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Integration and Divergence of Patent Systems across National and International Institutions

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Abstract

Based on a framework grounded in the institution-based view, this paper addresses the extent of global patent system integration and development. Our findings suggest that nations' patent systems have yet 'met' the 'international standards', despite national and international endeavor toward this goal. The impact of international institutions on national institutions is reflected in the process rather than the outcome. Among the three components of patent systems across 88 nations, conformity is the strongest for 'patent mechanism', operations is the most diverse for 'patent administration' and 'patent enforcement' does not form a cross-nation divide due to most nations being moderate enforcers.

Keywords

Patent; Intellectual Property; Global Patent Systems; Institution-based Views; Patent System Development

Integration and Divergence of Patent Systems across National and International Institutions

1. INTRODUCTION

The relationship between institutions and international business (IB) has gained much attention in recent years. The focus of the relationship seems to center around institutional diversity across countries, its implications for multinationals, and their business (Delios & Henisz, 2003; Chao & Kumar, 2009; a special issue was dedicated on this topic in the *Journal of International Business Studies*, volume 39, 2008). Several institutional topics associated with the patent system were also published in business journals. Examples include the role of patent system on foreign direct investment (Luo, 2001; Khoury & Peng, 2011), culture impact on patent system understanding (Yang, 2005), patent impact on industries (Ghauri & Rao, 2009) and significance of patent protection for business (McGaughey, Liesch & Poulson, 2000). We define the patent system as a nation's system to legislate patent laws (stipulating national patent policy), administer patent filing and granting (patent offices' functions) and enforce patent protection (judicial actions to resolve disputes and execute verdicts). National patent systems interact with, interrelate to and inter-depend on one another, harmonized by international patent organizations (i.e., World Intellectual Property Organization – WIPO and World Trade Organization – WTO). In short, institution-IB linkages

indicate the need for international institutions and opportunities of cross-national convergence under globalization.

International institutions, however, imply the complexity for IB that might lead to ineffective global strategy execution (Griffith, 2010). The complexity is interstate and inter-dependent: “The institutional environment is not a parameter but a rich constellation of interdependent structures and systems within a country, across dyadic pairs of countries and at the level of the international state system” (Eden, 2010, p. 175). The complexity is also associated with the relationship between national and international institutions where international organizations attempt to integrate nations with a set of standards for the purpose of efficient and effective multi-lateral business activities. International compliance of patent systems across countries is a typical example of such a complexity. Nations are required to meet the minimum standards set out by major international patent organizations as a trade-off to become a member and benefit from integrating with the rest of the world.

International institutions of patent systems are important for national institutions due to the indispensable links between patent systems and international business. First, the inabilities of countries to generate sufficient technologies for economic growth decide that a shortcut is international technology transfer through IB activities. However, nations’ desire to access foreign technology will not be realized if owners do not feel that their patent rights are protected (Bosworth & Yang, 2000). Second, exporting and

investing countries realize the importance of protecting their indigenous technology, they thus require policy guidance when considering transferring technology to unfamiliar countries (Bosworth & Yang, 2000). Third, external pressure from major developed countries has also intensified patent-IB links. A series of cross-border disputes have pressurized nations to negotiate and sign memoranda (Sherwood, 1997). Finally, patent system differences between developed and developing countries lead to intensive international intervention. As a result, the Trade-Related aspects of Intellectual Property Rights Agreement (TRIPS) signed in 1995 among WTO members establishes a direct link between patent systems and trade, and to resolve dispute across countries.

Given the patents-IB links, research seems yet to catch up with the realities of fully understanding the convergence and divergence of patent systems across borders, particularly its association with international patent system. For example, it seems unclear as to what specific role the WTO and WIPO, as international institutions, have played in national institutions, and how patent systems, as a formal institution should be understood. Theoretically, awareness of these details enables extension and specification on institutional understanding. In practice, understanding of international inventive activities, research and development, and technological advancement help inform firms of the level of patent risks associated with IB activities, allowing them to take strategic measures to minimize them (Ostergard, 2000). Our research thus intends to contribute knowledge from

this perspective by addressing two questions: (1) Have nations integrated their patent systems under the influence of international institutions? (2) How are the three components of patent systems compared and contrasted in terms of development across the world?

2. CONCEPTUAL AND THEORETICAL DEVELOPMENT

2.1. Conceptual Development

We propose a comprehensive framework (Figure 1) to examine patent system development with three components: patent mechanism, administration and enforcement. ‘Patent mechanism’ means patent laws and regulations, and their legislature to safeguard ownership rights and public interests. ‘Patent administration’ is governmental functions to examining and granting patent rights, interpreting laws, supervising patent activities and resolve disputes without going through legal proceedings. ‘Patent enforcement’ refers to judicial systems for patent dispute settlement and execution (e.g., court proceedings and special courts to handle patent cases).

< Figure 1 >

The three components are interrelated to influence how the patent system works. First, the three components are inseparable to one another. Patent mechanism is a patent policy on paper that requires patent administration to function and monitor related patent activities, meanwhile, patent enforcement needs to be in place when disputes occur. Second, the relationship lies within the national institution where countries decide how a patent system should serve the state interest and its relationship with other nations. Finally,

international patent institutions influence national systems and coordinate cross-national patent activities.

While a patent system is nation-based, it does not isolate itself from international institutions for two reasons. First, the degree of influence depends on how a nation is integrated with the rest of the world. For example, if a nation becomes a member of the WTO, it has an obligation to comply with TRIPS. A national patent system should reflect on international standards. Second, nations depend on one another. When they have strong trade ties, they desire compatible patent systems to ensure smooth bilateral business. However, how integrated or disintegrated of nations' patent systems is unclear and requires further examination (Weismann, 2010).

Both scholars and practitioners recognize the indispensable nature of the three components for patent systems, but an integrated justification and examination has yet taken place. Academically, four major pieces of work have assessed global patent systems (elaborated when formulating hypotheses), but our paper appears to be the first to examine these three components systematically. In practice, nations emphasize patent mechanism as an important legal matter, and both patent mechanism and enforcement are explicitly stipulated in international treaties, conventions and agreements. As for patent administration, though little researched, it is important to address the efficiency of granting patent rights and handling patent disputes, and enhance public awareness of government policies (Sherwood, 1997).

