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Title: International patent systems strength 1998 - 2011

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Abstract:

In this paper we report on a composite index of international patent systems strength for 48 developing and industrialized countries annually from 1998 to 2011. Building upon earlier indices we develop a conceptual framework informed by transaction cost theory and derive measures which emphasize the importance of enforcement-related aspects of the patent system of countries. Findings reveal harmonization of the regulative aspects of patent protection internationally in the post-TRIPs era but not of overall national patent systems. The index should inform studies on the relationship between national patent systems and a range of international business and other phenomena.

Keywords:

Intellectual property, patent, national patent systems index, patent enforcement, patent system development.

International patent systems strength 1998 - 2011

1. Introduction

This study reports a new composite index of patent system strength for 48 countries annually for the period 1998 to 2011. Research shows that national patent protection strength has a strong determinant effect on a range of international business activity, including foreign direct investment, inter-firm alliances, exports, R&D, innovation, licensing and technology transfer (Allred & Park, 2007; Fink & Maskus, 2005, Ghauri & Rao, 2009; Hagedoorn, Cloodt & Van Kranenburg, 2005; Ivus, 2010; Kafouros & Forsans, 2012; Khoury & Peng, 2011; Papageorgiadis, Cross & Alexiou, 2013). Much of this empirical investigation has relied upon quantifiable measures that capture the evolution of patent systems in countries. To this end, numerous intellectual property (IP) indices have been devised, such as those by Rapp and Rozek (1990), Ginarte and Park (1997) and Ostergard (2000). However, these existing measures have become outdated, with the exception of the most frequently employed indices of national patent protection strength reported by Ginarte and Park (1997) and updated by Park (2008). These two indices (henceforth the GP indices) have become widely accepted as standard measures of patent protection levels (and arguably, of IP protection regimes in general) not least because they account for the presence, or not, of particular items of patent-related book-law contained in the statutes of countries.[1]

[1] According to the Social Sciences Citation Index, the total citation count for the GP indices is presently in excess of 300 (and 1300 in Google Scholar), demonstrating how extensively they have been applied in international business and related research.

In contrast to what the GP indices measure, the ability of firms to extract value, or to appropriate returns, from the patents they own is dependent not only upon the existence of patent-related book-law in the legal framework of countries but also upon the ability of government agents and institutional actors (such as the judiciary, law enforcement and customs officials) to administer, police and enforce these laws in practice (Keupp, Beckenbauer & Gassmann, 2010; Shultz & Saporito, 1996; Staake & Fleisch, 2010; Yang, 2005; Yang, Fryxell & Sie, 2008; Yang, Sonmez & Bosworth, 2004). Indeed, as Park (2008, p. 761) points out, the GP indices were "designed to provide an indicator of the strength of patent protection, not the quality of patent systems". Consequently, although the GP indices are commonly used as proxies for the regulatory environment that underpins national patent protection in terms of book-law, more research needs to be done to quantify additional aspects of the patent system of countries within which patent rights are granted, infringed and enforced (Arora, 2009; Cockburn, 2009; Ivus, 2010; Maskus, 2000). We achieve this with the new index reported here.

The need for a new index that measures the strength of a national patent system – and which places particular emphasis on the effectiveness of enforcement practices, together with the overall administrative functioning of the system as perceived by managers – can be justified on both managerial and empirical grounds. From a managerial perspective, the original Ginarte and Park index was created largely in response to a time when levels of book-law protection of patents were highly variable across countries (Chaudhry & Walsh, 1995). Widespread adoption of principles set down by the Trade-Related

Aspects of Intellectual Property Rights (TRIPS) agreement has harmonized to a great extent the minimum standards of legal protection for patents offered by countries.[2] However, the same cannot be said for enforcement levels (IPO, 2011; Li & Correa, 2009; OECD, 2009; USTR, 2011). The fact that patent enforcement levels and practices are often ineffective or inadequate in countries can be demonstrated in three ways: (i) by the latest IP-related plurilateral Anti-Counterfeiting Trade Agreement (ACTA), concluded in October 2011, which aims to establish international standards for IP enforcement across signatory States on the basis that current conditions are often unsatisfactory; (ii) by the patent enforcement-related clauses and conditions which are regularly included for the same reason in bilateral trade and investment agreements (such as the EU-India and EU-China trade agreements presently under negotiation); and (iii) by the growing extent of counterfeiting and piracy around the world, which is estimated to account for between 1 and 2 per cent of current global merchandise trade in value terms (OECD, 2009; Staake & Fleisch, 2010).

On the empirical front, several recent contributions to the international business literature have called for stronger measures to facilitate understanding of how institutional variables such as IP systems matter to the strategic management of intangible assets as firms extend their activities abroad (Peng, 2003; Peng, Sun, Pinkham & Chen, 2009). As Jain (2002) comments, international business researchers need to be more mindful of IP-related issues

[2] The TRIPS agreement (instigated in January 1995) is the most comprehensive multilateral agreement related to intellectual property rights (IPR). However, the agreement allows for numerous exclusions, and includes nothing about how individual countries should enforce their IP laws. We are grateful to an anonymous reviewer for this observation.

in general, and especially in relation to variable levels of enforcement and other factors that influence patent protection intensity in a country. For all these reasons, the need exists for a new index that extends the scope of coverage offered by the GP indices by accounting for variable levels of patent enforcement across countries.

This study contributes to existing literature by reporting a novel composite measure of national patent system strength for 48 countries and economies annually for the period 1998 to 2011. Following the rationale of transaction cost theory, we calculate a new dataset that captures how managers perceive levels of patent enforcement in a country as well as the general effectiveness and efficiency of the national patent system. To create the new index we use a number of uniform techniques recommended by the Organization for Economic Co-operation and Development in their *Handbook on Constructing Composite Indicators* (OECD, 2008). This is arguably the most authoritative guide currently available on the creation of nationally comparable measures of macro phenomena (Archibugi, Denni & Filippetti, 2009; Fagerberg, Srholec & Knell, 2007).

The remainder of the paper is organized as follows. Section two provides a brief background on patent systems and the IP index literature to which this study relates. Our purpose here is to identify attributes that have led the GP indices to become widely used as proxies for national patent and overall IP protection strength, along with methodological insights from related studies which we use to inform the design of the new index. In section three we develop a conceptual framework upon which the design of the new international

patent systems strength index is based, following the directions of transaction costs theory. Section four then explains the methodology used to construct the new composite index, with particular emphasis placed on transparency to facilitate replication and future extension. In section five we report on the new index for 48 countries and discuss its contribution in the context of a comparison with the individual country scores of the GP index and with national GDP per capita data. Finally, in section six we conclude by discussing the implications of this study for both researchers and managerial decision-making.

2. Background

2.1. National patent system

Patents represent a key source of competitive advantage to innovative firms since, once granted, legal redress by the owner can be sought if the patent is infringed or otherwise misappropriated through the sale, manufacture, use, importation or distribution of the patented technology without permission (Macqueen, Waelde & Laurie, 2008; WIPO, 2008). A national patent system within which ownership rights are conferred is comprised of three elements, namely: (i) the legal framework and instruments set out in book-law that define and enable the formal protection of patents in a country; (ii) the operations which enforce these rights in practice; and (iii) the efficient governance and activities of public and private organizations concerned with the operations of the patent system (Gowers, 2006). The legal framework sets forth the rules that patent owners can use to defend and uphold their rights. A balanced and

coherent legal framework provides a safeguard for patent owners who can seek redress from the judicial system should misuse, infringement or misappropriation of legal rights occur (Papageorgiadis et al., 2013; Peng et al., 2009). However, the availability of a comprehensive legal framework is a necessary but not sufficient condition to defend against imitation and misappropriation. In order to uphold their rights, the patent owner is required to engage with the administrative bodies responsible for the governance and operations of the patent system and, especially, enforcement-related actors. The administrative bodies are responsible for the clerical functions required for the patent system to operate effectively, such as the efficiency of prior art searches, patent examinations, and timely responses to applicants (Yang et al., 2008). Similarly, enforcement-related operations involve the existence, availability, effectiveness and quality of organizations and firms such as police forces and customs officials as well as private enforcement agencies who facilitate the effective use of the patent system by economic actors (Keupp et al., 2010; Shultz & Saporito, 1996; Yang et al., 2008).

