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Patent System Measurements: Review, Critique and Proposal

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This paper reviews and critiques existing literature on means of patent system measurement across countries and accordingly proposes an integrated framework to advance this under-studied area by considering the impact of international organizations. The literature review reveals that studies have been conducted to measure patent systems across the world in diversely conceptual, empirical and methodological manners. The paper discusses all these differences and reveals their strengths and weaknesses. The proposed conceptual framework consists of three components: patent mechanism (e.g. patent laws), patent administration (e.g. patent filing and grant) and patent enforcement (e.g. judicial dispute resolution). The initial testing of this framework seems to show valid results and paves the way for further examination. This paper makes two main contributions: establishing a comprehensive framework to allow cross-country comparisons by firms and policy makers, and helping an effective process of patent commercialization through a critical understanding of strategic patent environment, thus allowing strategic decisions to be made to generate value from patents.

Keywords: Patent, innovation, patent system measurement, strategic patent environment, literature review

It is widely recognized that innovation, patents and patent systems affect one another and influence patent utilization. One of the measures of innovation is through the analysis of patents. This measure provides a more comprehensive comparison (country, industry, technology and firm) than other measures (e.g., R&D, survey, product announcements, and expert judgment).¹ Therefore, an effective patent system or an effective way of assessing the system can help firms understand the strengths and weaknesses of the patent environment, technological capability,² and make decisions as to country choice and strategic actions to overcome any patent related issue. Here the patent system is defined in a broad sense: the nation-based system of patent mechanism, administration and enforcement with international treaties, agreements and conventions as the benchmark to ensure interrelated, interacting and interdependent relationships among nations being considered for the purpose of integration with the rest of the world. Given the increasing trend of global integration, patent system harmonization across countries becomes a priority.³

This paper therefore has two objectives. One is to review and critique existing studies on patent system measurements. The other is to propose an integrated framework for future studies. Through the results of

this study, the author attempts to provide insights for managerial decision making and policy making, and directions for future research in this under-studied field.

It is argued that patent system measurements require scholarly attention on the following grounds. Firstly, existing research reveals the need for advancing this field to respond to the call of rising technology transfer across borders. Prior research shows that four major studies have directly measured patent systems in the global context, but have adopted diverse approaches to execute the measures conceptually, empirically and methodologically.⁴ Also, these studies were conducted mostly in the early 1990s. The divergence of measurements and dated data make cross-country comparison impossible. Secondly, the role of international patent organizations needs to be addressed in the measurement. Existing studies have not taken into account the impact of international patent organizations (e.g. World Trade Organization and World Intellectual Property Organization) apart from the membership counts for treaties, conventions and agreements.⁵ Nonetheless, these organizations have played a vital role in accelerating cross-country patent system harmonization. That is, international 'standards' for patents are set within these treaties, conventions and agreements, but they have not been accounted for. Thirdly, this is also a response to the urgent need for promoting a positive patent environment for commercialization. Technology commercialization

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which has been cited to be 'the least developed of the issues involved in innovation management...' is in urgent need of further development, from both theory and measurement viewpoints.⁶ Understanding of international inventive activities, research and development, and technological advancement help inform firms of the level of patent risks associated with

international business, allowing them to take strategic measures to minimize them.⁷

Existing Studies on Patent System Measurements

Sporadic research has been conducted on patent measurements with four major studies worth deliberation. Table 1 shows a list of works that

Table 1—Literature review on patent system studies and measurements

Study	Measurement	Sample size/ Time	Variables	Strengths	Weaknesses
Bosworth (1980)	Patent laws	50 countries/ 1974	1 Patent life 2 Time of application or grant 3 Novelty examination 4 Length before revocation 5 Compulsory licensing 6 Ratification of Lisbon Amendment	Explains variations in transferring US technology abroad	1 Dummy variables derived with difficulty in comparison 2 No enforcement measure 3 No administration measure
Rapp and Rozek (1990)	Patent laws	159 countries/ 1980s	0 No IP laws 1 Inadequate IP laws and no law curtailing piracy 2 Seriously flawed laws 3 Flaws in laws, but some enforcement 4 Generally good laws 5 Protection and enforcement consistent with US	1 Measure IP strength globally 2 Recognize enforcement	1 No real enforcement measurement 2 Vague conceptual boundaries
Ferrantino (1993)	IPI	77 countries/ 1980s	1 Paris Convention 2 Berne Convention 3 Membership of three Conventions 4 Duration of patent	Measuring IPI	1 IPI is only part of IPS 2 Dummy variables derived with difficulty in comparison
Mansfield (1994)	Practitioners' view on IP	180 US firms in 14 countries/ 1994	IP effect on technology transfer, FDI and licensing	Link IP with IB	1 Subjective 2 Difficult to replicate
Seyoum (1996)	Practitioners' view on IP	27 countries/ 1975-1990	Patents, copyrights, trademarks and trade secrets	Measure IP laws separately	Vague conceptual boundaries
Sherwood (1997)	Practitioners' view on IP	18 countries/ 1994-1996	1 Enforcement (25) 2 Administration (10) 3 Laws (59) 4 Treaties (6) 5 Public commitment (3) =103 points	1 Comprehensive constructs 2 Measure five laws 3 Recognize enforcement 4 Recognize administration	1 Crude and arbitrary data 2 Five laws cannot be separately measured 3 No actual measurement of enforcement 4 Researcher experience-bound and interviewee based subjectivity
Ginarte and Park (1997)	Patent laws	110 countries/ 1960-1990	1 Industrial coverage 2 Membership of international agreement 3 Provisions for loss of protection 4 Enforcement mechanisms 5 Duration of protection	1 Measure changes 2 Clear conceptual boundaries 3 Identify determinants of patent protection	1 Some measures are outdated 2 Dummy variables derived difficulty in comparison 3 No actual measurement of enforcement
Ostergard (2000)	IP laws & enforcement	76 countries/ 1994	1 Patent laws 2 Trademark laws 3 Copyright laws 4 Enforcement based on US standard	1 Examine three types of IP laws 2 Evaluate enforcement 3 Replicable study with less subjectivity than early research	1 Different IP laws are measured 2 Results can be decomposed