Patent administration is also emphasized in patent system practice.

First, WIPO requires the establishment of satisfactory patent administration in national patent strategies (WIPO, 2005) to permit “coordination of policies relating to innovation and IP asset development ... [such as] the coordination and/or consolidation of ... [IP] offices”. Second, an effective patent administration demonstrates governments’ commitment to patent activities, including incentivizing innovation. Thus, a country’s patent administration also reflects government efficiency in granting patent rights (Sherwood, 1997).

2.2. Theoretical Foundations: Institution-based View

Institutions - ‘rule of the game’ (structures & activities) - deal with humanly devised constraints for the purpose of guiding human interaction, maintaining stability and reducing uncertainty, and governing social behavior (Scott, 2001). Informal institutions are imbedded within culture (e.g., norms) and formal institutions are associated with legal and regulatory activities (Peng, Wang & Jiang, 2008), which seem to create a larger hazard to multinationals (Slangen & Beugelsdijk, 2010). Our study focuses on the latter form.

Institutions capture the complex and changing nature of environments and its relationship with organizations (Kiggundu, Jorgensen & Hafsi, 1983; Rugman & Verbeke, 1998). Institutional pressure steers strategic choice and therefore firm performance (Delios & Henisz, 2003; Hoskisson, Eden, Lau & Wright, 2000; Wright, Filatotchev, Hoskisson & Peng, 2005). The interplay of institutions and organizations leads firms to adopt institution-based strategies to overcome constraints. As a result, institution-based view impacts on firm

decisions across borders from organizational founding and failure, organizational conformity, competitive advantage, partner selection to inter-organizational relationship (Bjorkman, Fey & Park, 2007; Li & Filer, 2007; Meyer, Estrin, Bhaumik, & Peng, 2009). It should, therefore, be treated as a main and direct driver of firm behavior instead of background information (Peng, 2003).

Institution-based view attaches a particular relevance to the rule of law (Roy & Oliver, 2009). Weak rules of law increase the uncertainty of patent protection for owners and affect their legitimate returns (Delios & Henisz, 2003), thus indicating its impact on business strategy decisions. The stronger the patent protection is in a country, the higher the scale of internationalization (Allred & Park, 2007; Chung & Beamish, 2005; Luo, 2001). When it comes to R&D partnership selection, firms opt for joint venture rather than contractual agreement to protect their ownership right (Hagedoorn, Cloudt & Kranenburg, 2005) and adopt hierarchical governance when IP protection is weak (Oxley, 1999).

Literature on institution-based view suggests the importance of the patent system – the national institution on strategic behaviors and businesses and its relationship with international institution. First, patent laws are important for IB due to their impact and complexity (e.g., a lack of international standards). Thus, the convergence of integrated patent systems appears to be an IB ambition to reduce transaction costs. Second, patent systems as a national institution are pressured to comply with ‘international

standards' given the globalization trend. This is because internationally complied patent systems would aid cross-border business efficiency by reducing uncertainties, and help firms be less dependent on contractual surveillance (Walder, 1995; Gao, Murray, Kotabe, & Lu, 2010).

2.3. Hypotheses: Integration and Divergence of Global Patent Systems

2.3.1. Global Patent Integration

International institution theory emphasizes universalism, that is, to allow nations to have a shared destiny (Ruggie, 1992). This shared destiny is driven by the need of national institutions for global harmonization. That is, international institutions are in demand so that certain arising interstate sensitive issues (i.e., security, diplomatic disputes, and intellectual property) are resolved and mutual benefits can be gained (i.e., trade, foreign direct investment). IP has been on the agenda of international institutions particularly in the past two decades due to nations' intensified technology transfer (patents), cross-border business dealing (trademarks) and cultural exchanges (copyrights). Nations' call for institutionalizing certain rules helps countries toward a broad integration thus, a direction for harmonization.

International institutions of patent systems are an integral part of and a great influence on nation-based institutions. These are a 'philosophical or culture institution' (Massel, 1973, p. 673) that set a minimum standard for nations to comply with toward integration across nations. Global patent integration considers how countries have conformed to international patent mechanisms by ratifying treaties, conventions and agreements (Ferrantino,

1993). It also looks at nations' administrative efficiency in patent filing and granting (Sherwood, 1997). Moreover, it examines how nations resolve cross-border patent disputes and settlement (Ostergard, 2000). While the interrelated, interacting and interdependent relationships among nations have increased the need for global integration, countries seem to operate independently within the broad international patent system due to their different institutional background.

With efforts toward integration of international institutions, treaties, conventions and agreements are set for nations to comply. This includes the objectives and functioning of the three-component patent system in the international context. International treaties, conventions and agreements serve as 'models' to assist nations in drafting their IP laws. Of the 28 treaties, conventions and agreements, 25 are under the auspices of WIPO; among the others, TRIPS (under the WTO) aims to 'fill the gaps' in respect of judicial enforcement.

International administration allows for a single application of a patent within all (or selected) members to be made to a designated WIPO Bureau from the applicant's country. Thus, an owner can gain worldwide protection for a patent in all WIPO member states (the WTO has no administrative system to handle international filing).

Enforcement represents the major difference between these two organizations. WIPO has limited enforcement power. If two countries have a patent dispute, a WIPO tribunal may arrange a settlement. However, if one

refuses to implement the verdict, the organization has no power of control. A WTO settlement, on the contrary, is enforceable. Thus, when a member refuses to implement the verdict, the WTO can instruct the complainant to take actions (e.g., embargos or trade sanctions) against the offender.

TRIPS integrates nations' patent systems more extensively than other treaties, conventions and agreements, in four ways. First, it is the only agreement that directly links patents with trade (WTO, 1995) and production and services. Second, it is an agreement that balances stakeholder interests between rights holders' and general public (WTO, 1995, Article 7). Third, TRIPS members are obliged to implement enforcement. Judicial execution is monitored by the WTO at national and international levels. Finally, TRIPS is the most comprehensive multilateral agreement on IP because it sets minimum standards for legal mechanisms, procedures, enforcement remedies and dispute settlements (WTO, 1995, Articles 1 & 41).