2.2. Indices measuring intellectual property strength

Over the last thirty years, many studies have reported indices of IP strength in an effort to quantify and depict differences in the level of book-law protection or enforcement offered by the IP systems of countries over certain periods of time.[3] In this context, the two dominant approaches used are as follows: (i) indices which seek to quantify the existence and scope of IP law (book-law,

[3] For a comprehensive review of this literature and a discussion of key limitations associated with extant IP indices see Papageorgiadis (2010).

statutes, and so forth) and (ii) indices which seek to quantify differences in the quality of IP enforcement.

2.2.1. Indices measuring IP book-law protection

Measurement of dissimilarities between book-law protection provisions within the regulative systems of countries is the most widely adopted approach followed in the IP index literature. These studies account for the level of book-law protection in a country using binary variables to depict the existence (or not) of particular items of IP-related legislation (Bosworth, 1980; Ferrantino, 1993; Ginarte & Park, 1997; Kondo, 1995; Rapp & Rozek, 1990; Seyoum, 1996; Van Kranenburg & Hogenbirk, 2005).[4] In general, a country is awarded one point when a certain legal provision is incorporated into its IP regulatory system and none when it is absent. In addition, countries are rewarded if they are members of an international IP treaty such as the Paris or Berne Convention. A final composite index is then calculated by summating the points received from all variables. The higher the number of legal provisions offered the higher a country scores in terms of the strength of its regulatory system. With the exception of the GP index, all the studies following this approach use differing methodologies to derive values for various country sets and different time periods prior to 1998 and were then discontinued.

The first iteration of the GP index quantified the strength of book-law patent protection for 110 countries, in five-year intervals for the period 1960 to

[4] Rapp and Rozek (1990) and Seyoum (1996) used the US Chamber of Commerce Intellectual Property Task Force (1987) Guidelines for Standards for the Protection and Enforcement of Intellectual Property Rights to capture enforcement-related book-law provisions in countries but not the enforcement of these laws in practice (Ostergard, 2000).

1990 (Ginarte & Park, 1997). It was subsequently extended by Park (2008) up to the year 2005 and for a total of 122 countries. The index is comprised of five constructs, namely: (i) patent coverage, (ii) membership of international treaties, (iii) enforcement mechanisms, (iv) restrictions on patent rights, and (v) duration of patent protection. The 'coverage' construct includes eight variables designed to capture the availability of patent protection in certain industrial sectors where patent protection is perceived as being particularly beneficial to the patent holder, such as the patentability of pharmaceutical products. The 'membership of international treaties' construct includes five variables relating to whether or not a country is signatory to patent-related treaties, such as the TRIPS agreement. It should be noted that the TRIPS agreement is concerned not only with matters relating to patents but also with other types of IP such as copyright and trademarks. The 'enforcement mechanism' construct captures the existence of laws that can enable patent enforcement, such as the availability of preliminary injunctions. Importantly, in the GP indices this construct concerns only the availability of book-law protection, not how such laws are actually enforced. Nor does it concern other enforcement-related activities. The 'restrictions on patent rights' construct considers the existence of laws that have the potential to negatively affect the appropriation of patent rights by owners, such as those that enable the revocation of patents. Finally, the fifth construct, 'duration of patent protection', is measured by one variable where countries offering protection for less than 20 years from the date of application score lower than those meeting or exceeding this condition. The summated value of the binary variables constitutes the total index number for that particular

construct. The overall patent protection score of a country reported in the GP indices then consists of the unweighted sum of component construct values, with scores ranging between '0' (which signals an absence of patent protection in a country) and '5' (which signals much higher levels of protection).

Two important features of the methodology used to create the GP indices have reinforced their usefulness as quantitative tools for researchers. Firstly, the conceptual framework is easily comprehensible, whereby the five constructs concerning patent-related law are clearly identified, defined and quantified. Consequently, what the indices seek to proxy for and why is clearly discernible. This means that researchers can readily determine if they are fit for purpose. Secondly, the methodology employed is transparent, enabling replication and extension of the index if required. Both these features have resulted in the GP indices becoming the IP index of choice for international business scholarship, as well as by policy-making organizations (Arora, 2009; Cockburn, 2009; Intellectual Property Office, 2011).

2.2.2. Indices measuring IP enforcement

The second methodological approach found in the IP index literature focuses on quantifying the enforcement-related aspects of the IP system. Indices that sought to measure IP enforcement levels were developed for selected years in the 1990s and were subsequently discontinued, mainly due to the difficulty associated with identifying and collecting relevant data (Gadbaw & Richards, 1988; Marron & Steel, 2006; McCalman, 2004; Ostergard, 2000; Smarzynska, 2004). The studies by Gadbaw and Richards (1988) and Ostergard (2000) applied content analysis of US governmental and agency reports about the

quality of IP protection and enforcement in different countries. For example, Ostergard (2000) calculated an IP enforcement index using content analysis of the *Country Reports on Economic Policy and Trade Practices* published by the US Department of State (USDS, 2013). The USDS report described in qualitative terms IP enforcement levels evident in different countries.[5] Ostergard collated time series data for 76 countries across three time intervals (1988, 1991 and 1994). Similarly, Smarzynska (2004) developed an index that proxies for IP enforcement in 24 countries for the year 1995, and used it in a study together with the GP index. This index was calculated using evidence derived from the qualitative analysis of IP systems in the US Trade Representative's (USTR) Special 301 Report which reviews IP protection and enforcement issues for countries on an annual basis (USTR, 2013). Finally, Marron and Steel (2006) attempted to account for IP enforcement using piracy rates calculated by the Business Software Alliance for the period 1994 to 1997 in 70 countries, while McCalman (2004) used the Corruption Perceptions Index (CPI) published by Transparency International in conjunction with the GP index to develop a composite index of enforcement strength in 1997 for 40 countries.

This literature on IP-related indices – most notably the GP indices – provides a useful platform on which to base the design of a new international patent systems strength index, especially with regard to methodology, as we explain below. Following OECD (2008) guidelines on the construction of composite indicators, we first derive a conceptual framework which is then

[5] USDS abolished the report used by Ostergard (2000) in 2002 (USDS, 2013).

used to identify the variables required to calculate the new index. We now discuss and explain the component elements of a patent system and establish a conceptual framework using transaction costs theory to illustrate how it impacts on international business activity.

3. Conceptual framework and theoretical foundation

3.1. The effect of patent systems on international business activity

Studies show that firms encounter difficulties when engaging with foreign institutions that are substantively different, or "distant", from their home institution or those with which they are already familiar (Kostova, 1999; Xu & Shenkar, 2002). Firms seeking to appropriate value from their intellectual assets need to ensure that they adequately account for institutional differences associated with a host country (Kostova, 1999). The performance of institutions such as the patent system becomes crucial when firms engage in cross-border transactions (Henisz, 2003; Mudambi & Navarra, 2002; Peng, 2002, 2003). The nature, structure and effectiveness of a national patent system impacts on the way that firms are able to appropriate or extract value from their innovations and, it follows, how business activity is organized and conducted within the system and country (Teece, 2006).

According to Hargreaves (2011), the patent system imposes transaction costs to firms in the form of search, administration and enforcement costs. Transaction costs arise mainly from interactions between the patent system and the strategies that patent owners undertake in order to successfully exploit their intellectual assets (Teece, 2006). Friction caused by institutional inefficiency of

the patent system raises the transaction costs that a company faces (Demirbag, Glaister & Tatoglu, 2007; Jarzabkowski, 2008). In turn, and following transaction costs thinking, the patent system influences firm decision-making such as whether to internalize activities or transact outside corporate boundaries using external markets (Papageorgiadis et al., 2013). Consequently, it is necessary to understand the transaction costs that companies experience when interacting with a country's patent system.