have measured patent systems, or more broadly intellectual property (IP) systems of which four are highlighted. Some works in the table are not discussed in detail either because the work focuses on membership count only,⁸ or is based on interviews.⁹ This section mainly concentrates on four studies for at least one of the reasons: comprehensiveness in geo-coverage,⁹ measurement coverage,¹⁰ longitudinal study,¹¹ enforcement measurement and separation of patent from other IP laws.⁷

Rapp and Rozek¹² used patent laws as a proxy to examine the cost and benefit of IP protection (IPP) for developing countries with a focus on the pharmaceutical industry in the late 1980s. Their study used a 0-5 scale to measure the strength of IP laws [0 indicating no IP laws; 5 indicating protection and enforcement consistent with the minimum standard set out by the US Chamber of Commerce (USCC)]. The findings showed that economic development and IP level were closely correlated. That is, strong IPP boosts economic growth with innovation and investment while inadequate IPP impedes economic development. However, IPP was also found to impact pricing, regulation, and investment recovery, and hurt the local industry when foreign owners monopolized a particular business due to their advantage in patented products and licensing clauses. This paper appears to be the first study to measure IP systems globally and probably the most comprehensive piece in terms of geo-coverage (159 countries).

Nonetheless, Rapp and Rozek recognized and measured only legal stipulations, not administration and enforcement of IP. For example, although they recognized the importance of enforcement, they did not include it as an actual measurement due to the difficulties of quantifying enforcement and the subjectivity of measuring it. Moreover, validity concerns arise due to vague boundaries between measures (e.g. the boundary between 'seriously flawed laws' and 'flaws in laws, but some enforcement'). However, this could perhaps be overcome by clarifying the operationalization of each measure to minimize subjectivity.

Sherwood¹⁰ measured the IP system using a combination of personal knowledge, experience and professional interviews with local attorneys. The study revealed the effectiveness of IP systems across 18 countries, mostly from Latin America. Basically, the author graded a country's IP system up to 103 points based on the assessment of enforcement,

administration, laws, treaties and public commitment. In this process, the USCC guideline was the minimum standard to benchmark. The study seems to be the most comprehensive in measurement and considers legal, administrative and judicial aspects of IP with different weighting to reflect the varied degree of importance in the chosen components. This is probably the only study emphasizing the importance of IP administration because it measured transparency, efficiency of administrative protection (speed of granting an IP right, and administrative efficiency to resolve disputes) and costs of administration all of which demonstrate government commitment.

Sherwood argued that the reduction of costs in administration was an indication of administrative efficiency by eliminating unnecessary steps. This argument is opposed to Landes and Posner,¹³ who believed that the rise of processing fees for IPP is an indicator of IP development. They cited government expenditure in the US for copyright, trademark, and patents and showed that the costs increased over 7 per cent, 13 per cent and 34 per cent respectively for copyrights, patents and trademarks. Nonetheless, both arguments are challenged on the ground that the fall or rise of administration does not reflect government efficiency, as the amount of spending can be dependent on many factors related to IP activities.

Like Rapp and Rozek, Sherwood's results allow country comparison and benchmarking. However, Sherwood admitted his study as 'crude and arbitrary', generating subjective data, thus difficult to replicate (e.g. transparency and non-feasibility can be difficult to measure on a global scale). In addition, the focus on Latin American countries may make data generalization difficult. One step further by Sherwood over Rapp and Rozek, though, was the recognition and address of the potential importance of enforcement by measuring judicial independence, ability to request court action and the right to take civil action. However, the construct did not actually examine the performance of enforcement. In other words, whether enforcement would result in an efficient outcome of IPP is unknown. Another concern is that the separate strengths of different IP laws cannot be identified although five laws were examined. This as a result, has made it difficult to understand how the patent system works for a particular country or in comparison to another country.