Accordingly, one part of our arguments emerges based on the need of integration toward international institutions for patent systems. First, international patent system development has a long history of convergence. Since 1883, member states (now 184 members for WIPO and 153 for the WTO) have been active toward international compliance. Most member states could have met the minimum requirements set out by WIPO and the WTO to institutionalize their patent system. Second, relevant treaties, conventions and agreements in WIPO and WTO have been the set standards for patent policy and actions. Take the patent law in China for example. It was drafted on the

basis of the Paris Convention, Patent Treaty and revised according to TRIPS. Third, as a requirement of entry into the WTO, members must ratify a new entrant's eligibility. This allows members to look at bilateral relationship and the consistency of policy stipulation in patent systems. On the basis of the above discussions, we expect that

H₁: Nations' patent systems are likely to be integrated with the international patent system; that is, nations have met the minimum requirements stipulated by international organizations.

2.3.2. Divergence in Patent System Development

Functionalism of institutions emphasizes that despite the demand for integration in the international realm, states are the units of authority with distinctive national interests and transaction costs (Scholte, 2001). That is, these territory-based authorities have their own needs and wants for technology, trade, and cultural exchanges. This means that global integration among nations may receive national institution's resistance when state interest and sovereignty are compromised.

National institutions are the key for international transformation because they are the adopters, adapters and implementers for global patent system integration. National institutions stress the importance of sovereigntism to allow nations to preserve their own independence. Thus, universal jurisdiction has its limitations (Weismann, 2010): no uniformity in nations codifying international rules and regulations; hard to enforce international laws; and nations are free to ratify or not ratify the treaties, conventions and agreements.

Given the highly recognized country variations, international institutions are obliged to ensure global integration is functional, comprehensive enough to consider transaction costs and sovereign interests by setting minimum standards. To ensure functional global integration, nations focus on specific, sensitive areas of national interests, such as intellectual property. Therefore, global patent integration is the functional integration played by both national and international institutions. As a result, nations tend to have varied development in the process of implementing their patent system.

Sporadic research has recognized such development variations with four studies worth deliberation (Rapp & Rozek, 1990; Sherwood, 1997; Ginarte & Park, 1997; Ostergard, 2000). Rapp and Rozek (1990) measure the strength of patent laws in 159 countries on a zero-to-five scale (0 indicates 'no patent laws' and 5 'patent laws consistent with the minimum standard set out by the U.S. Chamber of Commerce'). This study examines patent mechanism and compares patent system differences and the impact on economic development. It also recognizes the importance of enforcement without providing any measures. Empirically, though, this study has much wider geo-coverage to examine patent systems than any other research.

Sherwood (1997) studies 18 countries' strength of IP systems, based on personal knowledge, experience and professional interviews using a score ranging between 0 and 103. The score takes account of enforcement, administration, laws, treaties and public commitment (U.S. State Department, 1989-1995). It seems to be the only prior work recognizing the strength of IP

administration by testing the transparency (public awareness of decision making), efficiency (time scale to deal with IP issues) and costs of administration.

Sherwood's findings (1997) show that patent mechanism is the highest in development, and administration the lowest. Sherwood also addresses the importance of enforcement by measuring judicial independence, ability to request court action and the rights to take civil actions. Like Rapp and Rozek (1990), however, Sherwood (1997) did not examine the performance of enforcement. Thus, it is unclear whether these enforcement measures will result in an efficient outcome of patent protection. Moreover, the separate strength of different IP laws cannot be identified, as they are all examined as a whole.

Ginarte and Park (1997) propose an index construction to study what determines patent rights using data of 110 countries from 1960 to 1990. The patent system in each country was measured using five variables - the extent of coverage, membership of international patent agreements, provisions for the loss of protection, enforcement mechanisms, and duration of protection (scaling 0-1 with one indicating the strongest protection). This research quantifies patent protection and identifies protection determinants by linking the patent indices with IB activities. It also assesses both patent mechanism and enforcement based on documentation. It appears to be the only longitudinal study to address patent system development. Finally, Ostergard (2000) argues that IP mechanism differs considerably from enforcement in

terms of development. Using trademark, copyright and patent data from 76 countries, the study shows that 60 countries demonstrate higher scores in patent mechanism than in enforcement and significant gap between the two.

In summary, prior research all recognizes that patent mechanism is an essential part of the patent system, and is the most developed component of the three. The significance of administration and enforcement as part of the patent system is recognized, but understudied empirically. Relevant findings are varied and incomplete, and reinforcing the need for further testing and validation. Prior research also shows a high focus, recognition and development of patent mechanism, relatively slow development and high recognition in enforcement, and slow development and low recognition of the significant role of patent administration.

Linking these empirical studies with the element of functionalism discussed earlier, we observe the following consistency and contradictions. Functional international institutions are the exercise of nations to align their national patent rules and regulations with international treaties, conventions and agreements. Nations demonstrate their commitment based on state environment. One important part of the international institution is, thus, to manage and coordinate states and inter-states (patent administration), and resolve conflicts (dispute resolution and patent system enforcement). However, international institutions in the form of resolving conflicts 'is historically the least frequent' due to functional considerations (Ruggie, 1992, p. 567).

Given the theory-empirics linkages, this present research would argue that international institutions as functional institutions emphasize process rather than implementation. The implementation of patent systems in line with international institutions lies in each individual state. Stipulating relevant rules and establishing administrative coordination become the priority for nations. In addition, while both patent administration and enforcement take time involvement to be effective, enforcement probably takes longer time for experienced judges and lawyers to be in place. Although patent administration requires many experienced examiners, the process of filing and granting is more administrative and coordinating, rather than resolving, as in enforcement.

To sum up, the integration of institutions is conditional of preferences and capabilities within the national strategic environment (Caporaso, 1992). Nations pursue universal goals taking account of constraints to them (e.g., costs, interdependence, and economy). “[P]robably no two ‘systems’ are exactly alike”, and commonly “... they operate within the confines of a single nation” (Massel, 1973, p. 647). Thus, “TRIPS...is a minimum standard... which allows members to provide more extensive protection of IP if they so wish. Members are left free to determine the appropriate method of implementing the provisions of the Agreement within their own legal system and practice.” (WTO, 1995). In consequence, a lack of global consensus in both policy and actions is inevitable within and among nations. Thus, ‘resolving issues’ (e.g., enforcing patent protection) becomes more intricate

than ‘coordinating matters’ among nations (e.g., procedural requirements of patent filing). On the above basis, we expect

H_{2a}: Nations are likely to be more developed in patent mechanism than in patent administration and enforcement.

