Impact of Foreign Intellectual Property Rights Protection on U.S. Exports and FDI

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ABSTRACT

Since the early 1990s, there has been a growing interest in the potential contribution of intellectual property rights (IPR) protection to global trade and investment. However, there is an ongoing debate among analysts regarding the extent to which stronger IPR actually stimulate international transactions via transfer of technology. This paper addresses this issue by evaluating how foreign intellectual property rights (IPR) protection affects how U.S. firms serve overseas markets through exports and foreign direct investment (FDI). Using panel data from 53 countries over 1994-2006, the empirical analysis was based on a dynamic system GMM modeling framework. The empirical results suggest that IPR has a weak negative effect on U.S. exports, but a statistically significant positive effect on U.S. FDI. In addition, the results also indicated that less US exports flow to countries with weak imitative ability after they strengthen IPR protection.

Key Words: export, FDI, technology transfer, intellectual property rights, GMM.
JEL Classification Numbers: C33, F21, F23, F14, O34, K33.

1. Introduction

The passage of the World Trade Organization's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS) in 1995 is a major milestone in global efforts to harmonize international laws governing intellectual property rights. Since the inception of the TRIPS agreement, the potential impact of stronger intellectual property rights (IPR) on international trade and global investment has been a subject of great interest among researchers and policymakers. While no consensus has emerged among experts, the strengthening of IPR laws has the potential to benefit producers and consumers in both industrialized and developing countries via the encouragement of innovative activities and easier flow of technology and knowledge-based factors of production.

There are three major ways through which companies can serve foreign markets and transfer technologies across international borders: exports, foreign direct investment (FDI), and licensing (Maskus, 2004; Smith, 2001). According to government statistics, U.S. exports was $623 billion in 1996, U.S. FDI was $795 billion, and U.S. received royalties and license fees (including those from both affiliates and the unaffiliated) was only $32 billion at the same period. In contrast by 2006, this values these numbers have increased significantly for exports ($1,037 billion), FDI ($2,384 billion) and received royalties and license fees ($62 billion), respectively (U.S. Bureau of Economic Analysis (BEA). Among the three types of international transactions, licenses account for the least amount and the data for license fees are not as readily available for it. Thus, this paper focuses on the impact of IPR protection on exports and FDI only.

There is an ongoing debate among analysts regarding the extent to which stronger IPR actually stimulate international transactions via transfer of technology (Park and Lippoldt, 2003). Despite a growing literature on the issue, the question remains as to whether the strengthening of IPR protection is an effective way to promote technological

transfers to developing countries? Two opposing views exist on the issue. First, critics argue that stronger IPR increases the market power of technology holders and leads to higher prices, with the possible consequence that some developing countries may have even less access to new technologies. In addition, stronger IPR could also impose higher cost barriers to local firms in developing countries that may want to develop their products imitation of knowledge-based technologies embedded in foreign imports.

In contrast, proponents of stronger IPR protection contend that infringements of IPR laws have only short-term benefits. In the long run, a regime that permits free technology copying and piracy of intellectual property will discourage innovation. The lack of consensus on the impacts of stronger IPR protection on trade and investment points to a need for more empirical investigations of this important issue. Unfortunately, empirical evidence on impacts of IPR protection is relatively scarce (Ferrantino, 1993; Maskus, 1998a; Smith, 2001; Park and Lippoldt, 2003).

This paper addresses this issue by evaluating how foreign intellectual property rights (IPR) protection affects how U.S. firms serve overseas markets through exports and foreign direct investment (FDI). Based on Smith (2001), this paper extends the literature in three ways. First, in contrast to most previous studies that study the effects of IPR on exports and FDI separately, we analyze the relationships jointly. Second, this paper goes beyond the common cross-sectional analysis based on one year of data for multiple countries (Maskus and Penubarti, 1998; Smith, 2001). Rather we adopt a panel data estimator that allows for capturing the dynamics in the relationships among the variables in the system. For example, the panel data (1994-2006) used in this study could potential capture the variations in the data due to evolution of foreign IPR regimes since mid-1990s. Third, instead of using basic OLS regression models (and its variants), this paper better addresses potential endogeneity issues by adopting dynamic system panel GMM estimator.