3.2. Transaction costs originating from engagement with the patent system

Following the thinking and terminology of Hargreaves (2011) and Williamson (1975) we recognize three specific types of transaction costs which arise from the interactions of foreign firms with the patent system of host countries, namely servicing costs, property rights protection costs and monitoring costs (see also Anderson & Gatignon, 1986; Clegg & Cross, 2000).

3.2.1. Servicing costs

Servicing costs are those costs that arise from the transfer of patent rights to a contracting party (either a related or unrelated concern) in a host country (Clegg & Cross, 2000). Servicing costs are generated from both within and beyond the boundaries of the firm. Internally, servicing costs consist of, *inter alia,* those costs associated with (i) codifying the intellectual asset to facilitate its transfer, (ii) implementing security measures to mitigate the threat of inappropriate leakage of intellectual assets to rivals, and (iii) education, training and support of contracting parties on how to effectively operationalize or exploit the intellectual asset, such as the provision of practical advice, expertise and know-how (Clegg & Cross, 2000; Keupp et al., 2010; Shultz & Saporito, 1996).

Greater absorptive capacity of the recipient will have the effect of reducing these internal servicing costs. Externally, servicing costs arise when dealing with the patent system of a country. External servicing costs are determined by (i) the quality of administration in terms of the efficiency, transparency and timeliness of agencies that deal with patent-related matters and their systems and routines; (ii) the complexity, clarity and communication of patent-related regulations and procedures; and (iii) the quality of administrative decisions made by government agencies who deal with patent-related matters for and on behalf of foreign and domestic firms.

3.2.2. Property rights protection costs

The transaction costs which arise from property rights protection relate to, first, whether or not ownership rights are upheld by the patent system when, for example, infringement cases are taken to court and, second, the general effectiveness of the judiciary, police forces, customs officials and other government agencies when undertaking patent enforcement-related activities. Should such actions fall short of the expectations of the patent owner, or are otherwise deficient, then costs will be incurred as steps are taken to ameliorate the effects of this outcome. With regard to the upholding of ownership rights, time-related issues are important, since there are various costs involved in the period between taking a patent-related case to court and the delivery of a verdict. Long delays translate to direct costs (in the form of legal fees, for example) and to the opportunity costs arising from the ability of the defendant to continue to profit from sales of the disputed articles (with regard to patent infringement cases). So far as enforcement efficiency is concerned, this

involves costs arising from the inefficiency of local judicial enforcement procedures (Yang et al., 2008). On the one hand, transaction costs will be lower when the judicial system is transparent, even-handed, independent and does not behave arbitrarily and when it functions efficiently in terms of resourcing levels and timeliness. On the other, an opaque, arbitrary or inefficient judicial system that is receptive to corrupt practices will elevate transaction costs for foreign firms engaging with a national patent system (Hillman & Keim, 1995; OECD, 2009; Papageorgiadis et al., 2013; USTR, 2011).

3.2.3. Monitoring costs

Monitoring costs arise from the efforts undertaken to constrain the activities of those related or unrelated parties who behave opportunistically, thereby infringing upon the property rights of patent owners (Clegg & Cross, 2000; Shultz & Saporito, 1996). These concerns are closely related to the issues of opportunity cost and free-riding potential. A firm whose intellectual assets are exploited illegally may miss the opportunity to appropriate some or all of the market returns. In addition, any resulting infringement acts which are not pursued may help to establish a competitor in the marketplace who is then able to profit illegally from the intangible assets of the patent owner (Granstrand, 1999; Maskus, 2000). Monitoring costs are thus incurred as the patent owner scans the marketplace to identify instances of infringement of its intellectual assets. Such costs also arise as the patent owner motivates, informs and influences the activities of the relevant police forces, border customs and other enforcement agencies in order to uphold their rights as and when patent infringement is spotted (Shultz & Saporito, 1996; Yang et al., 2008). Such

agencies can be ineffective in combatting infringement for a variety of reasons, including understaffing, lack of resourcing, inexperience, and corruption, amongst other things (USTR, 2013; Yang et al., 2008).

To a great extent, the need for enforcement-related intervention will be dependent upon cultural and societal attitudes towards the production and consumption of infringing goods, as well as on public commitment to patent protection in general. Societal attitudes largely determine the extent to which infringing acts are acceptable and if a market exists for the consumption of infringing goods, since it is among society members that legitimization and approval is achieved. A society in which a significant majority regards the production, purchase and use of infringing products as acceptable behaviour is more likely to foster and legitimize such activity (Yang, 2005). Similarly, individuals may not be aware of what constitutes legal protection and the rights of patent owners, and may therefore be more prone to violate those rights in the belief that they are acting legally (Bryce & Rutter, 2005; Hung, 2003). In contrast, greater awareness of the positive economic effects of patents within a society will lead to higher commitment to patent protection (Lee & Yoo, 2009) since consumers understand better the benefits of an effective patent system (e.g. for employment or wealth creation reasons). Therefore, societal understanding of, and commitment to, patent protection as well as enforcement represent an important component of the national patent system. It contributes to the success of enforcement measures, and also to the propensity in a country for infringing goods to be manufactured or purchased.

Identification of these three types of transaction costs that arise from a patent owner's interaction with the patent system enables us to construct the framework presented in Table 1. Here, we identify the focal transaction cost type, the precise component of the patent system which generates the cost, and the proxy variables we use to measure the component and build the index. The new index contains proxies for each of the transaction costs identified above. These focus on the enforcement dimension of the patent system as it is perceived by managers.

----------Table 1 goes about here----------

4. Data Sources

We now discuss the secondary data and sources used to quantify the effect of transaction costs resulting from a firm's interaction with the national patent system, as defined and described in our conceptual framework. To strengthen the reliability and validity of the new composite index, and to allow it to be regularly updated and recalculated (e.g. annually), it was decided *a priori* that the selection of secondary data should first satisfy six criteria. These were that the data should: (i) have a close conceptual relevance to the theoretical framework in order to serve as meaningful proxies of the patent system and its associated transaction costs; (ii) have an early date of initial publication to increase the longitudinality of the index; (iii) be collected consistently over time to enhance the reliability of the index; (iv) be reported frequently to strengthen the discriminatory power of the index; (v) cover a wide range of countries to bolster the applicability of the index; and (vi) be readily available to facilitate future replication and regular updating of the index by any researcher.

4.1. Measures

Following an extensive review, six secondary data sources were identified which satisfy each of the above criteria. These are: (i) the *Global Competitiveness Report* (GCR) of the World Economic Forum (WEF); (ii) the *World Competitiveness Yearbook* (WCY) of the International Institute of Management Development (IMD); (iii) the *International Country Risk Guide* (ICRG) published by the Political Risk Services (PRS) Group; (iv) the *Corruption Perceptions Index* (CPI) produced by Transparency International; (v) data on piracy rates reported by the Business Software Alliance (BSA); and (vi) the USTR Special 301 Report. From these sources ten variables were obtained to proxy for each of the transaction costs constructs discussed above.