H_{2b}: Nations are likely to be more developed in patent administration than in patent enforcement.

3. METHODS

3.1. Research Design

This research adopts four exploratory techniques - secondary data analysis, experience survey, focus group and two-way design (Cooper & Schindler, 2006) to ‘seek new insights; ... to assess phenomena in a new light’ (Robson, 2002, p. 59) and to clarify the suitability and feasibility of the study (Saunders, Lewis & Thornhill, 2009). Secondary data analysis leads to establishing a preliminary framework. In this process, we are able to review prior research and justify why we have examined global patent system development.

The experience survey focuses on interviewing 13 WIPO and WTO directors and their representation of global patent perspectives is evidenced. The WIPO development division organized a seminar to examine patent system measurements in 2007. In this seminar opened by a deputy director general of WIPO, four experts in the field were invited and presented their work, including the first author, who presented the preliminary framework of measuring patent systems. The deputy director general in charge of the division subsequently had a meeting with the author to discuss the importance

of establishing a new framework and directed all regional directors to collaborate. These directors are specialist policy practitioners in the field. That is, they hold directorship in charge of IP policy and development in different regions across the world (i.e., North America, South America, South and Southeast Asia, West Europe, East Europe, Africa, and Middle East).

Their representation is also shown in that all these UN experts have at least ten-year experience in IP policy and development. Our interviews with them allow us to find out their overall views on our study (three components and measurements). While they were confident that the measurements were objective; patent administration was a logical new factor; and the framework was concise, they also commented on improving relevant measures. Subsequently, the improved framework was presented to them again for further comments.

We have also used a focus group to further improve the framework. This focus group consists of six people from the IP audit division of WIPO, which conducts global scale IP audit. These auditors understand the need for a comprehensive but measurable IP framework. Thus, their input helped us further revise the patent system framework.

Finally, we have measured the research feasibility through a two-way design. One way includes conceptualization, operationalization and piloting with WIPO and WTO directors and a focus group; the other includes establishing the index and conducting statistical analysis to test whether and how the framework works.

3.2. Data Sources

This study examined all 153 WTO members, but drew its conclusions based on the analysis of 88 countries that form 58% of the population. We excluded 65 countries from the population due to non-available or incomplete dataset. Some members of developing and least developed countries are not obligated to implement the compliance of international standards until the end of their transitional years (e.g., 2016).

Our indexing data are sourced from WIPO, the WTO and national patent offices. ‘Patent mechanism’ variables are indexed based on the patent laws and regulations of nations lodged in the ‘Collection of Laws’ on the WIPO website. ‘Patent administration’ data are indexed based on country information from WIPO, WTO and national patent offices (national offices were contacted only when information was unclear). ‘Patent enforcement’ data are drawn from the “Enforcement Checklist” compiled by the WTO, and member states are required to report their enforcement progress (Council for TRIPS, 1997). Where countries have not reported to the WTO, we examine relevant data based on their laws, annual reports and other available patent information.

We should note the strengths and weaknesses of the patent data we have used. The WTO and WIPO organize data in a simple, systematic and unified manner. They are the main sources of data on the global trends of patent system development and the data are widely used by researchers and practitioners. These data are compiled based on national government reporting, and the ways of reporting data may vary across countries. For example, ‘availability of courts

to handle patent disputes' can be interpreted in two ways: a special court may be available to deal with patent disputes, or the court may handle litigations. The former can be more efficient due to cases being handled in a concentrated manner, which also helps accumulate related experience. Such variations in the raw data make it difficult for WIPO and WTO to follow a strictly standardized approach to compiling and incorporating these data; thus possibly affecting our indexing scoring.

3.3. Indexing and Measurements

Table 1 details the conceptualization and operationalization for each variable. The variable selection for each component is based on prior research and practice of two international patent organizations - WIPO and the WTO. The index scores allow the patent system of each nation to be reflected in a range between 0 and 1 for consistency and comparison. '0' indicates that a nation has made no effort to conform to an international patent standard specific to a measurement; '1' indicates that a nation has fulfilled (and may even have surpassed) the minimum standard. We conducted a principal axis component analysis to test whether the measurements clustered toward each construct.

<Table 1 >

We have examined multi-collinearity between variables in three ways and concluded its existence can be tolerated within certain thresholds (Bowerman & O'Connell, 1990; Hair *et al.*, 2009). Our results show the correlation coefficients are mostly below 0.70 with the largest value at 0.83 (see detail in Table 2; within the threshold of 0.9), VIF smaller than 5.3

(smaller than the threshold 10) and tolerance greater than 0.19 (larger than the threshold 0.1). Methodologists argue that multi-collinearity is inevitable when dummy variables are used (Hair *et al.*, 2009) and unavoidable in statistical analysis (Field, 2009). As a result, we retain all the variables and address the relations in our analysis.

<Table 2>

3.4. Analytical Methods

We test our hypotheses using two statistical methods. We first conduct a Wilcoxon signed-rank test to respond hypothesis one (question one): nations' patent systems have integrated with international patent systems. This analytical method allows us to identify the gaps between the actual and intended patent system. We, then, used an ANOVA test to address hypothesis two (addressing question two): to what extent patent system development diverges across the world.

3.5. Reliability and Validity

The reliability of this research is four-fold. First, a conceptual and operational framework was established to guide data collection and pilot study with WIPO experts. Second, we followed a protocol throughout the research process from research design, data collection procedures, data coding, analysis and interpretation. Third, we have documented the study database from the base materials (e.g., raw data and documents) to written materials (e.g., synthesis notes). Finally, reliability test yields Cronbach's alpha scores of 0.91, 0.71 and

0.72 (see Table 1), showing that our method measures what it intends to measure.