The rest of the paper is organized as follows. Section 2 contains a brief review of the literature while section 3 presents an outline of the conceptual framework on the relationship between IPR protection and multinational firm's international transactions and the hypotheses tested in the empirical analyses. Section 4 describes the empirical methodology and data and section 5 contains a discussion of the results. The last section provides concluding remarks.

2. Conceptual Framework

In Dunning's (1993) famous OLI paradigm, production and marketing decisions by multinational enterprises are driven by three factors: ownership (O), location (L), and internalization (I) advantages. Ownership (or firm-specific) advantages over certain technology and knowledge-based assets (e.g., patented technology, trademarks, marketing processes, etc.) are necessary for a MNE to be able to effectively compete with local firms in a foreign country. Ownership advantages must be strong enough to compensate for the additional cost of operating abroad.. Ownership advantages must also allow for the firm to have exclusive rights and control over intellectual property that would prevent its knowledge-based assets from being pirated or imitated by other.firms in the foreign country. Thus, stronger IPR protection can better protect multinational firms' ownership rights over their knowledge assets. Hence, stronger IPR could encourage international transactions through the channels of exports and FDI.

In contrast, location (country-specific) advantages are the basis for the MNEs decision to either export or engage in local production in the host country. MNEs decision to locate production overseas is often driven by the firm's desire to take advantage factor advantages (e.g., lower labor cost, extractive natural resource, market size) in the host country. There are often imperfect markets for key intermediate products and factors (e.g., human capital, knowledge and managerial skills), MNE uses their internalization (or

control) advantages to control and internalize transaction costs. MNEs may be reluctant to license their technology to foreign producers in countries with weak IPR laws where the likelihood of illegal imitation is high.

Nevertheless, the existing theoretical literature provide no definitive guidance on whether enhanced ownership advantage via stronger IPR protection increases or decreases international trade and investment. It is plausible to expect that the strengthening of IPR protection would have a positive "market expansion effect" such that multinational firms can increase their market shares in the host country. In contrast, it is equally likely that stronger IPR protection would result in a "market power effect" that would induce the firm to restrain its output sales in foreign markets in order to enjoy monopoly advantages and higher prices (Maskus and Penubarti, 1995; Smith, 2001). Therefore, the net theoretical effect of IPR on international trade and investment through ownership advantage is indeterminate. This is an empirical question in need of further investigation. Thus, the following testable hypotheses are postulated.

Hypothesis 1. *Stronger IPR-promoted ownership advantage increases U.S. exports and FDI according to market expansion effect and decreases them due to market power effect.*

The impact of stronger IPR protections may vary between exports and FDI. Stronger IPR protection can increase the cost of imitation, and thus decrease the probability of piracy and other violations of knowledge-based assets. Therefore, for different host countries with their certain levels of IPR regime, U.S. firms have to balance their possible costs of disadvantages in operating abroad including knowledge imitation and their benefits from location advantages, then make decisions on whether and how to access to and expand in overseas markets. This means that IPR should have different

influences on U.S. firms' exports and FDI. To be more specific, strong IPR should confer a location advantage inducing more FDI, while weak IPR should offset the advantage and make firms lean to exports (Smith, 2001). It also indicates that IPR protection is more important to FDI than to exports, given FDI is easier to have knowledge assets violated. Therefore, during this international trade and investment decision process, relative effects of IPR on exports and FDI are expected to be different.

Hypothesis 2. *Strong IPR confers a location advantage which increases more U.S. FDI relative to exports.*

The above hypothesis on IPR and international transaction relationship, however, is conditional and affected by other specific factors. These factors include, but are not limited to, foreign countries' imitative ability (Smith, 2001) and knowledge assets sophistication (Nicholson, 2002). Regarding IPR enhanced ownership's market power effect, Smith (2001) proposes that when IPR has been strengthened, countries with strong imitative ability usually will not be easily controlled by this IPR enhanced ownership's market power effect, while countries with weak imitative ability often have to experience at least temporary monopolies. Therefore, countries with weak imitative abilities may experience a decrease in international trade and investment while their IPR regime strengthened. Strong IPR may enable foreign trade and investment become smoother in strong imitative ability countries with well-educated workers. Therefore, stronger IPR should have little positive or even negative effect on international transaction to countries with weak imitative abilities but large positive effect to countries with strong imitative abilities (Smith, 2001).