Ginarte and Park¹¹ proposed an index of patent rights and measures to study what determines the strength of patent protection. The study was conducted using data of 110 countries for the period from 1960 to 1990. The patent law 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. Each category was rated with a value between 0 and 1, with 1 indicating the strongest protection. The findings showed that R&D levels, market environment and international integration, all affected the degree of patent protection and due to these reasons major developed countries provide stronger protection than the rest of the world. However, the R&D impact on patent protection was subject to the condition that the research sectors reach a 'critical size' to motivate patent protection.

This research advances knowledge in quantifying patent protection and identifying protection determinants by linking the IP indices with international business activities. It is probably the only longitudinal study so far to examine patent systems. Several authors have used the indices to conduct further research and examine the relationship of innovation, economic development with patent protection.¹⁴ However, the measurements need to be improved so as to comprehensively reflect patent systems (e.g. to include patent administration as Sherwood emphasized).

Methodologically, this research attempts to avoid the few drawbacks from previous research. First, it reflects the changing nature of patent protection system using time series data (1960-1990). Second, it has used a composite indexing method. Early studies used either dummy variable approach¹⁵ or survey data.¹⁶ The disadvantage of using dummy variables is that the differences across countries in IP cannot be subtly distinguished. Survey studies focus on corporate managers' perceived views on IP strength thereby generating crude and arbitrary outcomes. Third, this research defines clearly the boundaries between concepts making replication feasible.

The three demerits of this study are also pointed out. Firstly, the patent system is more complex than the measurements in the study. Ginarte and Park measured only five factors. This means the parameters of the patent system associated with legislation, enforcement and administration were not

explored in detail as required in international treaties. Secondly, some of the variables are outdated in the context of current TRIPS standards. For example, TRIPS (Article 27.1) stipulates that countries should provide patent protection 'without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced'. Therefore, as nations are required to protect patents in all field of technologies, this variable is not only outdated but also creates difficulty in finding data. Finally, there is actually no measurement of patent enforcement, although this study provides the most comprehensive examination of enforcement compared to previous studies. The examination is based on legal stipulations, not the practice of enforcement. As Ginarte and Park argued, 'given the difficulty patentees have of proving that others are infringing on their patented processes (since there are often several ways of producing the same product), the shift in burden can be a powerful enforcement mechanism.' Ostergard⁷ recognized the lack of enforcement evaluation in early studies and proposed a new model. He assigned equal weight to law and enforcement to measure their importance. The enforcement strength is a single variable measurement using the US Country Reports on Economic and Trade Practices published annually. His study included both the IP laws and enforcement of 76 countries to examine the IPP strength using content analysis. The IP laws include patents, copyrights and trademarks applying the USCC minimum standards. Two separate coders were employed to conduct the coding using the laws in 1988, 1991, and 1994. The patent laws are scaled between 0 and 5, copyrights 0-10, and trademarks 0 and 8 with 0 indicating no law to safeguard IPP. The enforcement strength is measured based on the assessment of the US State Department¹⁷ with a score ranging between 0 and 4. The overall IPP of a country is reflected by multiplication of IP laws and enforcement scores.

Ostergard demonstrated that nations have different treatments in the patent, trademark and copyright laws (e.g. there is no standard concept of IP laws). Therefore, the three laws should be treated separately when conducting research. One remarkable progress made by this research in comparison to previous studies is the enforcement measure by which the author demonstrated that laws and enforcement are both important for IPP. In addition, it measured three types of IP laws separately instead of focusing on patents or combining all the IP laws as previous

researchers did. However, the author assigned different weight to various IP laws. The justification as to why the three laws should be treated differently appears to be unconvincing. Nonetheless, the data were less subjective, making replication feasible.

As Ostergard pointed out, the extent of IPP was more the subject of qualitative study due to the difficulties in constructing quantitative measures. However, a number of studies have attempted to approximate the degree of IPP using different scores. Ostergard's paper examined few quantitative measurements reported in early scholars' work and proposed a measurement to include three types of laws and an enforcement factor.

Critique on Patent System Measurements

Following the review carried out above, this section synthesizes and critiques prior work in three categories: theoretical, empirical and methodological.

Theoretical Critique

The literature review indicates that construct coverage should be more comprehensive to systematically address the need for patent systems aligning to international standards. To emphasize the importance of comprehensiveness, prior work is categorized into three areas - laws, administration, and enforcement, because all these areas form an important part of patent systems. Patent laws reflect a nation's commitment to protect patents and social interests on paper, whereas patent administration demonstrates government effort to put patent laws into practice and exercise rules and regulations to ensure efficient patent filing and granting. If the aim of patent administration is to ensure good patent practice, that of patent enforcement is to facilitate conflict resolution so that barriers to patent creation, protection and dissemination can be eliminated.