4.1.1. The servicing costs measures

The servicing costs construct is captured by one element, namely the "quality of IP administration". Two variables are used to proxy for the measurement of this construct: firstly, the "bureaucracy quality index" reported in the ICRG and secondly, the "bureaucracy does not hinder business activity" indicator published in the WCY. With regard to the first variable, the PRS Group ranks the perceived political risk levels of countries in the ICRG, in which the "bureaucracy quality index" is one of twelve components comprising the overall political risk score. This measures a country's ability to implement its policies without significant changes and interruptions to government services. Therefore countries with weak bureaucracies which cannot absorb policy changes without affecting daily administration score low, whereas strong and established bureaucracies which act without government intervention score

high. The values assigned to this component range along a scale from "0" (weak bureaucracy) to "4" (strong bureaucracy). Our assumption is that the quality of those agencies which administer patent-related laws and regulations is approximated by the overall level of national bureaucratic performance as reflected by this index. Regarding the second variable, the IMD evaluates in the WCY the actual and perceived competitiveness of nations by, amongst other things, collecting annual data through its "Executive Opinion Survey". The "bureaucracy does not hinder business activity" indicator is calculated from responses to this survey question, with a minimum score "0" equating to bureaucracy levels that heavily influence business activity, and the maximum "10" to bureaucracy that does not restrict business activity. We incorporate this variable to capture the additional effect of patent-related government agencies on business activity beyond the quality of these agencies as indicated by the ICRG score.

4.1.2. The property rights protection costs measures

The property rights protection construct is estimated using two elements, namely judicial enforcement and the level of corruption in the judiciary. We use three variables to proxy for the judicial enforcement component of the national patent system and one to proxy for corruption levels. With regard to judicial enforcement, first we take the indicator "justice is fairly administered" reported in the WCY. Again, this is constructed from survey responses and varies along a scale from "0" ('low levels of fairness and even-handedness') to "10" ('high levels'). We assume a close correlation between the way that patent rights are enforced by the judicial system of a country and respondents' perceptions of the

overall fairness of a country's judiciary. Second, we employ the "law and order" indicator as quantified in the ICRG using two different sub-components, those of "law" and "order", with both ranging from a minimum score of "0" to a maximum of "3". The "law" sub-component is a measure of the strength and impartiality of a country's legal system, while the "order" sub-component is calculated by evaluating popular beliefs concerning law enforcement (i.e. crime rates). The combined indicator therefore ranges along a scale from "0" to "6" (a summation of the two sub-variable scores). The third proxy derives from the "judicial independence" indicator originating from the annual "Executive Opinion Survey" published in the GCR, which was introduced in 1998 and is measured by executives' responses to the question "Is the judiciary in your country independent from political influences of members of government, citizens or firms?". The minimum score is "1" (political influence is high) while the maximum is "7" (the judicial system is entirely independent). Our assumption is that higher levels of political interference correlate to weaker judicial enforcement and therefore to higher property rights protection costs, especially in relation to the patent system. Finally, following McCalman (2004) we proxy for levels of corruption in the judiciary using the Corruption Perceptions Index (CPI). This is an annual composite index calculated using data from thirteen different sources and ten institutions to estimate corruption levels in a country, with scores ranging from "0" (highly corrupt countries) to "10" (highly 'clean') (Transparency International, 2011).

4.1.4. The monitoring costs measures

The monitoring costs construct is operationalized using five elements: (i) the perceptions of patent owners to changes in a country's patent protection and enforcement regime; (ii) cultural and societal attitudes towards the purchase of infringing goods; (iii) the level of public commitment to patent protection in general; (iv) the effectiveness of police enforcement; and (v) the strength of border controls. We identify four variables to proxy for the measurement of these elements, namely: a) the "intellectual property rights" indicator reported in the WCY; b) the "intellectual property protection" indicator reported in the GCR; c) data from the Global PC Software Piracy study by the Business Software Alliance (BSA); and d) data from the USTR Special 301 Report.

An indicator for "intellectual property rights" was introduced in the WCY in 1997 and is measured by managers' responses to the statement "Intellectual property rights are adequately enforced". The lowest score assignable is "0" (weak or non-existent IP enforcement), and the highest is "10" (the maximum level of IP enforcement available). We use this value to proxy for perceptions of patent owners towards national patent enforcement levels. Second, an "intellectual property protection" indicator was introduced in the GCR in 1997 and it is measured by executives' responses to the statement "Intellectual property is well protected in your country". The minimum score assignable is "1", equating to weak or non-existent IP protection and the maximum is "7", equating to protection levels comparable to "the world's most stringent" (a concept not defined further). This value is used to measure perceived patent protection levels in countries. Third, the BSA publishes an annual report that estimates piracy levels and software-related revenue lost to

piracy. We employ BSA data here on the basis that software piracy rates indicate the general preparedness of consumers in a country to acquire and use products of questionable origin (Marron & Steel, 2006). These data are used to proxy for the monitoring costs arising from two elements of the patent system, namely: (i) cultural and societal attitudes towards the purchase of infringing goods, and (ii) levels of public commitment to patent protection. The scale was inverted to align it with the directionality of our other variables.

Finally, we construct a fourth indicator using the reviews of IP enforcement efforts of countries published annually by the USTR. This is used to measure the effectiveness of police enforcement and strength of border controls present in the patent system. The reviews are published annually in the "Special 301 Report". Each report offers a qualitative assessment whereby countries that are considered to offer inadequate levels of IP protection and enforcement are grouped into one of three different categories, namely: (i) "Watch List", (ii) "Priority Watch List" and (iii) "Section 306 Monitoring". Countries named in the "Watch List" are those with problematic IP protection and enforcement levels. Those placed in the "Priority Watch List" suffer from the same issues but garner greater attention from the US government because of their importance in bilateral trade (i.e. they attract more complaints from US companies requesting remedial actions by US authorities).[6] Lastly, the "Section 306 Monitoring" list includes countries previously named in the "Priority Watch List" and that the USTR is monitoring closely with the aim of actually imposing

[6] The Special 301 Report has been criticised for categorizing countries not only on the basis of their IP-related performance but also on US commercial and political grounds (Smarzynska, 2004).

trade-related and other sanctions if they do not comply with its recommendations. Additionally, some countries are not named in specific USTR categories (due to their generally acceptable IP enforcement levels) but are still mentioned in the report because they are perceived to suffer certain enforcement-related deficiencies concerning particular aspects of the IP system. This suggests that these countries offer what firms and policy-makers might regard as an acceptable level of IP protection and enforcement but that this can still be improved in some way. On the other hand, countries not named in the report are assumed to present fewer patent enforcement-related concerns. To quantify the information contained in the Special 301 Report we follow Smarzynska (2004) who assigned different values depending on the list in which a country is placed. However, we go one step further in order to positively reward those countries which are not categorized, but are mentioned in the report in addition to those not mentioned at all. Thus data are codified with values ranging from a minimum of "1" (weak patent protection and enforcement) to a maximum of "5" (strong) depending on whether a country is listed in the USTR 301 report as follows: in "Section 306 Monitoring" ('1'), in the "Priority Watch List" ('2'), in the "Watch List" ('3'), negative IP perceptions are indicated but the country is not named in an aforementioned list ('4'), the country is not named in any aforementioned list or it is mentioned as a positive example of good practice in the area of patent protection and enforcement ('5').[7]

[7] Data for each year were coded on two separate occasions by three different coders, achieving the same result.

5. International patent systems strength index: results and discussion

We now report on the new international patent systems strength index. Following the recommendations of the OECD (2008) for composite index construction, we focus on (i) the normalization of data, (ii) multivariate analysis (in order to evaluate the index scales), (iii) weighting and aggregation of the data, and (iv) linkages with other variables.

Because the data sources we employ use differing measurement scales, we first normalized all the data using a standardization technique (z-scores) to transform them into a single scale with a mean of zero (0) and a standard deviation of one (1) (OECD, 2008).[8] There were no missing values in the dataset since countries for which data were not available were omitted from our calculations. To apply the multivariate tests, and in accordance with our conceptual framework, we categorized and aggregated the data according to the transaction cost construct they were used to proxy. This led to the derivation of scales that captured the effect of each of the three transaction cost constructs. Two multivariate analysis tests are commonly reported in the index scale construction literature, namely Cronbach's coefficient alpha and factor analysis (OECD, 2008). The Cronbach's alpha test was applied to the servicing costs, property rights protection costs and monitoring costs constructs. Tests revealed strong internal consistency for each of the three constructs, with all variables scoring significantly higher or very close to the generally accepted 0.70 threshold (Hair, Anderson, Tatham & Black, 2009; Nunnally, 1978). The

[8] A variety of different normalization techniques were considered (e.g. ranking, rescaling, distance to a reference indicator/country, and so forth) but were deemed irrelevant or inapplicable to our theoretical framework.