Here this paper examines these proposals about foreign countries' strong/weak imitative abilities again with more updated data and comprehensive models. We suggest that given strengthened IPR, weak imitative countries are more easily dominated by market power's negative effect on international trade and investment while strong imitative countries are more affected by market expansion's positive effect, without considering effects from location advantage. Then with regards to the effects from location advantage, this paper proposes the following hypothesis:

Hypothesis 3. *Strong IPR makes countries with weak imitative ability more easily dominated by market power's negative effect on exports and FDI. But for FDI, this negative effect may be offset by IPR enhanced location advantage.*

Hypothesis 4. *Strong IPR enables countries with strong imitative ability to be more affected by market expansion's positive effect on exports and FDI. For FDI, this positive effect can be further strengthened by IPR enhanced location advantage.*

Helpman (1993) developed a two-region (North-South) general equilibrium model for FDI and showed that the ultimate effect of IPR reforms on the global economy hinges on the manner and the extent of the MNE's response to the reforms. Later studies by Lai (1998) concludes that stronger IPR in the South leads to an acceleration of production-shifting from North to South and to higher rates of innovation in the North. Branstetter, Fisman, Foley, and Saggi (2007), in their North-South product cycle model, predict that IPR reform in the South leads to increased FDI too. By analyzing responses of U.S.-based MNE to the foreign IPR reforms in the 1980s and 1990s, they further empirically found that MNE indeed expanded the scale of their activities in IPR reforming

countries. However, Glass and Saggi's (2002) model demonstrates the opposite, that by making imitation more costly, stronger Southern IPR protection forces the South to spend more resources on imitation and causes resources scarcity which reduces FDI from the North.

So far we have focused on a narrow interpretation of how IPR protection affects FDI in terms of technology transfer. Many scholars, however, claim that stronger IPR is of broader importance in signaling to potential investors how a host country recognizes and protects the rights of MNE (Maskus, 1998b; Sherwood, 1990). In this view, trade liberalization, or market restriction removal, is insufficient to provide assurances that an economy becomes more open to MNE. Stronger IPR regimes convey a commitment from governments in emerging economies to shift toward a more business-friendly environment. Overall, most time people expect stronger IPR would encourage FDI.

3. Empirical Literature Review

3.1 IPR with Export and FDI together

As noted earlier, few country-level empirical studies examined export and FDI together. Such research include Ferrantino (1993), Maskus (1998a), Fink (2000), Smith (2001), Lesser (2002), and Park and Lippoldt (2003). Ferrantino (1993) uses 1982 cross-country data to investigate the effects of membership in the intellectual property treaties in the context of U.S. exports and foreign affiliate sales. The membership stimulates flows of U.S. receipts of unaffiliated royalties and license fees from the host country with a sufficiently strong IPR regime. Moreover, he also finds that exports from U.S. firms to their overseas affiliates are significantly higher in countries without IPR membership than with the membership, indicating that stronger IPR protection may switch away exports to

subsidiaries and replace it with other exchange modes. Nevertheless, Ferrantino (1993) also shows that the IPR treaties membership has minimal impact on U.S. exports to unaffiliated firms and FDI.

Maskus (1998a) estimates a simultaneous set of equations by seemingly unrelated regressions (SUR) to capture the joint impacts of IPR on exports, FDI and licensing, controlling for market size, tariff protection, the level of local R&D by affiliates, distance from the United States, and investment incentives and disincentives provided by local authorities. This is done for a panel of 46 destination countries, using annual data from 1989-1992. His index of patent strength is taken from Maskus and Penubarti (1995). He finds positive effect of IPR on U.S. exports to affiliates in developing countries and insignificant effect of IPR on U.S. affiliates' sales.

Fink (2000) studies the relationship between IPR and FDI and trade for both the U.S. and Germany. However, he finds no important role for IPR in influencing total international transactions for the U.S. at country level.