Early studies regard patent laws as the highest form of IPR and have compared them to other types of IP laws, such as trademarks.¹⁸ However, despite the consistent recognition of patent laws as a measure of the IP system, there seems no consistency on how these laws were measured.

Three researchers measured enforcement in metric format. Sherwood¹⁰ measured the perceived views on enforcement performance, but it is unclear whether these views reflected actual patent practice. Ginarte and Park¹¹ presented the most comprehensive examination of enforcement based on legal stipulations instead of actual practice. And Ostergard⁷

used the US government assessment as a standard to measure actual enforcement. Despite the inconsistency in measurements, all of them believed that this factor formed the fundamental divide of patent systems for both developing and developed countries. This divide may be associated with human resources necessary to accumulate knowledge and experience to make the system function and evolve with time. Nonetheless, how to measure enforcement remains a challenging task.

The least measured construct is administration, including integration (i.e. the level of compliance with treaties, conventions and agreements under the auspices of WIPO and WTO taking into account the number of memberships). While Bosworth, Ferrantino and Ginarte and Park¹⁹ measured integration as an effective indicator, only Sherwood¹⁰ addressed IP administration in a detailed manner by measuring the efficiency of administrative protection (the speed of granting IP rights and of handling IP disputes) and transparency (the level of public awareness of decision-making). These were measured based on the perceived views of IP practitioners.

In addition to construct comprehensiveness, two issues appear to relate to the conceptualization in previous research. One issue is that concept boundaries tend to be vague. For example, in Rapp and Rozek,¹² the boundary between the five variables is blurred while in Ferrantino²⁰, the variable 'membership of Paris Convention' overlaps with 'membership of three conventions'. The other issue is that, as much prior research uses US standards or interviews as benchmarks, it appears there is a need to benchmark international standards for patent systems given the salient roles of WTO and WIPO, and their treaties, conventions and agreements for member states.

Empirical Critique

Three empirical issues suggest the need for fresh data to examine patent systems. The first is the timescale: early studies measured patent systems from 1960 to 1996 and it is unclear how patent systems have evolved since then. This implies the urgent need to address this issue since 153 countries have now ratified TRIPS and dramatic changes have taken place over the last nearly 20 years. Future research should thus focus on how nations comply with TRIPS,⁷ and conform to the international trends in patent systems using TRIPS as a minimum standard.²¹ Secondly, the changing nature of patent systems should be reflected. Early studies - with the exception of Ginarte and Park

- treated national patent laws as static phenomena. In reality, however, nations tend to revise their patent regulations on a regular basis, stipulate new laws and improve administrative efficiency and enforcement capabilities to integrate with the rest of the world.

Thirdly, the extent of geographical coverage is also an issue to consider. Early studies researched countries ranging from 18 to 159. Some focused on developed countries, and used surveys and interviews (e.g. managers and attorneys from developed countries) to consider patent systems in developing countries. It is uncertain whether these views represent the state of patent system development in a nation, or whether there is a gap between their viewpoints and those from developing countries.²² Prior research also overlooked some countries like China and India, where recent patent developments in these countries demonstrate that they should be examined.

Methodological Critique

The methodological critique is also three-fold, and warrants the need for more objective and decomposable measurements. High levels of subjectivity involved in previous studies tend to make measurements researcher-bound, and liable to problems of indistinct measurement boundaries, thereby undermining their reliability, validity and replicability for a global study. Dummy variables are often unable to distinguish patent system differences across countries with sufficient subtlety. For example, Ginarte and Park¹¹ recognized that the US and Denmark have the same IP system index, but great variations exist between these two countries. Finally, the constructs of prior models have not been separable, so that, while, for example, different types of IP laws were studied, findings only reflected their overall strengths.²³ In reality, the legal treatments of various types of IP are distinct across countries, and separate examinations therefore need to be conducted.⁷

Proposing an Integrated Framework

Integrated Framework and Justification

Figure 1 shows the proposed framework for examining nations' patent systems, which is argued to be an advance over prior work. Specifically, this framework is comprehensive since it emphasizes the importance of mechanism, enforcement and administration simultaneously, focused since it

concentrates on patents only, and parsimonious since it groups system variables under three constructs to reflect patent systems. In addition, this framework and related definitions have also put great emphasis on the international impact without undermining the major role of nations in the patent system. The discussions in the previous section show that despite the inconsistency in patent system measurement, prior research recognized the importance of patent laws, administration and enforcement for a country's patent system development, but hardly ever examined them together.