The study also demonstrates construct, internal and external validities. It uses multiple sources of evidence, including data sourced from WIPO, the WTO and national governments as well as from an experience survey and focus group interviews. A chain of evidence was established toward the construct validity, including database, citations, study protocol, face validity and operationalization with the findings validated by WIPO directors.

4. RESULTS

Table 3 reports the gaps between national and international institutions in terms of patent system development across the three components (i.e., actual and intended integration toward international standards). The non-parametric test allows us to compare the three pairs of means. If countries fully complied with the international patent standards, the scores across countries for different variables would be 1. The Wilcoxon signed-rank test, however, indicates all the comparative factors show significant differences ($p < 0.000$) between intended and actual integration levels, and effect sizes for all the comparative factors show above the 0.05 levels.

<Table 3>

The results of negative ranks show a large gap between international patent system and national patent systems, implying global patent integration has not taken place. Meanwhile, the effect size for the three components suggests that international efforts toward global patent integration have had

significant effect on member states. The development of patent mechanism shows an effect size at 0.92 followed by patent administration at 0.87 and patent enforcement at 0.85. The results indicate that the development is apparently visible among countries to introduce new patent laws and organize training for patent officials. To establish a new patent system, for example, countries have spent at least U.S.\$1.5 million (Maskus, 2000) to guarantee that the patent office functions, human powers are available, and judicial system is in place for patent activities.

In summary, our findings refute H_1 . We conclude that nations' patent systems are not integrated with the international patent systems. Nations have not met the minimum requirements stipulated by international organizations. However, international organizations' effort on integrating nations is highly recognized in the process rather than in the outcome, and patent systems across the world remain nation-based.

Table 4 shows the varied patent system development between the three components and across the countries. Post hoc testing indicates that all the constructs have different population means based on the 88-country sample analysis (i.e., the findings based on the sample represent those based on the population). In terms of the extent of development, it is apparent that patent mechanism is more advanced than the other two components and enforcement has made the slowest progress.

<Table 4>

The results support hypotheses 2a and 2b. As argued in H_{2a} , nations are

more likely to be more developed in patent mechanism than in the other two areas of patent system; H_{2b} : nations are likely to be more developed in patent administration than in patent enforcement. The results are in line with the finding relevant to H_1 that international efforts toward global patent integration have had significant effect on member states. This is not only reflected in treaties, agreements and conventions becoming the ‘templates’ of legislation, but more importantly is evidenced in the active involvement of WIPO and the WTO in training human resources, and creating opportunities for nations to exchange views and experience. The results suggest strengthened patent administration across countries over the past years.

Different from patent administration, patent enforcement appears to be culture-bound. Each nation’s patent enforcement is embedded within its own legal system. It requires resources (particularly time and human power) to accumulate experience (e.g., antecedents, skilled lawyers and judges). Given most WTO members are developing countries, time factor to enforce patent systems plays an important role.

The relative frequency of the mean scores further demonstrates the varied development across the three areas of patent systems and across countries (Figure 2). The sample skews heavily toward the upper end of the scale for patent mechanism (0.91-1), indicating nearly 90% of the nations have mechanism compliance in place. For patent administration, the distribution spreads relatively evenly from 0.61 to 1, suggesting that nations have made efforts toward the development, though in a diverse manner. The distance

toward one another is relatively comparable, and further commitment is required from governments in this area. As for patent enforcement, the sample largely scatters between 0.51 and 0.7, indicating larger distance between international and national institutions. Such variations also demonstrate that most countries are moderate enforcers of patent rights, and have considerable room for improvement.

< *Figure 2* >

5. DISCUSSIONS AND CONCLUSIONS

5.1. Findings in Comparison to Prior Research

This paper examines the integration and divergence of patent systems between national and international institutions with two questions addressed: (1) Have nations integrated their patent systems development under the influence of international institutions? (2) How are the three components of the patent systems compared and contrasted in terms of development across nations?

Based on the study of 88 members screened from the WTO membership, our findings show that the patent system is yet to be integrated across the world. It refutes hypothesis 1 and asserts that nations remain different in their own institutions. The result is in line with Massel (1973) that despite the efforts by national and international institutions over the past years, there has been no impact on the outcome of integration. Our evidence shows that international institutions have had strong influence on global integration, particularly in the development of patent mechanism (with effect size at 0.92, 0.85 for enforcement, 0.87 for administration). The findings disconfirm prior

research (Bosworth, 1980; Ferrantino, 1993; Ginarte & Park, 1997; Sherwood, 1997) that ratifying treaties, conventions and agreements represents nations' integration with the rest of the world. This variable was insignificant in influencing integration at the factorial analysis stage. One possible explanation, in line with Deardorff (1992), is that countries are unlikely to have similar demands for patent protection due to their different expectations for invented goods. Different behaviors toward patent administration and enforcement yield different results. The other explanation is associated with TRIPS' dominant role. Over the past decade, it appears that TRIPS has become more important a gauging factor for patent integration than any other treaties, conventions, and agreements; thus rendering irrelevant the number of ratifications. This result allows us to confirm that international institutions have strong impact on the process of integration by nations.

Regarding question 2, our findings also show that the three components of patent systems do not advance in equal stance and there have been different degrees of development across countries resulting in our support for H2_a and H2_b. Patent mechanism takes a center stage of development for most countries (90% of the countries examined have established TRIPS-based patent mechanism), indicating greater effort toward global integration than patent administration. The findings show that patent administration is diversely operational across countries, but still on average, more advanced development than enforcement (most countries are moderate enforcers). These findings corroborate prior research that countries' patent mechanism tends to be the

most developed (Ostergard, 2000; Sherwood, 1997). Our results also confirm that nations are more developed in patent administration than in patent enforcement. This finding aligns with our logical argument and prior work by Ostergard (2000) that enforcement is difficult to implement and takes time to evolve due to the need for accumulating knowledge and experience.

The findings confirm prior research that enforcement is a factor to consider for improvement across nations, but taking prior research further, this study compares and contrasts these three components and identifies the degree of development. In particular, our findings clarify that the difference across countries in patent administration lies in nations' way of operations. Patent enforcement does not form a significant cross-country divide due to most countries being moderate enforcers, but a wide gap of national-international institutions. This result contests Sherwood (1997) that patent administration is the weakest and the contradiction is probably due to Sherwood's study having a small sample and different timeline of examination. Nowadays, countries are more active in establishing new patent administration, as evidenced by the increasing number of countries setting up patent offices.