Using cross-sectional data in 1989 for a sample of 50 countries, Smith (2001) studies the impact of patent index on U.S. exports, FDI, and licenses. By applying seemingly unrelated regressions (SUR), she shows that strong patent protection increases U.S. affiliate sales, particularly across countries with strong imitative abilities. However, she finds weak statistical evidence that IPR affects exports.

Lesser (2002) develops a new index of IPR protection for 44 developing countries in 1998. Using this index and a set of cross-country data for the year 1998, he performed a linear model using a non-normalized dependent variable. He concludes that the relationships between the IPR score and FDI and between IPR and foreign countries' imports are both positive and significant. A one point increase in the score, meaning stronger IPR protection, would on average increase FDI by $1.5 billion.

Park and Lippoldt (2003) investigate the IPR relationship with FDI and trade using data at both national and industry levels from 1990 to 2000. They find that the patent rights as described by index are associated positively with FDI and moderately with trade. Their results indicate that variation in FDI in relation to strengthened patent rights is largest for the least developed nations where IPR regimes are weakest, and second largest for the developing nations where IPR regimes are next weakest. Thus, patent rights appear to have a positive but diminishing association with increased FDI as the strength of those rights increases. Yet, the results do not imply that stronger patent protection will always raise FDI and trade. There may come a point where these types of IPR are too strong – in the sense that they grant producers of intellectual products excessive market power – in which case IPR may negatively influence FDI and trade. Thus, their empirical finding is that the positive effect of strong IPR is only conditional on systems that do not reach an excessive level of strength. Although papers above have well addressed IPR's effects on both exports and FDI, little has been done about endogeneity problem in their models. This paper will tackle the issue through using GMM estimators.

3.2 IPR with only Export

Apart from more comprehensive analyses above, several empirical studies can be found on the relationship of IPR and trade flows exclusively (Fink and Primo Braga, 2005; Maskus, 2000; Maskus and Penubarti, 1995; Primo Braga and Fink, 1997; Smith, 1999), but the results are ambiguous. Maskus and Penubarti (1995) are the first to relate international trade flows to the cross-country strength of patent laws. They applied two-stage least squares method to a data set of bilateral imports from OECD countries to themselves and to a large group of developing countries in detailed manufacturing categories. Their conclusion is that import volumes were positively and significantly affected by increases in Rapp and Rozek's (1990) patent index across most manufacturing

categories, particularly in large and middle-income countries. Primo Braga and Fink (1997) estimate a similar model and found the same positive links between patent protection and trade flows. Later their another work in 2005 further confirms the the significantly positive effect of higher levels of IPR protection on nonfuel trade. However, their result also show that when confining the estmiation to high-technology goods, there is no such significant effect found.

Smith (1999) refines Maskus and Penubarti (1995) by distinguishing between types of importers, i.e. countries presenting an imitative threat and countries not. She uses data on state-to-country manufacturing exports in 1992 and performs regressions with fixed effects. Her IPR indices from both Rapp and Rozek (1990) and Ginarte and Park (1997). Smith (1999) results show that U.S. firms would indeed expand their exports to strong imitative nations significantly if they have stronger IPR regimes. She also finds that the poorest countries with no imitative threat might not experience rising international technology transfer through imports even upon adopting TRIPS-consistent IPR regimes. Strengthening patent rights in those countries reinforces monopoly power and reduces U.S. exports to them.

3.3 IPR with only FDI

Also many empirical studies have been done regarding the relationship between IPR protection and just FDI (Branstetter, Fisman, Foley, and Saggi, 2007; Javorcik, 2004; Kumar, 2000; Lee and Mansfield, 1996; Mansfield, 1994; Nicholson, 2007; Nunnenkamp and Spatz, 2004; Seyoum, 1996). Among them, Branstetter, Fisman, Foley, and Saggi (2007) analyzes responses of U.S. MNE to well-documented discrete changes in patent regimes over the 1980s and 1990s in sixteen countries at firm level. They apply time and affiliates/industry fixed effects and find that MNE expand the scale of their activities in reforming countries after IPR reform. Javorcik (2004), using a unique firm-level data set

from Eastern Europe and the former Soviet Union, adopted probit model to study MNE FDI decisions. He finds that weak IPR protection deters FDI in technology-intensive sectors that rely heavily on IPR for the security of knowledge assets. He also indicates that weak IPR regime encourages MNE to undertake FDI projects focusing on distribution rather than local production.