Given the impact of international organizations, particularly the WTO and WIPO on patents, national patent systems should reflect the objectives and functioning of the three-component patent system in the international context. This is because international treaties, conventions and agreements serve as 'models' to assist nations in drafting their patent laws. At present, 28 treaties, conventions and agreements are associated with patents and other IP rights under the auspices of relevant international organizations.²⁴ When a country ratifies a treaty, convention or agreement, it becomes obligatory for its patent law to meet the minimum standards set out in it. Patent mechanism therefore, refers to the laws and regulations relevant to patent activities from filing, grant, dissemination and commercialization to resolution of disputes with relevant stakeholders. All prior research has included patent laws and their contents and related views as part of their patent system assessment. Patent mechanism is also the first step for nations to consider in establishing a patent system and a component explicitly stipulated in TRIPS under the WTO and other patent related treaties, conventions, and agreement under the auspices of WIPO.

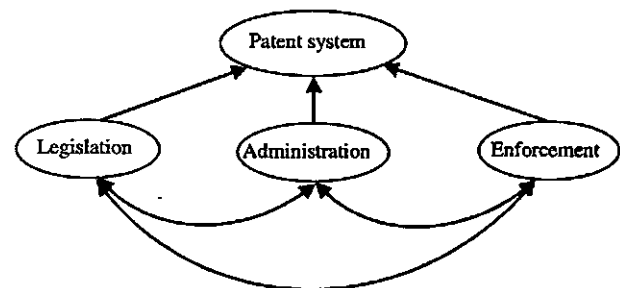


Fig. 1—Framework for examining patent systems

International administration allows for a single application of a patent within all (or selected) member states to be made to the designated WIPO Bureau from the applicant's country. Thus, an owner can gain world-wide protection for a patent in all WIPO states by adhering to the Patent Cooperation Treaty (PCT) or protection in selected countries of his/her own choice depending on the need. Unlike WIPO, the WTO has no administrative system to handle international patent filing.

Enforcement represents the major difference between these two organizations. WIPO has little enforcement power. Thus, if two countries have a patent dispute, a WIPO tribunal may arrange a settlement, but if one is dissatisfied and refuses to implement the verdict, WIPO has no power of enforcement. A WTO dispute settlement on the contrary, is enforceable, that is, when a member refuses to implement the verdict, the WTO can allow the complainant to take actions (e.g. embargos or trade sanctions) against the offender. Patent enforcement should be part of the patent system assessment as has been recognized by all the previous research. However, due to measurement difficulties, early studies (Rapp and Rozek, 1990; Mansfield, 1994) did not execute its operationalization. More recent studies have all attempted to measure enforcement as a construct by consulting with practitioners (Sherwood, 1997), by examining enforcement on paper,¹¹ and by benchmarking national enforcement laws against the US standard.⁷ Enforcement, as a measurement construct has been explicitly stipulated in TRIPS for nations to comply with. The WTO even set up a reporting system with specific questions listed so that nations can report their enforcement progress accordingly. From the perspective of practice, it is also important to consider this element because enforcement demonstrates a nation's actions rather than stipulations on paper.

The TRIPS Agreement integrates national patent systems more extensively than other treaties, conventions and agreements for four reasons. First, it is the only agreement that directly links IP with trade,²⁵ and the growth of international business activities, and of IP-embedded production and services, make this a vital link. Second, it is an agreement that balances stakeholder interests: whereas other treaties, conventions and agreements appear to lean towards the interests of creators, TRIPS stresses the balance of interests between rights holders' and general public (Article 7). Third, TRIPS members are obliged to implement enforcement.

With the enforcement stipulations in TRIPS, the WTO emphasizes enforcement actions at national and international levels with two requirements: enforcement stipulations in the national patent law and enforcement practice reporting to the WTO. Finally, TRIPS is the most comprehensive multilateral agreement on IP because it sets minimum standards for legal mechanisms, procedures and enforcement remedies as well as for dispute settlements (Articles 1 and 41).

Given the importance, TRIPS compliance appears to be unexamined as yet for three reasons, again rationalizing the need for a global investigation. First, a global study is particularly intricate due to the nation-based nature of patent systems. '[P]robably no two 'systems' are exactly alike', and commonly 'they operate within the confines of a single nation'.²⁶ '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.'²⁵ Second, there has been limited research that takes patent system development as a main theme from the perspective of international business: the main stream of IP study has always been a legal and economic matter²⁷ although in recent years, patent filing and grant data have been used actively to examine national policy and firm performance. Third, no study seems to have used TRIPS as a measurement framework. Thus, it is unclear to what extent TRIPS compliance has been fulfilled, to what extent global integration has taken place, and to what extent practices differ across countries.

Different from prior research measuring the IP system as a whole, it is argued that different IP rights should be measured separately for several reasons. First, the patent system is the most sophisticated and complex IP system, and the one nations tend to establish first when they form an IP system.²⁸ Second, prior research calls for such measurement to be undertaken separately⁷ due to their varied ways of administration, enforcement and legal stipulations in IP rights. Third, depth prevails over the width in examining different IP rights. Given the complexity of data analysis and increasing components for IP rights, it is important to separate their examination to provide deeper understanding.