5.2. Managerial Relevance

Our findings provide policy makers with implications for IB practice. They set a general direction of policy development for national and international patent organizations. Global comparison enables international organizations to examine in which areas (mechanism, administration or enforcement)

improvements should be so that they can effectively support countries to develop nation-based patent systems. National organizations can use the framework to examine their country's performance in comparison to others, thus helping them set strategic patent policy targets. This pragmatic approach is proposed based on the reality that nations tend to use 'model' countries as inspirations (e.g., U.S. for China; South Africa for African countries).

This research has also provided managerial implications from IB perspectives. First, managers may assess the factors proposed in the framework between home and host countries to identify gaps of patent systems and formulate strategies of defense and prevention for patent protection in the host country environment. For instance, if a comparative analysis reveals that the host country has no criminal proceedings to deal with counterfeiting, it would send a signal to managers that penalty is not severe enough to eradicate counterfeiters. The manager will thus have to consider whether and how to allocate resources to protect patents at the corporate level and to collaborate with government organizations to safeguard corporate interests. Second, through a comparative analysis of home and host country patent systems, companies can link findings with corporate knowledge and experience to assess the feasibility of strategic options for cross-border patent activities. For example, by comparing the patent system at home and host countries, managers are able to detect how different the legislation is and how fast a patent can be granted. Accordingly, they are able to decide what resources they should allocate for patent granting, thus, controlling the timing

of patent commercialization. This is crucial given most commercialization takes place at around patent granting time (Gans, Hsu & Stern, 2007). Third, this framework will help managers identify the strengths and weaknesses of patent system development in a host country, thus leveraging costs and benefits of strategic options. That is, they will be able to, decide whether they should opt for arm's length licensing or total control over the ownership to maximize patent value based on the assessment of the host country's patent system environment.

5.3. Contributions

This study advances knowledge in two-fold by establishing a comprehensive framework to assess patent systems across countries. First, it enriches understanding toward the institutional theory from the perspective of a formal institution - patent systems. It confirms that the integral and influential nature of international institutions on national institutions is in the effort and process rather than the actual outcome of integration; and global integration is more an option and prospect rather than an obligation due to the nation-based nature of patent systems. As a consequence, nations may take proactive or reactive approaches to comply with international institutions based on their needs and interests. The study consolidates the foundations of institution-based view that nations' formal institutions form constraints for global patent integration.

Second, it extends prior research to clarify the different degree of development across the three areas of patent system. This enriches the theoretical understanding of international institutions being functional in the

interests of nations. We are able to understand that patent mechanism is in place for member states. Patent administration across countries is operationally diverse and requires coordination. Patent enforcement across nations is consistently moderate, and there is large room for improvement.

Our empirical contribution is reflected in our effort to examine all the WTO members and use the WIPO and WTO international patent institutions to gauge nations' patent system development. This appears to be the first effort to systematically use WIPO and WTO standards to measure patent systems, and thus aligns with the world trend toward global patent system 'benchmarking'. This contribution thus highlights the interconnected nature of national and international institutions and emphasizes the inadequacy of only considering national environments as institutions. Such contributions advance prior research that adopted the developed countries' patent institutions to examine developing countries' progress. While we should acknowledge the impact of major developed nations on the formation of international patent institutions, international patent institutions have become relevant with the intensive involvement of developing countries in recent years. Although our final sample only includes 88 members, we have examined the entire population of the WTO membership and only selected nations with complete datasets. The study, thus, is a starting point to examine the impact of international patent institutions on national institutions.

We make methodological contribution by proposing and exploring a comprehensive framework for global patent systems to aid our understanding

as to how international and national patent systems integrate and diverge. The introduction of the three-component examination of patent systems asserts the role of patent laws, but more importantly confirms the significance of enforcement and governmental administration of patents. Moreover, our framework allows decomposable patent system development measurements. This feature progresses prior research because it allows researchers and practitioners to focus on specific patent system development components according to their needs. For example, given China is constantly criticized for having weak enforcement, the Chinese government and interested researchers may examine the specific areas that can be improved to shake off the ‘weak enforcer’ image. Moreover, our sample includes some emerging economies (e.g., BRIC and Eastern Europe); thus enriching prior research setting and making these dynamic economies represented in the study.

5.4. Limitations and Further Research

This study has weaknesses to overcome through future research. First, further investigation is both feasible and necessary to confirm our integrated framework. With time, more members are obliged to conform to TRIPS, richer data will become available for further analysis. Second, there are gaps in statute and practice particularly for the enforcement component. Our indices were scored based on country enforcement reports, but it is unclear whether these reports entirely reflect actual practices. Future research can survey practitioners associated with patent system development and find out whether external survey scores correlate with our scores.

Third, patent system development is nation-based, and countries continue to differ no matter how great their efforts are toward integration with international standards. This individuality means that nation-based cases need to be incorporated. For example, studies of countries like the UK, Germany, U.S, China, India and Brazil will provide readers with an understanding of the challenges and opportunities in a comparative manner. Finally, the changing nature of patent system development dictates the need for serializing data. With longitudinal data being accumulated, rich resources will be available to investigate the degree of integration and divergence, thus predicting development trends and enriching patent-related IB research and practice.