Cronbach's alpha score for the property rights protection construct is 0.92, with a standard item alpha of 0.94. The monitoring cost construct also revealed an extremely high internal consistency with a Cronbach's alpha score of 0.87, and a standard item alpha of 0.89. The Cronbach's alpha test for the servicing cost construct also exhibited an acceptable score of 0.77, and a standardized item alpha of 0.82. Results of the Cronbach's alpha test suggest that the variables used to estimate the three constructs form reliable scales that are internally consistent.

Factor analysis was then used to discern the relationship between the different component variables of each of the constructs and to inform the application of a weighting scheme to aggregate the variables into a single numerical value for each construct. According to the OECD (2008, p. 89), a weighting scheme derived from factor analysis "intervenes only to correct for overlapping information between two or more correlated indicators, and is not a measure of the theoretical importance of the associated indicator. If no correlation between indicators is found, then weights cannot be estimated with this method". In other words, the weighting applied to construct the index does not differentiate between the importance of each factor but instead represents the highest possible variation in the indicators. Thus, "the composite (index/construct) no longer depends upon the dimensionality of the dataset but rather is based on the "statistical" dimensions of the data" (OECD, 2008, p. 89). The ordering of the variables and the weighting of each of the constructs is based on achieving high score variability (OECD, 2008). A more formal as well as general representation of the process underlying the widely used

methodological approach adopted in this study in relation to the construction of the index and composite indices can be expressed as follows:

$$Index = \sum_{i=1}^{n} X_i w_i$$

where X_I denotes the variables used in the factor analysis and w_i stands for the respective weights (variances) that have resulted from the factor analysis. As Table 2 shows, the communalities table for the monitoring cost construct revealed that all four variables are equally represented in the calculation of an aggregate index for this construct. The table of total variance explained indicates the weighting to be used to calculate the monitoring cost construct index, with the WEF IP protection variable receiving a weighting of 82%, the IMD IPR variable 10%, the BSA piracy rates variable 5%, and the USTR Special 301 Report variable 3%. Similarly, with regard to the property rights protection construct, the communalities table revealed that all four variables have a very good representation in the total scale of the construct. Findings indicated that the CPI component of this construct should receive the highest weight of 85%, with the WEF variable receiving 9%, the IMD judicial independence variable 3% and the ICRG law and order variable receiving 3%. Finally, the communalities table for the servicing costs construct also revealed an equal representation of the two component variables in each calculation. The ICRG bureaucracy variable should receive a weight of 85% and the IMD bureaucracy variable 15%.

----------Table 2 goes about here----------

The weighting scheme suggested by factor analysis was applied to the data for each of the variables within the servicing costs, property rights protection costs and monitoring costs constructs. This allowed us to calculate individual index scores that reflect the extent of transactions costs a firm is likely to experience as it engages with the patent system of a country.

The same process was then followed to construct the overall composite index of international patent systems strength. Again, this was done using reliability and factor analyses to derive a composite index comprising the three previously calculated constructs. The reliability analysis revealed a high internal consistency for the composite index, receiving a Cronbach's alpha score of 0.89, and a standardized item alpha of 0.95. The factor analysis test and the communalities table presented in Table 3 show that all factors have a very good representation in the composite index, with each having a much higher extraction score than 0.70.

----------Table 3 goes about here----------

Regarding the weighting scheme applied to the calculation of the composite index, the table of total variance explained indicates that the construct receiving the highest weight in the index is the property rights protection costs construct (accounting for 91% of the final variance), followed by the monitoring costs construct (6%), and the servicing costs construct (3%).

Average values of the new international patent systems strength index for the period 1998 to 2011 are presented for 48 countries in Table 4, with higher values (maximum of 10) indicating stronger patent systems. Table 5 presents annual values for each country across the same period. As shown

above, the new index has been proven statistically to be reliable and internally consistent. The mean score for all countries is 6.3 with a standard deviation of 2.1, suggesting that the average country measured by the composite index offers slightly higher than the medium levels of patent system strength for the 14-year period in question. The lowest mean score is 2.9 for Venezuela (with a minimum of 2.5 for 2009, 2010 and 2011, respectively) and the highest is 9.5 for Denmark and Finland (with maximum values of 9.9 for Finland in 2000 and Denmark in 1999, respectively).

----------Tables 4 and 5 go about here----------

5.1. The international patent systems strength index and GP indices compared

We now compare the scores of the new international patent systems strength index with those of the GP indices for the year 2005. Our purpose is to investigate if there are any differences between the levels of national patent system strength as quantified here and book-law patent protection reported by the GP index. If such differences are observable, this would elucidate the added explanatory value of capturing enforcement-related issues associated with the patent system of countries in the new index. In addition, we regress the new index with data on national GDP per capita to reveal if it conforms to theoretical expectations.

A simple regression between the international patent systems strength index and the GP indices shows a positive and significant relationship. The correlation coefficient between the two indices is relatively low at 0.58, with a total variance explained (R^2) value of 0.30. To better comprehend this relationship we ran a paired two samples for means t-Test which revealed that

the two indices are not identical. Results indicate that they are different in terms of their values and range. This is to be expected, both in terms of conceptualization and theory, since the new international patent systems strength index was devised to go beyond the measurement of the book-law effects of the patent system as captured by the GP indices by quantifying enforcement-related issues that arise from engaging with this system.

To investigate this relationship further, we compare diagrammatically the new index with the GP index for 2005 by transforming the latter into a 0 to 10 scale, as seen in Figure 1.[9] Substantial differences are observable between the scores of certain countries. A number of (mainly developing) countries, such as Argentina, China, India and Indonesia are scored lower by the new index than by the GP index. Whilst these countries have adapted their legal systems to include provisions for stronger patent protection (as required by the TRIPs agreement), and therefore score highly in the GP index, they remain weak in enforcing these laws as reflected in the new index (USTR, 2011). Additionally, the slightly lower values assigned by the new index to countries that score highly in the GP indices (e.g. the Netherlands) reflect certain enforcement-related deficiencies in countries with comparatively strong book-law protection. In short, divergent performances across the two indices highlight variable conditions in terms of the levels of book-law protection for patents on offer in different countries and perceptions about how efficaciously these rights are enforced in practice. This is an important finding, because it

[9] Such transformation is not appropriate statistically but is done to show visually the differences in country scores across the two indices.

demonstrates that scholars investigating the relationship between patent strength and international business activity can use either the new index or the GP indices depending on whether the focus of attention is on the book-law or the enforcement aspect of the patent system of countries. Put another way, researchers whose subject of enquiry includes the enforcement dimension will be able to apply the new international patent systems strength index, whilst those focusing on the role of the regulative book-law environment can continue to use the GP indices.

----------Figure 1 goes about here----------

5.2. The new index and GDP per capita

To investigate further the performance of certain countries in the new composite index, and to reveal if it conforms to theoretical expectations, we regressed the mean scores with the mean of national GDP per capita data for the years 1998 to 2011. Prior research indicates that higher national GDP per capita levels are closely associated with stronger patent protection levels (Gould & Gruben, 1996; Park & Ginarte, 1997; Pryor, 2006; Thompson & Rushing, 1999). This is because as incomes rise so do consumer demand for higher quality and more differentiated products on the one hand and the technological capabilities of domestic producers on the other, putting pressure on national governments to strengthen their IP system (Maskus, 2000). GDP per capita figures (at current prices) were obtained from the United Nations Statistics Division for each of the 48 countries included in the new international patent

systems strength index.[10] In line with theoretical expectations, a positive and statistically significant relationship was found between GDP per capita and the new index scores (with a correlation coefficient of 0.69 and an R^2 score of 0.58) (see Figure 2).[11] Therefore, the new index makes theoretical sense when viewed in conjunction with prior work on the relationship between the economic development of a country and patent protection levels.