Lee and Mansfield (1996) using least squares estimation find a positive relationship between IPR and FDI, based on data obtained from a survey of almost 100 U.S. MNE regarding their perceptions of IPR protection in various host countries. Mansfield (1994) has similar findings, particularly in high-technology industries. He also indicates, as Javorcik (2004) does, that IPR seems to influence the composition and extent of U.S. FDI although the size of the effects seems to differ from industry to industry. Nunnenkamp and Spatz (2004) adopts two-stage least squares method to disaggregated data for seven industries in 1995 and five industries in 2000. They conclude that the relationship between FDI and IPR depends on characteristics of both industry and host-country by using sectorally disaggregated FDI data for a large sample of host countries.

Similarly, Seyoum's (1996) results of IPR's influence on FDI are varied from different host countries. Moreover, he distinguishes different types of intellectual property rights into patents, copyright, trade secrets, and trademark. He finds that copyright's protection has constant positive effects on FDI across different types of countries, while the other IPR's effects can be positive or negative according to how developed a country is. Seyoum also concludes that, for the less developed, IPR factors can explain 13 percent of the variation in FDI flows, while in the emerging economies IPR capture 43 percent of FDI variation and is a much more important factor than other economic policy variables. However, in his intellectual property rights model, Seyoum (1996) does not include any

economic policy variables, which may induce estimation bias and arouse questions to the results.

Though most studies above find significantly positive relationship between IPR and FDI, there are a few others concluding no such connection. For instance, Kumar (2000) studies affiliates of US and Japanese MNEs in seven broad sectors of manufacturing in 74 host countries at three points of time over the 1982-1994 period. Applied fixed effects, he shows that the strength of patent protection regime although with a positive sign never has a statistically significant coefficient for affiliate sales in his case for U.S. MNE. In his case for Japanese MNE, patent rights protection is only significant upon inclusion of dummy variables distinguishing Asian host countries.

3.4 Other Factors Affecting Export and FDI

Apart from the potential effect of IPR, a second influential element is distance between the transaction parties that has especially been emphasized by gravity model. The model presents an empirical analysis for international trade. It suggests that trade is based on the distance between countries and the interaction of the countries' economic sizes, mimicking the Newtonian law of gravity which considers distance and physical size between two objects. Gravity model has been proven to be strong through both theoretical foundations (Anderson, 1979; Anderson and Wincoop, 2003; and Bergstrand, 1990) and many empirical econometric analyses. Later, other factors, such as income level and populations, are also included in expanded versions of the model, depending on different cases. This paper uses GDP for countries' economic sizes in addition to variable distance.

GDP, in addition to its function in the gravity model, is also good measurement for host countries' market sizes. Many empirical works have shown significant effects of market size on international trade and investment. For example, Bandera and White (1968) find a statistically significant relationship between U.S. FDI in

European countries and their national incomes (GNP). They concluded that motives for FDI can be adequately summarized as a desire to penetrate the growing market defined in terms of level and growth of GNP of host countries. Similar results are found by Scaperlanda and Mauer (1969) and many other studies afterwards (Fink, 2000; Lesser, 2002; Maskus, 1998). Thereafter, market size has become a well-recognized variable to be used in later studies which would be too many to cite. Moreover, from the perspective of FDI types, this market size effect is likely to be valid for the FDI undertaken to produce final goods, i.e. horizontal FDI; but it has less power to explain vertical FDI meant to produce intermediate goods for exports afterwards.

Foreign country's openness to trade and investment is another factor related with international involvement and has been widely used (Branstetter, Fisman, Foley, and Saggi, 2007; Lesser, 2002; Smith, 2001). Most economists agree that higher openness should enable more international transactions. Lee and Mansfield (1996) found openness has a significantly positive effect on U.S. FDI. Wheeler and Mody (1992), however, suggested the opposite effect and claimed that when FDI production is for the local market, openness of the economy actually reduces investment. This outcome might result from different type of openness or more intensive competition brought by the openness. And at the same time, some other studies suggest mixed effect of openness on international trade and investment (Smarzynska, 2004 and Smith, 2001). These ambiguous results may be also due to the variation in openness measurements used by different studies.