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Table 1: Conceptualization and Operationalization – Patent Mechanism, Administration and Enforcement

Component & Variable	Conceptual Justification	Operational Delineation
Mechanism (= 0.91) 1. Product & Process Inventions 2. Novelty, Inventiveness & Utility 3. Rights Conferred for Product Patents 4. Rights Conferred for Process Patents 5. Rights Conferred for Transactions 6. Patent Protection Duration	Countries must protect product and process inventions in the law Three conditions for patentability set out by WIPO and the WTO Countries must stipulate exclusive rights to prevent third parties without owner consent from making, using, offering for sale, selling, or importing patented product inventions Countries must stipulate exclusive rights to prevent third parties without owner consent from using, offering for sale, selling, or importing patented process inventions The owners should have the right to assign, or transfer by succession, the patent and to conclude licensing contracts Members should stipulate that the duration of patent protection is 20 years upon filing	Both inventions: 1; one missing: deduct 0.5; no protection: 0 Full patentability: 1; one missing: deduct 0.333; no patentability: 0 Complete stipulation: 1; one missing: deduct 0.20; no stipulation: 0 Complete stipulation: 1; one missing: deduct 0.25; no stipulation: 0 Complete stipulation: 1; One missing: deduct 0.333; no stipulation: 0 20-year: 1; each missing year, reduce 0.05; no protection: 0
Administration (= 0.71) 7. Transparency 8. Frequency of Patent Law Revision 9. Timescale to Grant Patents 10. Patent Educational Institutions 11. Non-Patent Stipulations 12. Non-Infringement Stipulations 13. Compulsory Licensing	Patent law in English and in native language is available online and this demonstrates equal treatment to foreign and local inventors Revisions of patent laws since 1995 demonstrate government efforts to improve patent mechanisms based on TRIPS standards The speed of granting shows government efficiency in disseminating knowledge, helps owners focus on inventive exploitation & minimize anxiety while the patent is pending; IP education reflects the IP awareness of the general public, or the potential to have such awareness; Both help intensify demand for IP protection Members are required to set exceptions and limitations in line with each nation's tradition and interests. This includes stipulations as to what is excluded for patenting grants Nations are required to stipulate what is considered non-infringement Nations should stipulate compulsory licensing to enforce non-voluntary technology transfer	Full availability: 1; law in one language: 0.5; no law: 0 Revision takes place after 1995 (inc. 1995): 1; no revision: 0 Timescale clearly indicated: 1; no stipulation: 0 Education Institution Available: 1; Unavailable: 0 Exceptions and limitations are stipulated: 1; only exceptions or limitations: 0.50; no stipulations: 0 Non-infringements stipulations are listed: 1; Otherwise: 0 Compulsory licensing provision stipulated: 1; No: 0
Enforcement (= 0.70) 14. Judicial Review of Patent Application 15. Civil Judicial Procedures & Remedies 16. Administrative Procedures & Remedies 17. Provisional Judicial Measures 18. Provisional Administrative Measures 19. Border Measures 20. Criminal Procedure 21. Court Available for Disputes	Judicial review of patent applications (e.g., rejected application by the patent office) should be available Court functions, evidence presentation, remedies for damage, compensation for wrong enjoinders, and costs and timeframe for implementation are available The administrative functions, evidence presentation, remedies for damage, compensation for wrong enjoinders and costs and timeframe for implementation are available Authorize provisional judicial measures to prevent infringements and preserve their evidence, including the length of time and costs involved and indemnification of injuries Authorize provisional administrative measures to prevent infringements and preserve evidence, including the length of time and costs involved and indemnification of injuries Allow owners to apply to Customs to suspend pirated product import with valid evidence Have jurisdiction over criminal offences, and criminal procedures and penalties for infringements Nations are required to report their court support for patent to the WTO and WIPO; Courts should be available to handle patent related disputes	If applicants are given rights to appeal judicially for their rejected patent application: 1; otherwise: 0. Complete functions: 1; one missing: deduct 0.2; no functions: 0 Complete function: 1; one missing: deduct 0.2; no function: 0 Complete function: 1; one missing: deduct 0.2; no function: 0 Complete function: 1; one missing: deduct 0.2; no function: 0 Yes: 1; No: 0. Complete criminal procedure: 1; one missing: deduct 0.3333; no function: 0 Patent disputes resolution court available: 1; otherwise: 0

Notes: The above variables are selected based mainly on WIPO and WTO stipulations. The reliability of the measurements is justified on two counts. Firstly, the internal consistency shows that all variables lump together in a reliable manner toward the three main factors resulting in Cronbach's Alpha () at 0.91, 0.71 and 0.70 respectively. Secondly, we have consulted experts within WIPO regarding the variable selection and relevance. This inter-rater approach allows us to finalize the framework based on their comments, and to have an assurance from them about the consistency of the framework.

Table 2: Descriptive Statistics and Correlations

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Product & Process Inventions	0.97	0.17	1.00																			
2. Novelty, Inventiveness & Utility	0.95	0.18	.81***	1.00																		
3. Rights Conferred for Product Inventions	0.93	0.23	.61***	.50***	1.00																	
4. Rights Conferred for Process Inventions	0.92	0.26	.66***	.49***	.83***	1.00																
5. Rights Conferred for Transactions	0.93	0.20	.76***	.60***	.56***	.56***	1.00															
6. Patent Protection Duration	0.96	0.20	.67***	.59***	.56***	.72***	.58***	1.00														
7. Transparency	0.64	0.39	0.14	0.17	0.15	0.14	.24 ⁺	.28**	1.00													
8. Frequency of Revision	0.58	0.50	.22 ⁺	0.15	0.14	0.14	.24 ⁺	0.16	.42***	1.00												
9. Timescale to Grant Patents	0.82	0.37	.29**	.27 ⁺	.32**	.39***	.49***	.40***	0.18	0.06	1.00											
10. Educational Institutions for IP	0.77	0.42	.23 ⁺	.30**	0.14	0.09	.21 ⁺	0.15	.30**	.30**	0.14	1.00										
11. Non-patentable Stipulations	0.92	0.27	.51***	.49***	.40***	.36**	.49***	.36**	.26 ⁺	0.19	.31**	.33**	1.00									
12. Non-infringement Stipulations	0.78	0.40	.29**	.32**	.32**	.39***	.31**	.39***	.21 ⁺	0.16	.43***	0.03	.21 ⁺	1.00								
13. Compulsory Licensing Provisions	0.82	0.35	.40***	.54***	0.16	0.18	.31**	.22 ⁺	0.06	0.16	0.17	.32**	.48***	.26 ⁺	1.00							
14. Judicial Review of Patent Application	0.92	0.28	.45***	.46***	.31**	.26 ⁺	.31**	.35**	0.12	.24 ⁺	.30**	.22 ⁺	.36**	0.14	.32**	1.00						
15. Civil and Judicial Procedures & Remedies	0.79	0.14	.54***	.57***	.34**	.32**	.44***	.46***	0.19	0.07	0.15	.39***	.47***	.28**	.28**	.32**	1.00					
16. Administrative Procedures & Remedies	0.28	0.44	0.03	0.12	0.16	0.12	0.11	0.15	0.14	-0.04	0.10	0.14	0.08	-0.05	0.02	0.20	0.18	1.00				
17. Provisional Judicial Measures	0.77	0.17	.31**	.25 ⁺	.21 ⁺	0.13	.25 ⁺	0.20	0.18	0.01	0.02	0.14	0.18	0.04	0.12	0.12	.40***	0.14	1.00			
18. Provisional Administrative Measures	0.19	0.36	0.09	0.14	0.15	0.15	0.10	0.12	0.10	0.01	0.15	0.13	0.04	0.00	0.02	0.16	0.06	.65***	0.15	1.00		
19. Border Measures	0.53	0.28	.27 ⁺	.22 ⁺	.32**	.33**	.36**	.25 ⁺	.25 ⁺	.22 ⁺	.31**	.21 ⁺	.31**	0.19	0.03	.25 ⁺	.32**	0.14	.37**	.22 ⁺	1.00	
20. Criminal Procedure	0.74	0.22	.22 ⁺	0.18	.23 ⁺	0.19	0.13	0.18	0.05	-0.07	0.01	0.07	.32**	0.01	0.04	0.07	.41***	0.15	0.20	0.15	.25 ⁺	1.00
21. Court Available for Disputes	0.91	0.29	0.18	0.13	0.18	0.13	0.15	0.13	0.12	-0.03	-0.04	0.11	0.19	-0.03	-0.05	0.05	.27 ⁺	0.12	.29**	0.16	0.19	.38***