Preliminary Testing of the Framework

This study selected relevant variables, based on TRIPS and WIPO 'standards' taking account of prior

work, and conducted a preliminary test with these. Indexes were constructed by nation, based on multiple data sources from the WTO, WIPO, national patent offices, and by consulting relevant officers in these organizations for clarification and data access. Preliminary results of confirmatory analysis show that the variables are relevant and lump together for each construct with at least 70 per cent of the significance. This is therefore the first step towards future studies of this patent system framework. In the following, the conceptualization of each variable is explained in brief. Variable operationalization is summarized in Table 2.

Patent Mechanism

Six measures (V1-V6) derived from the TRIPS Agreement have been included to explain the patent mechanism construct. TRIPS stipulates that nations have obligation to protect 'product and process

inventions' (V1) in their patent law. Both inventions represent technological progress but in different forms (e.g. process inventions are related to technological solutions embedded in a production process rather than the product itself). In order for an invention to be patented for inventive protection, three conditions must be met. They are 'novelty, inventiveness and utility' (V2). That is, an invention must be original and not disclosed or in actual use before the application; represent inventive steps that are not obvious to a person with average knowledge or skills in the field; and demonstrate applicable procedure to be put into industrial production. 'Rights conferred for product patents' (V3) mean that nations in their patent laws should provide the exclusive right to prevent third parties (without the owner's consent) from making, using, offering for sale, selling or importing patented product inventions. Similarly, this

Table 2— Operationalization – Patent mechanism, administration and enforcement

Construct & Variable	Operational delineation
Patent mechanism ($\alpha = 0.91$)	
1 Product & process inventions	1 Both inventions: 1; one missing: deduct 0.5; no protection: 0
2 Novelty, inventiveness & utility	2 Full patentability: 1; one missing: deduct 0.333; no patentability: 0
3 Rights conferred for product patents	3 Complete stipulation: 1; one missing: deduct 0.20; no stipulation: 0
4 Rights conferred for process patents	4 Complete stipulation: 1; one missing: deduct 0.25; no stipulation: 0
5 Rights conferred for transactions	5 Complete stipulation: 1; One missing: deduct 0.333; no stipulation: 0
6 Protective duration	6 20-year: 1; each missing year, reduce 0.05; no protection: 0
Patent administration ($\alpha = 0.71$)	
7 Transparency	7 Full availability: 1; law in one language: 0.5; no law: 0
8 Frequency of patent law revision	8 Revision takes place after 1995 (inc. 1995): 1; no revision: 0
9 Timescale to grant patents	9 Timescale clearly indicated: 1; no stipulation: 0
10 Patent educational institutions	10 Education institution available: 1; unavailable: 0
11 Non-patent stipulations	11 Exceptions and limitations are stipulated: 1; only exceptions or limitations: 0.50; no stipulations: 0
12 Non-infringement stipulations	12 Non-infringements stipulations are listed: 1; otherwise: 0
13 Compulsory licensing	13 Compulsory licensing provision stipulated: 1; No: 0
Patent enforcement ($\alpha = 0.70$)	
14 Judicial review of patent application	14 If applicants are given rights to appeal judicially for their rejected
15 Civil judicial procedures & remedies	15 patent application: 1; otherwise: 0.
16 Administrative procedures & remedies	16 Complete function: 1; one missing: deduct 0.2; no function: 0
17 Provisional judicial measures	17 Complete function: 1; one missing: deduct 0.2; no function: 0
18 Provisional administrative measures	18 Complete function: 1; one missing: deduct 0.2; no function: 0
19 Border measures	19 Complete function: 1; one missing: deduct 0.2; no function: 0
20 Criminal procedure	20 Yes: 1; No: 0.
21 Court available for disputes	21 Complete criminal procedure: 1; one missing: deduct 0.3333; no

Notes: The reliability of the measurements is justified on two counts. Firstly, the internal consistency shows that all variables lump together in a reliable manner towards the three main factors resulting in Cronbach's Alpha (α) at 0.91, 0.71 and 0.70 respectively. Secondly, experts have been consulted within WIPO regarding the variable selection and relevance. This inter-rater approach allows finalization of the model based on their comments, and an assurance from them about the consistency of the model.

applies to 'rights conferred for process patents' (V4). The owners of a patented invention should also have the right to assign or transfer their ownership by inheritance, or conclude licensing agreements with interested parties for the purpose of commercialization; the collectively so called 'rights conferred for transactions' (V5). Patent protection is not perpetual, and nations are required to provide a 'protective duration' (V6) of 20 years.