----------Figure 2 goes about here----------

6. Conclusions

It has long been recognized that a host country's patent system has an important effect on the strategies and decision-taking of multinational enterprises (MNEs), not least because it shapes their ability to appropriate returns on their investments in R&D and innovation (Ghauri & Rao, 2009, Maskus, 2000; Teece, 2006). In the post-TRIPs era, the formal patent protection regimes of countries have converged as governments have sought to improve and harmonize book-law protection levels to align them to international standards and norms as part of their obligations as signatory States. However, problems associated with the enforcement of book-law in practice means that MNEs continue to experience difficulties in upholding their patent rights around the world and countering the threat of illegal imitation and infringement (USTR, 2013; OECD, 2009). Hitherto, researchers investigating the relationship

[10] With the exception of Taiwan (ROC), for which GDP per capita data were collected from the International Monetary Fund (2012) *World Economic Outlook* database.

[11] This contrasts with the correlation coefficient of the GP index which, when regressed with GDP per capita data, receives a score of 0.34 and an R^2 of 0.14. In passing it should be noted that during the estimation of the bivariate model a log-linear specification was adopted. The model was free from any problems associated with violations of the assumptions pertaining to the Classical Linear Regression model.

between patent rights and the behaviour of economic actors have generally employed the indices of Ginarte and Park (1997) and Park (2008) in empirical work. However, these indices specifically measure the book-law conditions of a country and not the enforcement dimensions of the patent system. Hence, the main theoretical and empirical contributions of this study are threefold. First is the development of a new index which extends the GP indices by capturing the important role played by the enforcement dimension of a national patent system and how this is perceived by managers. Second is the development of a conceptual framework which identifies the costs experienced by firms as they engage and interact with a national patent system. Our third contribution concerns the application of a methodology which is fully transparent, following established and reliable procedures recommended by the OECD (2008). Several important implications for research and managerial practice arise from these contributions.

6.1 Implications for research and policy-making

The new index of international patent systems strength reported here provides up-to-date information for a good mix of developing and developed countries. We expect it to be a useful tool for researchers investigating a range of contemporary international business issues and a variety of different macro-economic phenomena across a broad set of country types. Similarly, the index should be helpful to empiricists (e.g. from international economic and developmental organizations) who are looking to model and understand the policy implications of macro-economic and institution-related phenomena from a patent-related perspective. Importantly, the choice of measures is now

expanded so that researchers can employ the new index in order to proxy for the overall impact of the enforcement dimension of a national patent system, should theory necessitate it. At the same time, the new index can be used alongside the GP indices if differential effects of both the book-law and enforcement aspects of national patent systems are under investigation or are anticipated. Moreover, because we follow standard OECD (2008) guidelines for the construction of composite indicators, the new index can be replicated and extended readily, updated regularly, and applied in future research in combination with datasets constructed using the same or similar methodological approaches, should this be required.

6.2 Managerial relevance

Our study has implications for the management of the firm, especially in an international context. Firstly, we provide a framework which illustrates and highlights key aspects of patent enforcement mechanisms that managers should take into account when evaluating the patent system of countries. It is not sufficient for an assessment of the legal framework of host countries to be restricted to the state of book-law protection. This is because there is a clear contrast between levels of book-law protection on the one hand and the enforcement system (as it is perceived by managers) on the other, as the new index reveals for the majority of countries covered. In other words, when legal protection for protectable technology is readily available, adequate enforcement of these rights might not be. Secondly, and it follows, rather than simply responding to infringement issues as they arise, managers should be cognizant of, and sensitive to, the nature of local patent protection and enforcement levels

as they formulate strategies and take decisions when developing business activities abroad. Whilst it is relatively straightforward to establish the state of book-law protection, since this is codified and reported by most countries, it is much harder to determine *a priori* how well government agencies enforce these laws in practice, especially for inexperienced or under-resourced firms. Managers will be able to use the new index to identify those countries where the enforcement aspect of the patent system is liable to be problematic or to consider numerical values that may confirm or reject their preconceptions. Although such knowledge can be acquired using in-house or external legal expertise, it is nevertheless important that product and area managers also understand the implications arising from weak patent systems in countries, since this is likely to determine their ability to appropriate returns on market entry and development and, it follows, influence the costs of international expansion. In countries where patent systems are weaker, managers are likely to experience greater transaction costs as they engage with enforcement issues. For example, for R&D, technology and licensing managers, this may arise from the need to introduce or make more stringent those security systems, procedures and organizational structures implemented to mitigate the threat of technology leakage to rivals. For product and supply chain managers this may arise from the greater resources allocated to, and expended on, engaging with local organizations such as the police, customs officers, IP-specialist firms and other patent enforcement-related agencies (Hopkins, Kontnik & Turngage, 2003; Staake & Fleisch, 2010). Following the argumentation of Peng et al. (2009), managers should evaluate the role of differential patent enforcement levels

alongside an understanding of both industry-specific competitive forces and the resources and managerial capabilities of their firm when designing and implementing an international expansion and development strategy. The new international patent systems strength index provides valuable information on perceptions about variable patent enforcement levels across countries.

6.3 Limitations and future research

The limitations of our study provide pointers for future research opportunities. First, to design the new index, we incorporate those enforcement aspects of the patent system that have become increasingly relevant in the post-TRIPS era. It is foreseeable that new patent enforcement-related treaties will be negotiated and concluded by countries. These may bring to the fore additional and related factors and concerns which are not addressed by the new index. Subject to data availability, our conceptual framework and theoretical approach can be used by future researchers to identify new variables and data to develop proxies for such additional factors under the relevant transaction costs construct depicted in Table 1. This is because no matter how many aspects of the patent system are measured, their theorized effect will continue to impact upon the three types of transaction costs we consider in the new index. If the new index is to be extended, the fundamental structure underpinning its measurement remains unchanged. Secondly, and depending on data availability, a comparable methodology to ours could be followed to develop patent-related indices for specific industries or sectors. Finally, it would be interesting to revisit studies on the relationship between patent systems and international business activity

by incorporating the new index reported here to see if enforcement-related issues have a determinant effect.

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Table 1.

Transaction costs originating from the patent system and proxies used to calculate the new composite index

Cost Type	Component of the Patent System	Data and Sources
Servicing Costs	Quality of patent administration	Bureaucracy quality index (ICRG)
		"Bureaucracy does not hinder business activity" (WCY)
Property Rights Protection Costs	Judicial enforcement	"Judicial independence" (GCR)
		"Law and order" (ICRG)
		"Justice is fairly administered" (WCY)
	Level of corruption in judiciary	Corruption perceptions index (Transparency International)
Monitoring Costs	Effectiveness of police enforcement	Country listings from the Special 301 Report (United States Trade Representative) (USTR)
	Strength of border controls	
	Positive/negative perceptions of patent owners about national patent protection and enforcement levels	Intellectual property rights (WCY)
		Intellectual property protection (GCR)
	Cultural and societal attitudes towards the purchase of infringing goods	Global PC software piracy (BSA)
	Level of public commitment to patent protection	

Table 2.

Results of the "communalities table" for the monitoring, property rights protection and servicing costs constructs

Component	Communalities	
	Initial	**Extraction**
Monitoring Costs Construct		
WEF IP protection index	1.000	0.834
IMD IPR index	1.000	0.816
BSA piracy rates	1.000	0.768
USTR Special 301 Report	1.000	0.723
Property Rights Protection Costs Construct		
Corruption perceptions index	1.000	0.921
WEF Judicial independence index	1.000	0.883
IMD justice is fairly administrated index	1.000	0.867
ICRG law and order index	1.000	0.742
Servicing Costs Construct		
ICRG bureaucracy quality index	1.000	0.847
IMD bureaucracy does not hinder business activity index	1.000	0.847

Source: The authors

Table 3.