The incentives to international involvement, especially income tax exemption, would be a third factor worth special attention. According to De Mooij and Ederveen's (2003) detailed discussion of taxes effects on FDI literature across 25 studies, a median tax-elasticity of FDI is -3.3, which implies that higher taxes do affect FDI inflows negatively. There, however, are others who argue that those incentives from governments

do not really help attract international trade and investment. The main reason is that usually disincentives will also be attached to the incentives or that incentives have too many restrictions to apply. More comprehensive discussion can be found in Agarwal (1980). Empirically, Smith (2001) finds significant effect of taxes on FDI, and so do Smarzynska (2004) and Branstetter, Fisman, Foley, and Saggi (2007) though their results are mixed.

Last, there are many other factors affecting international trade and investment, for instance, exchange rate and its volatility, labor cost, political stabililty, managerial unrational behavior, institution quality, oligopolistic reaction, past international experience, diplomatic relationships between countries. This paper here only uses exchange rate and past international experience as additional variables. The others are not included in this analysis, so that these complicated variables that usually mingle empirical results or are difficult to measure would not prevent us too much from studying our key variable IPR. And this paper does include control variables commonly used in most previous relevant studies.

4. Empirical Methodology and Data

4.1 Econometric Model Specification

This paper uses gravity model for panel data as the basis for empirical model specification. Gravity model provides a generalized framework consistent with a variety of general equilibrium international trade models. In addition, the theoretical and empirical foundation for this modeling approach is well outlined in past research (Anderson, 1979; Anderson and Wincoop, 2003; Brainard, 1993; Bergstrand, 1990; Ferrantino, 1993; Fink and Primo Braga, 2005; Horstmann and Markusen, 1987 and 1992; Nicholson, 2007; and Smith, 2001). Therefore, the model specification here is:

$$\ln(Y_k) = \beta_0 + \beta_1 \times PAT_k + \beta_2 \times \ln(GDP_k) + \beta_3 \times \ln(DIST_k) + \beta \times X_k + \varepsilon_k \qquad (1)$$

where Y_k is international trade and investment outflow from U.S. to host country k, here in this paper Y takes the forms of exports (EXP) and FDI. GDP_k stands for gross domestic production or income of host country k. $DIST_k$ is for distance between country k and U.S., and PAT for measure of IPR protection strength. Furthermore, X_k includes all the other explanatory variables, i.e. lagged Y term (LY), exchange rate (EXR), openness to international economic involvement (OPEN), imitative ability (IMI), and FDI for export equation, foreign corporate tax rates (TAX) and export (EXP) for FDI equation. Last, ε_k is a normally distributed error term.

This paper also estimates a modified version of Equation (1) that interacts dummy variables of strong and weak imitative abilities with the IPR variable. This modified version would allow us to examine Hypothesis 3 and 4 in earlier section. The specification is:

$$\ln(Y_k) = \beta_0 + \beta_{0si} \times DUMSI_k + \beta_{1wi} \times PATWI_k + \beta_{1si} \times PATSI_k + \beta_2 \times \ln(GDP_k) + \beta_3 \times \ln(DIST_k) + \beta \times X_k + \varepsilon_k \qquad (2)$$

where $DUMSI_k$ is a 0/1 dummy variable for strong imitative ability of host countries, $DUMSI_k$ equals one for countries with strong imitative abilities and otherwise 0. There is also a counterpart variable $DUMWI_k$. It is also a 0/1 dummy variable for weak imitative ability of host countries, $DUMWI_k$ equals one for countries with weak imitative abilities and otherwise 0. $PATWI_k$ is the product of variable PAT and $DUMWI_k$ and $PATSI_k$ is the product of variable PAT_k and $DUMSI_k$. This diagonal dummy variable structure and interaction terms enable us to directly observe IPR's effects on Y to countries with strong imitative abilities and on Y to countries with weak imitative abilities respectively. This dummy specification also aligns with Smith (2001), who used the same setup. Equation (2)

also includes an intercept-shift term, $DUMSI_k$, that controls for strong imitative abilities' effect by itself and unmeasured determinants of international transaction related to the imitative abilities of countries[1].