Patent Administration

Seven measures (V7-V13) have been included to explain the patent administration construct. 'Transparency' (V7) is associated with nations' way of publicizing patent system information so that inventors and other stakeholders can be duly informed of the necessary information to file and protect their rights. This should not only be in the native language, but also in the widely spoken English language. The reason to do so is to ensure that both local and foreign inventors have information access and equal treatment. This is different from the conceptual and operational direction set out by Sherwood,¹⁰ who referred to transparency as discretionary rational decision and is a subjective measure suitable for interviews. 'The frequency of patent law revision' (V8) here refers to the number of revisions made since 1995. This action demonstrates government efforts to improve patent mechanisms based on the minimum standards set out by TRIPS. 'The timescale to grant patents' (V9) refers to the speed of granting a patent. Prior work²⁹ shows that a majority of patent commercialization in the form of licensing takes place around the grant of a patent (i.e. a few months pre- and post-grant). This implies that the speed of patent grant is important to accelerate patent utilization and also demonstrates patent office efficiency to process patent filing and grant. This will assist owners in focusing on inventive exploitation and in minimizing anxiety caused by the pending patent.

'Patent education institutions' (V10) refer to the available patent educational institutions to teach and train patent related human resources. Patent education is important because it reflects patent awareness of the general public or the potential to have such awareness. Both help intensify demand for patent protection and diffusion. Given its importance, WIPO requires national government reporting on a regular basis about available educational institutions that teach IP, as part of country's IP information. Next, the TRIPS Agreement clearly stipulates that member

states are required to set exceptions and limitations in line with each nation's tradition and interest when granting patents (i.e. stipulations as to what is excluded in grant of patents). The 'non-patent stipulations' (V11) demonstrate WTO's flexibility and consideration of country variations for the purpose of public order or morality. The WTO's regulatory stipulations are in line with prior work emphasizing that national culture in the form of political economy, social structure, language, religion, traditions, and education, impact people's understanding of patent protection, attitude, and behaviour.³⁰ For example, countries tend to stipulate that discoveries are not patentable because they are not creative works. Stipulations like these will help administrative consistency of patent granting across countries.

Likewise, TRIPS has also stipulated two actions for patent administration in addition to legal stipulation – non-infringement and compulsory licensing. Infringement can be understood as violating others' rights, but it could be either an unintentional or deliberate act. Since patenting activities are often incremental on prior work, inventors can be unknowingly infringing others' work especially when a product contains several inter-related patents. Therefore, it is important to have administrative consideration as to what amounts to 'non-infringement' (V12) and what is considered a deliberate act. Finally, in reality, most patent licensing as a form of patent utilization is based on voluntary agreements between the owner (licensor) and the commercializing party (licensee), but sometimes, this may not work due to certain reasons; thereby nations should make clear under what circumstances 'compulsory licensing' (V13) can be imposed to enforce technology transfer for the benefit of society, that is, a non-voluntary licensing agreement without the owner's authorization and imposed by governments in the interest of the general public. For example, when there is a pandemic disease, compulsory licensing can be implemented to manufacture a patented drug in massive scale so that many people can be cured. As Yang³¹ observed and predicted, compulsory licensing is little practised and developing countries may be more likely to practise compulsory licensing than developed countries in future.

Patent Enforcement

Eight measures (V14-V21) have been included to reflect the patent enforcement construct based on the

checklist of enforcement the WTO sets out for member states. As elaborated earlier, the WTO requires that all member states report to it about their national enforcement practice by following a checklist set out by the organization. 'Judicial review of patent application' (V14) refers to the requirement that nations should have a system in order to judicially review patent applications that have been rejected by the Patent Office. A country usually allows at least one time to apply and one time to appeal for patent protection (if rejected at the first attempt). However, the WTO requires that nations also set up a judicial review system to allow an applicant the opportunity to take legal action if an invention is not granted a patent. The measure, 'civil procedures and remedies' (V15) is related to court functions. According to the WTO, nations should have civil or criminal procedures to identify and protect confidential information brought forward as evidence. In other words, how evidence should be presented in court to protect confidentiality, any remedies available for damages, compensation for wrong enjoinments, and costs and timeframe to resolve issues. In order to protect patent related confidentiality, relevant party can file evidence under seal. The court should have the power to decide whether or not and to what extent it is necessary for relevant information to be hidden from the parties involved. In addition, if in the end, it is proven a wrong accusation, how the relevant party should be compensated for any damages, such as tainted reputation, lost sales, etc.

'Administrative procedures and remedies' (V16) has actions similar to those listed in V15, but is an administrative way to handle judicial matters. The advantage of this function may be associated with lower costs and shorter timeframe. However, this depends on the efficiency and effectiveness of each individual nation. 'Provisional judicial measures' (V17) are necessary so that authorization can be given to prevent infringements and preserve evidence when issues occur. Such measures should also have indication of costs, timeframe and indemnification of injuries so that interested parties can be protected. Likewise, 'Provisional administrative measures' (V18) with similar functions as shown in V17 should also be available to ensure a fair and efficient way of handling disputes.