Results of the "Communalities table" for the new composite index

Component	Communalities	
	Initial	**Extraction**
Property Rights Protection Costs Index	1.000	0.940
Monitoring Costs Index	1.000	0.889
Servicing Costs Index	1.000	0.793

Source: The authors

Table 4.

International patent systems strength index scores, average values (1998 to 2011)

Argentina	3.6	Jordan	5.6
Australia	8.8	Korea (South)	5.3
Austria	8.3	Malaysia	5.5
Belgium	7.2	Mexico	4.1
Brazil	4.4	Netherlands	9.0
Canada	8.9	New Zealand	9.4
Chile	7.3	Norway	8.8
China	4.2	Philippines	3.5
Colombia	4.1	Poland	4.8
Czech Republic	5.1	Portugal	6.6
Denmark	9.5	Romania	4.0
Finland	9.5	Russia	3.1
France	7.2	Singapore	9.2
Germany	8.2	Slovakia	4.8
Greece	5.0	S. Africa	5.4
Hong Kong	8.2	Spain	6.9
Hungary	5.6	Sweden	9.3
Iceland	9.1	Switzerland	9.0
India	4.0	Taiwan (ROC)	6.1
Indonesia	3.1	Thailand	4.2
Ireland	7.9	Turkey	4.4
Israel	7.0	Ukraine	3.1
Italy	5.3	United Kingdom	8.5
Japan	7.4	Venezuela	2.9

Source: The authors

Table 5.

National patent systems strength index scores (annually for the period 1998 to 2011)

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Argentina	3.8	3.8	4.2	4.1	3.3	3.1	3.1	3.4	3.5	3.5	3.5	3.5	3.6	3.6
Australia	8.8	8.9	8.6	8.7	8.8	8.9	8.9	8.9	8.8	8.8	8.8	8.8	8.8	8.9
Austria	7.9	8.0	8.1	8.2	8.1	8.2	8.6	8.8	8.7	8.4	8.4	8.2	8.2	8.0
Belgium	5.9	5.9	6.6	7.0	7.3	7.7	7.7	7.6	7.6	7.4	7.6	7.4	7.4	7.7
Brazil	4.6	4.7	4.6	4.6	4.6	4.5	4.5	4.2	3.9	4.1	4.1	4.3	4.2	4.4
Canada	9.3	9.3	9.3	9.0	9.1	8.7	8.7	8.5	8.6	8.8	8.8	8.8	8.9	8.8
Chile	7.0	7.1	7.5	7.5	7.5	7.5	7.5	7.3	7.3	7.1	7.0	6.9	7.3	7.4
China	4.3	4.1	3.9	4.2	4.3	4.2	4.2	4.0	4.1	4.3	4.4	4.4	4.3	4.3
Colombia	3.0	3.6	3.8	4.2	4.1	4.2	4.3	4.5	4.5	4.4	4.4	4.2	4.1	4.0
Czech Republic	5.4	5.2	5.0	4.6	4.5	4.6	4.9	5.0	5.3	5.6	5.7	5.4	5.2	5.0
Denmark	9.8	9.9	9.7	9.5	9.5	9.5	9.5	9.5	9.5	9.4	9.4	9.4	9.3	9.4
Finland	9.6	9.7	9.9	9.8	9.7	9.7	9.6	9.5	9.6	9.4	9.1	9.0	9.3	9.4
France	7.1	7.1	7.1	7.2	6.6	7.2	7.4	7.7	7.6	7.6	7.3	7.2	7.2	7.3
Germany	8.2	8.3	8.0	7.8	7.7	8.0	8.4	8.4	8.3	8.1	8.2	8.2	8.2	8.2
Greece	5.4	5.4	5.5	4.9	4.9	5.0	5.0	5.0	5.1	5.2	5.3	4.5	4.3	4.2
Hong Kong	8.0	7.8	7.8	8.0	8.3	8.1	8.1	8.3	8.4	8.4	8.3	8.3	8.5	8.5
Hungary	5.6	5.9	5.8	5.9	5.5	5.4	5.4	5.5	5.7	5.8	5.6	5.6	5.2	5.2
Iceland	-	-	-	-	-	-	-	9.6	9.5	9.2	9.0	8.8	8.6	8.4
India	3.9	3.9	3.9	3.8	3.8	3.8	3.8	4.0	4.4	4.5	4.3	4.3	4.2	4.0
Indonesia	2.9	2.6	2.6	2.7	2.7	2.8	3.0	3.1	3.2	3.1	3.4	3.6	3.7	3.8
Ireland	8.4	8.0	7.6	7.9	7.4	7.8	7.8	7.8	7.8	7.9	8.0	8.3	8.2	7.9
Israel	7.5	7.3	7.1	7.9	7.6	7.5	6.9	6.8	6.6	6.7	6.5	6.6	6.7	6.4
Italy	5.2	5.3	5.2	6.0	5.7	5.7	5.2	5.4	5.3	5.6	5.3	4.8	4.5	4.6
Japan	6.4	6.6	6.9	7.4	7.3	7.2	7.3	7.6	7.9	7.8	7.6	7.9	8.0	8.2

Jordan	-	-	-	-	-	5.3	5.8	6.1	5.8	5.4	5.7	5.6	5.3	5.1
Korea (South)	4.8	4.5	4.7	4.8	5.1	5.0	5.2	5.6	5.6	5.8	6.1	5.9	5.8	5.8
Malaysia	5.9	5.6	5.3	5.4	5.5	5.8	5.7	5.8	5.7	5.8	5.7	5.2	5.1	5.1
Mexico	4.0	4.1	4.0	4.3	4.1	4.2	4.2	4.1	4.0	4.2	4.2	3.9	3.7	3.7
Netherlands	9.1	9.1	9.1	9.0	9.1	9.0	8.8	8.7	8.9	9.1	9.0	9.0	8.9	9.0
New Zealand	9.4	9.4	9.4	9.4	9.4	9.4	9.5	9.5	9.5	9.4	9.3	9.4	9.3	9.5
Norway	9.1	8.9	9.1	8.7	8.6	8.8	9.0	8.9	8.9	8.8	8.2	8.7	8.7	9.1
Philippines	4.0	4.3	3.7	3.7	3.4	3.3	3.4	3.3	3.3	3.3	3.2	3.2	3.2	3.4
Poland	5.2	4.9	4.8	4.8	4.6	4.3	4.1	4.1	4.3	4.7	5.1	5.4	5.7	5.9
Portugal	6.8	7.0	6.7	6.6	6.7	6.9	6.7	6.8	6.9	6.8	6.4	6.2	6.2	6.3
Romania	-	-	-	-	-	3.5	3.6	3.6	3.7	4.2	4.3	4.4	4.3	4.2
Russia	3.2	3.1	2.9	3.1	3.3	3.3	3.5	3.1	3.2	3.1	2.9	3.0	2.9	3.1
Singapore	9.0	9.0	9.1	9.2	9.2	9.3	9.2	9.3	9.3	9.2	9.2	9.2	9.2	9.1
Slovakia	-	-	-	4.4	4.3	4.3	4.6	4.9	5.2	5.3	5.4	5.0	4.8	4.5
S. Africa	5.7	5.5	5.6	5.4	5.5	5.1	5.4	5.2	5.3	5.7	5.5	5.3	5.1	4.9
Spain	6.5	6.9	7.3	7.3	7.2	7.0	7.2	7.1	6.9	6.8	6.7	6.3	6.3	6.4
Sweden	9.4	9.4	9.3	9.1	9.3	9.3	9.2	9.1	9.2	9.3	9.3	9.3	9.3	9.3
Switzerland	9.0	9.0	8.8	8.7	8.6	8.9	9.1	9.1	9.1	9.1	9.1	9.1	8.8	8.9
Taiwan (ROC)	5.7	6.0	5.9	6.2	5.9	6.1	6.0	6.3	6.2	6.1	6.1	6.0	6.2	6.5
Thailand	4.0	4.1	4.1	4.1	4.1	4.2	4.4	4.6	4.4	4.2	4.3	4.2	4.3	4.2
Turkey	4.2	4.3	4.5	4.3	3.9	3.8	3.9	4.2	4.5	4.7	5.1	4.9	4.8	4.7
Ukraine	-	-	-	-	-	-	-	-	-	3.4	3.2	2.9	3.1	3.0
United Kingdom	8.8	8.7	8.9	8.5	8.8	8.8	8.7	8.7	8.7	8.5	7.9	8.0	7.9	8.1
Venezuela, RB	3.0	3.3	3.3	3.4	3.0	2.8	2.9	2.9	2.8	2.6	2.5	2.5	2.5	2.5

Figure 1.

