05), and 2006-7 (Table 9.01)*, Oxford University Press. This variable measures Business Executive opinions on the quality of scientific research institutions (1 = nonexistent, ... , 7 = the best in their fields internationally).
6. University-Industry Research Collaboration. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 7.06), 2004-5 (Table 3.08), 2005-6 (Table 3.07), and 2006-7 (Table 9.03)*, Oxford University Press. This variable measures Business Executive opinions on the extent to which businesses collaborate with local universities to engage in R&D (1 = minimal or nonexistent, ... , 7 = intensive and ongoing).
7. Doing Business Rank. This variable measures the ease of doing business (e.g., the number of procedures required in starting a business, dealing with licenses, employing workers, registering property, getting credit, protecting investors, enforcing contracts, paying taxes, trading across borders, and closing down a business). Countries are ranked in ascending order (1=easiest place to do business, 2=next easiest, etc.) Source: World Bank Group <http://www.doingbusiness.org/CustomQuery>.

8. IPR Survey. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 7.09), 2004-5 (Table 6.04), 2005-6 (Table 6.04), and 2006-7 (Table 9.07)*, Oxford University Press. This variable measures Business Executive opinions on the stringency of intellectual property protection (1 = is weak or nonexistent, ... , 7 = is equal to the world's most stringent).
9. Physical Property Rights. Source: World Economic Forum, *Global Competitiveness Reports 2000 (Table 3.11), 2004-5 (Table 6.03), 2005-6 (Table 6.03), and 2006-7 (Table 1.01)*, Oxford University Press. This variable measures Business Executive opinions on how well private property is protected, including financial assets (1 = are poorly defined and not protected by law, ... , 7 = are clearly defined and well-protected by law).
10. Index of Legal Effectiveness. This variable is a composite score of judicial independence, impartial courts, security of property rights (tangible and intellectual), and integrity of the legal system. Source: Economic Freedom Network (EFN) and Gwartney *et al.*, 2006 Dataset: <http://www.freetheworld.com/release.html>.
11. Governance. Source: World Bank <http://info.worldbank.org/governance/wgi2007>. There are six dimensions of governance: Voice and Accountability (VA), Political Stability (PS), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), and Control of Corruption (CC). For purposes of this study, the six measures are averaged: Governance Index = (VA + PS + GE + RQ + RL + CC)/6.

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## **General Conclusion**

## General Conclusion

This dissertation has aimed to identify relevant insights from existing theoretical work and to test empirically a set of three principal hypotheses concerning a positive relationship of international influences on patent reform in developing countries and a positive relationship of that reform to certain economic developments. Chapter I finds support for the hypothesis that international IPR reforms (in particular the advent of the WTO TRIPS Agreement), operating in combination with industrial interests, have significantly influenced the evolution of patent rights institutions in developing countries during the period from 1990 to 2005. Chapter II presents evidence of a positive relationship between patent right reforms and selected international economic indicators including imports and foreign direct investment. Chapter III finds support for the hypothesis that patent rights reforms were positively associated with certain innovation-related indicators during the study period. Drawing on the analysis in the three substantive chapters, these brief general conclusions serve to highlight some cross-cutting points of policy relevance and to highlight some areas for further work.

The results underscore the importance of patent rights institutions for developing economies in terms of access to technology and promotion of innovation, particularly for those economies that have growing capacity to imitate and thereby threaten the ability of innovators to appropriate benefits of their inventions. This is an important empirical conclusion that was not clear *a priori* from a theoretical perspective. Nonetheless, it is a fortuitous convergence of interests that the pressures from innovators and rights holders have tended to coincide with certain broader economic and development objectives of many developing countries.

The finding of a relationship between international patent reforms and developments in domestic institutions in developing countries also underscores the importance of engagement by these countries in the bodies that are establishing, monitoring and promoting enforcement. Efforts to ensure that policy decisions affecting patent rights institutions reflect the interest of individual economies – each facing a specific set of conditions – will require a good

understanding of the empirical realities in each case. The literature is not yet at such a level of advancement and some suggestions in this regard follow below.

### ***Cross Cutting Policy Implications***

Various arguments have been put forward in defence of IPRs, including patent rights. For example, there is an argument that intellectual property should be accorded protection equivalent to that available for physical property. Or, it is sometimes argued that the provisions of the TRIPS Agreement should be respected as part a larger, single undertaking trade package under the MTS, a deal which involved trade-offs and benefits for developing countries in other areas (e.g., textiles). But, the findings from this dissertation point to potential benefits for developing countries from the perspective of enlightened self-interest. In other words, the evidence examined in this dissertation is consistent with the notion that developing countries providing improved market conditions for rights holders have tended to benefit as rights holders responded to the associated expansion of potential new market opportunities. This was manifested via a tendency towards increases in international inflows (both trade and investment) and domestic innovative activity. Moreover, it appears there was a feedback mechanism whereby the increased stocks of intangible capital associated with these developments also effectively motivated stakeholders to support strengthened patent rights.