Significance level at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Table 3: Degree of Global Patent Integration

Comparing Factors	Ranks	Observation	Mean Rank	Sum of Ranks	Test Statistics⁽²⁾	Effect Size
Patent Mechanism- Actual and Intended	Negative Ranks	88 ^a	44.50	3916.00	-8.583 (.000)	-0.915
	Positive Ranks	0 ^b	.00	.00		
	Ties	0 ^c				
	Total	88				
Patent Administration - Actual and Intended	Negative Ranks	88 ^a	44.50	3916.00	-8.157(.000)	-0.870
	Positive Ranks	0 ^b	.00	.00		
	Ties	0 ^c				
	Total	88				
Patent Enforcement - Actual and Intended	Negative Ranks	88 ^a	44.50	3916.00	-8.006 (.000)	-0.852
	Positive Ranks	0 ^b	.00	.00		
	Ties	0 ^c				
	Total	88				

Notes:

- (1) a: Actual < Intended; b: Actual > Intended; c: Actual = Intended (full compliance with international standard);
- (2) The Wilcoxon signed-rank test shows the Z score based on positive ranks for each comparison and significance in bracket.

Table 4: Multiple Comparison Using ANOVA Randomized Block Design

Between-Subjects Effects						
Source	Sum of Squares	DF	Mean Square	<i>F</i>	<i>P</i>	
Model	171.216 ⁽¹⁾	90	1.902	95.253	.000	
Constructs	4.024	2	2.012	100.746	.000	
Countries	5.638	87	.065	3.245	.000	
Error	3.475	174	.020			
Total	174.691	264				
Multiple Comparisons						
Factors ⁽²⁾		Mean Difference	S.E.	<i>p</i>	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.182	.0213	.000	.130	.231
	3	.302	.0213	.000	.250	.351
2	1	-.182	.0213	.000	-.231	-.130
	3	.120	.0213	.000	.070	.171
3	1	-.302	.0213	.000	-.351	-.250
	2	-.120	.0213	.000	-.171	-.070

Notes:

- (1) $R^2 = .980$ (Adjusted $R^2 = .970$)
- (2) 1 = Patent Mechanism (mean = 0.943); 2 = Patent Administration (mean = 0.761); 3 = Patent Enforcement (mean = 0.641)

Figure 1: Conceptual Framework – Patent Systems within Institutions

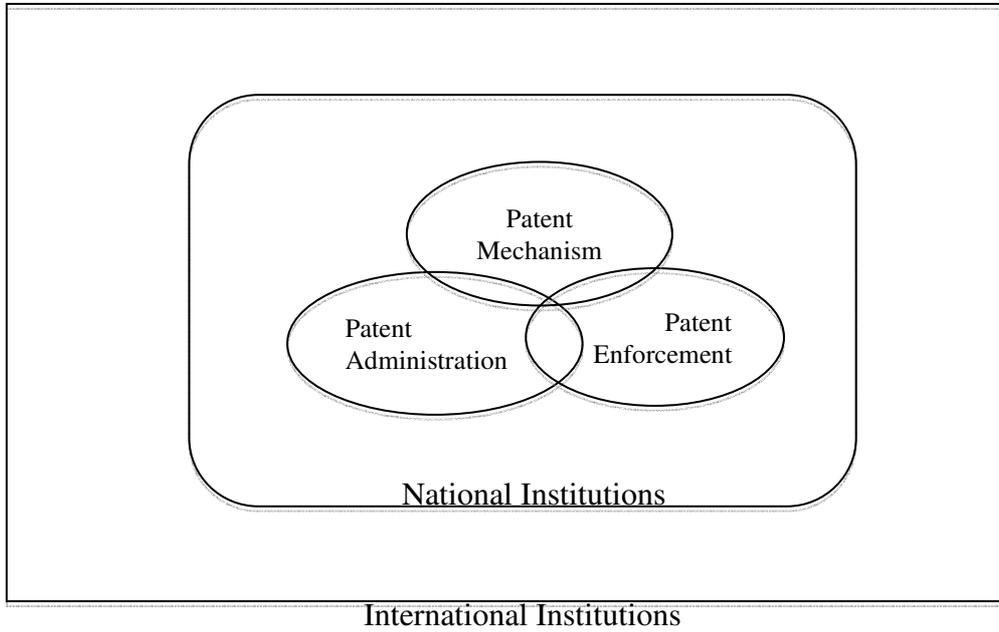


Figure 2: Relative Frequency of Patent Mechanisms, Administration and Enforcement (n = 88)