National patent systems strength index scores compared with Park (2008) for the year 2005.

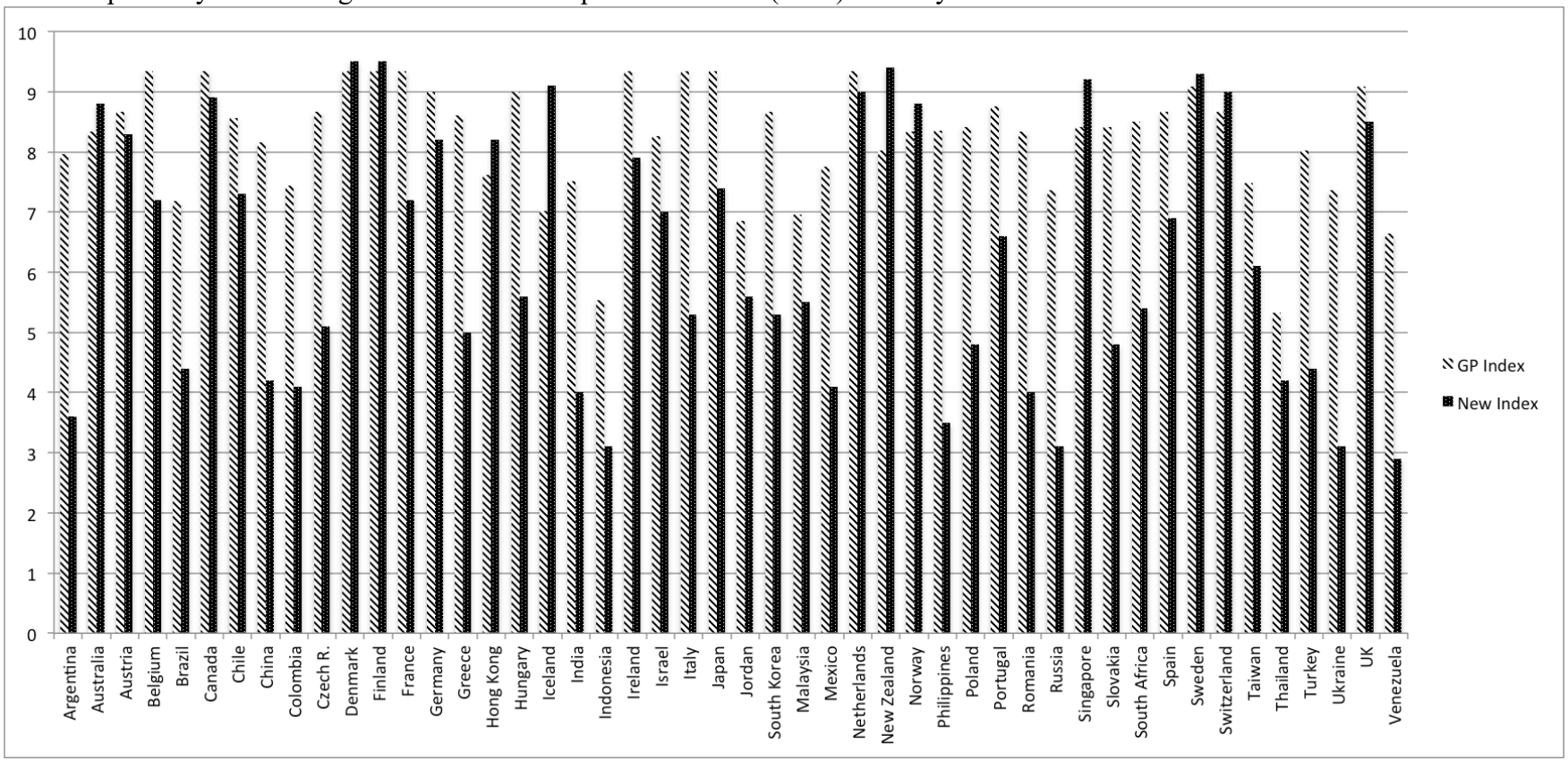
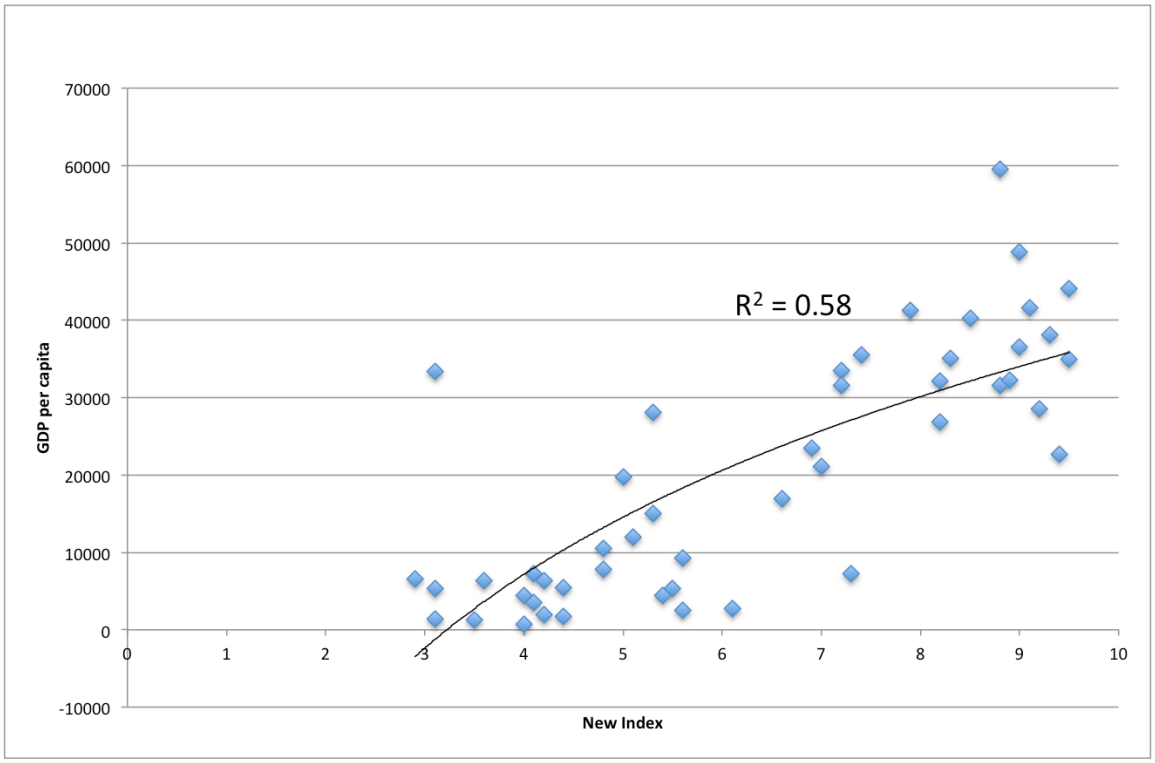


Figure 2.

Regression of the national patent systems strength scores and GDP per capita (US$)



International patent systems strength 1998-2011

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