At the same time, this is not intended to be an argument that patent protection is a silver bullet economic development solution. The analysis is applicable to a particular period and a particular range of strengthening of patent rights. It is possible that a country could extend overly stringent protection for patent rights holders, leading to undue exercise of market power or an overly litigious economic society (e.g., one where under certain circumstances it might be more profitable to focus on litigation for damages than innovation). Rather, the general conclusion is that countries that have tended to strengthen their patent rights institutions in line with the areas covered by the Patent Rights Index have tended to benefit in terms of the economic indicators covered by this dissertation, but results are influenced by a variety of factors and may vary.

In addition, it should be stressed that the TRIPS Agreement is not a one-size fits all type of arrangement. While the accord does specify certain minima (e.g., with respect to

duration of protection), it does not demand complete uniformity. As underscored by the continued variation in the Patent Rights Index score at the end of the study period, developing countries have exploited various combinations of policy settings in line with their interests. Moreover, similar Patent Rights Index scores can be obtained from various combinations of policy settings. Thus, with respect to patent rights, it would seem that developing countries can avail themselves of a certain degree of flexibility providing they manage to deliver protection that is adequate in terms of addressing the needs of rights-holders and innovators to the extent that the desired economic outcomes are achieved.

### ***Further research***

The foregoing aggregate analysis provides only a partial indication of the overall economic outcomes from the international wave of patent rights reform during the period from 1990 to 2005. In part, this is because there may be other benefits that are not captured by these indicators (e.g., with respect to technology transfer via the international movement of human capital). And, the analysis does not take account of the implementation costs associated with compliance with international obligations and domestic requirements. While these issues have been mentioned in the existing literature (e.g., Maskus, 2004, or Finger and Schuler, 2001), there is room for a more expansive empirical assessment in both areas. The availability of such work would contribute to development of a more comprehensive assessment of the patent reforms of the past two decades.

A further area for exploration concerns firm level responses to strengthened patent rights protection. There is a growing body of work on firm level behaviour in developed countries (some of it cited in this dissertation), but the availability of information on firms in developing countries is much more limited. While some substantial work is already underway (e.g., as can be seen in Maskus, 2008), additional empirical perspectives would be welcome on firms in developing countries. For example, it would be useful to better understand how economic agents react to the increased availability of patent protection, in some cases and conditions managing the transition from imitative to innovative orientations.

Additional empirical work is necessary to determine where, and under what circumstances, exercise of the TRIPS flexibilities may yield further tangible benefits. There are trade-offs in the various policy settings and a more comprehensive understanding of costs

and benefits would provide an important input for fine-tuning of the policy settings. A related question in each developing country is whether or not further strengthening overall (e.g., beyond current obligations) could yield tangible benefits, a question of relevance to both developing and least developed countries. In this regard, one area for exploration concerns enforcement. Various approaches have been tried, but a more nuanced understanding of the effectiveness of these approaches and the conditions for success in these countries may help to focus efforts and reduce tensions that sometimes arise between developed and developing country authorities.

Finally, the efficacy of patent rights policies varies and seems to be associated with the larger economic environment in a country. In other words, it appears that policy complements may in some cases facilitate positive economic outcomes from patent rights reforms. Drawing on the regression analyses in this dissertation, some insights can be obtained with respect to the control variables. For example, factors such as freedom to trade internationally, legal effectiveness or ease of doing business are significant in a number of analyses for countries at different levels of development. Such factors may be complementary to the strengthening of patent rights. This issue of policy complementarities and coherence constitutes a further area that may be usefully explored through more targeted empirical research.

### *A final comment*

The global economy has become increasingly integrated as technological advances, trade and investment liberalisation, reform in transition countries, institutional change and other factors have come together to break down barriers and increase international economic possibilities. The multilateral trading system has played a major role in promotion of economic integration, in part by influencing the evolution of institutions related to intellectual property rights in developing countries. Overall, the positive relationship of the Patent Rights Index with a range of economic indicators provides an indication that laws on the books do appear to matter to investors and other economic agents. As Lippoldt (2008, p 258) points out, with the increasing globalisation of markets and the establishment of international standards for IPR protection, competitive pressures are challenging growth-oriented developing countries to address any basic shortcomings in their national IPR regimes. Conformity with

the minimum global IPR standards may have become, in effect, a prerequisite for developing countries wishing to access and exploit the full range of global technologies and know-how.

The availability of protection for IPRs and the emergence of markets and new channels for dissemination provide incentives for innovation and diffusion of innovation. Globalisation, rules-based trade liberalisation, the Internet and other technological progress are combining to provide greatly increased opportunities or leveraging intellectual assets. The potential returns are greater than those that were available in the past.<sup>144</sup> While commercial interests may benefit from this profit potential, society at large may also benefit from the drive it can provide for new innovation and diffusion of innovation including through international technology transfer.

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<sup>144</sup> This applies not only to for-profit interests but also to those that may have other motivations to innovate such as social recognition or altruism, who can now extend the reach of their innovations.



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