'Border measures' (V19) allow owners to apply to customs for suspending pirated product from getting into the country. This action should be taken when

clear evidence of infringement is available. 'Criminal procedure' (V20) focuses on whether a nation has jurisdiction over criminal offences, and criminal procedures and penalties for infringements. Observations as to the current practice show that countries barely consider infringements a criminal offence unless there is serious social damage. For this reason, nations do not tend to stipulate criminal procedure for patent infringements. Finally, 'court available for disputes' (V21) means that nations are required to report their court support for patents to the WTO and WIPO and there should be courts available to handle patent-related disputes.

Discussion and Conclusions

On the basis of the argument that patent system measurements require scholarly attention, this paper has conducted a systematic review on the existing studies of patent system measurements and proposed an integrated framework for further investigation. Accordingly, this paper redefines the patent system in a comprehensive manner to include legislation, administration and enforcement of patents. It has also made clear that although patent systems tend to be nation-based, it is interrelated, interdependent on other countries' patent systems due to globalization and for integration with the rest of the world. In addition, the paper reviews major work in this area and assesses their strengths and weaknesses. On the basis of the assessment in the conceptual, empirical and methodological settings, the author was able to draw the strengths of prior research, add the logic of her own thinking, propose and justify an integrated framework to measure patent systems with particular consideration of the impact of international organizations. The initial test of this framework shows that it is valid for further refinement.

Research Contribution

This paper contributes to knowledge relating to the study of patent systems in the theoretical, empirical and methodological settings. Theoretically, it establishes an integrated framework to allow a comprehensive assessment of a country's patent system. This is improved as compared to prior research that mainly examined the legislative perspective of patent systems. The integrated framework allows the three areas of the patent system in a nation to be assessed, including patent legislation, patent enforcement and patent administration. The inclusion of these three factors sets the 'supply chain'

of patent activity from pre-patenting, protection, commercialization to dispute resolution, if any. In addition, this comprehensive framework will also help scholars to link up patent systems with countries and firms to examine the impact of the patent system.

Empirically, this framework has added importance to international dimension on two accounts. One is in considering the importance of international influence, particularly WIPO and the WTO. Thus, the framework has used related concepts and requirement set out by these two organizations because they set 'patent system standards' for the purpose of harmonizing nation-based establishment. The other is reflected in its examination of all member states of the WTO. All the 153 member states were examined, although, many eventually were left out due to missing data. This paves the way for further examination in future when data become more readily available with progress in national patent systems. In the current setting, this paper appears to be the first to examine patent systems using TRIPS standards. In comparison to prior work, this study is also more updated than prior work to examine patent systems by looking at the current patent system setup.

Methodologically, this new framework allows flexibility in comparison and decomposition. Nations learn from one another and tend to follow suit, particularly on the technology front. The integrated framework will allow for comparative assessment among countries so that they can identify differences for improvement and harmonization. The other flexibility is associated with the decomposable constructs and their variables. Such flexibility allows separate analysis of the three different components of patent systems. This is a helpful function when scholars and practitioners intend to examine a nation's system development to identify which specific area of the system in the country should be focused on for further improvement.

Implications for International Patent Management and Investment and Policy Making

International business and management nowadays frequently involve technology transfer across borders under the protection of patents, thus, it is important to have a framework to assess and compare cross-country patent environments (e.g. host and home countries). This study will allow firms to identify advantages and disadvantages to invest in the country concerned. Based on the gaps they identify, firms will be able to formulate relevant strategies of defence and prevention for patent protection and commercialization. As a

consequence, firms will be able to deploy resources effectively to utilize their patents at the firm level and to have effective political strategies to deal with relevant government organizations. The assessment of patent systems between home and host countries will also reveal what corporate knowledge and experience are available to deal with the patent environment issues so that resources can be utilized effectively for strategic actions. In addition to the above, such assessments would help firms' top management to leverage costs and benefits associated with cross-border activities so that patent value can be maximized effectively.

This paper has also provided policy making implications in the area of patent systems. Given the framework, countries can examine the national system in comparison to the international patent standards and thus identify the particular area of the patent system the nation should focus on for further development. Accordingly, policy makers of nations can seek support from international organizations for facts and data on implementation. Country comparison may also allow firms to identify similarities and differences so that strategic patent policy can be set out as targets.

Directions for Future Research

This paper sets a beginning for new research. Firstly, the framework has been conceptualized in a broad manner, but needs to be fine-tuned despite the valid preliminary result. Second, although all members of the WTO that have complete data have been examined, national patent system is a changing factor. Thus, it will be important to further examine these countries with the availability of new data so that any improvement in a national system can be identified. Third, the statute and practice gaps are reflected in prior work and this issue still subsists in this research although this work is an improved one as compared to prior work since it relies on up-to-date reports based on national enforcement practices. One solution could be to interview or survey practitioners in this area and find out if the findings are consistent with the current results. Finally, once the framework is confirmed, it may be necessary to establish time series data so that the indexes can be established and are available for firms, policy makers, and other relevant stakeholders to conduct analysis of patent systems.

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