Now we interpret the parameters based on predictions from the conceptual framework and literature review earlier. Table 1 summaries the expected parameter signs for each form of the international transactions. First, this paper expects positive coefficients for foreign GDP and negatives for geographical distance in the equations for exports and FDI. Second, we expect ambiguous signs for IPR coefficients in exports and FDI equations. This is because that when market expansion dominates market power we will have a positive coefficient but otherwise it will be negative or zero due to offsets from market power effect. Yet, market expansion effect on FDI will be reinforced by IPR enhanced location advantage. Third, strong imitative ability by itself should impose threats to knowledge assets and have a negative effect on international trade and investment. But it may also smooth international production with better educated labor for FDI. Fourth, for interactions between IPR's influence and country's imitative ability, according to previous section we suggest that given strengthened IPR, weak imitative countries are more easily dominated by market power's negative effect on international trade and investment while strong imitative countries are more affected by market expansion's positive effect. But as said before, the possible negative sign of IPR of weak imitative ability countries for FDI and licenses may also be offset by IPR enhanced location advantage. Moreover, this paper expects exports to decline and FDI to rise as USD strengthened. Also a positive sign of OPEN's parameter is predicted for both international transaction modes. Finally, we propose negative parameters on TAX in the equation for FDI.

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[1] The specification in the equation (1) and (2) are based on conceptual framework, Smith (2001), many trials, and other relevant papers.

4.2 Method

Hypothesis tests for multicollinearity, endogeneity, autocorrelation, heteroscadasticity, and fixed/random effects have been performed by Stata. They are VIF for multicollinearity, Wooldridge's test for autocorrelation, likelihood ratio test for heteroscadasticity, and Hausman test for fixed/random effects. This paper found no multicollinearity. Endogeneity problem with GDP has been detected for sure. First order autocorrelation and cross-sectional heteroscadasticity[2] do exist and have been addressed with the use of robust standard errors. Fixed effects estimates are preferred to the random. The sample years covered by this paper are 1994-2006. A list of 53 countries under study can be found in Appendix 1.

In order to better account for endogeneity problem under this circumstance, this paper adopts dynamic GMM. GMM is a well regarded method when an equation has the presence of lagged dependent variable, non-strictly exogenous independent variables, fixed effects, heteroscadasticity and first order autocorrelation problems. It especially fits for panels with short time period but large individual number and is found more efficient than 2SLS under heteroscadasticity and autocorrelation. One thing, however, is that GMM does require no second order autocorrelation existing. Here, after each GMM estimation, Arellano-Bond test for AR(2) in first differences has been performed. Sargan test of overidentification restriction have also been done. Additionally, this paper restricts sets the maximum number of lags of the predetermined variables that can be used as instruments to prevent too many instruments from being applied. The dangers associated with having many instruments relative to observations are documented in the applied literature. The instruments can overfit endogenous variables, failing to expunge their endogenous

[2] For exports equation, the test does not reject heterscadasticity at 10% but reject at 15% significant level. Given our sample with more than 50 countries, heteroscadasticity should be considered for sure.

components and biasing coefficient estimates. Meanwhile, they can also vitiate statistical tests.

Between differenced GMM (Arellano and Bond, 1991 and 1998) and system GMM (Arellano, 1995; Blundell and Bond, 1998), usually system GMM will be preferred because of its higher efficiency than differenced GMM by empirical literature and simulation studies (Hayakawa, 2007). Differenced GMM could be consistent, but also suffer from finite sample bias and estimated coefficients have down-ward biased problem. System GMM uses an additional set of moment conditions where the differenced are used as instruments for the level equations, which can better solve such problems. Therefore, this paper uses system GMM estimates.

Furthermore, between one-step GMM and two-step GMM, Arellano and Bond (1991) recommended using one step GMM results for coefficient inference because the two step standard errors tend to be biased downward in small samples. Two step GMM post-estimation hypothesis test, however, may be better for performing inference on model specification. Two-step GMM's Sargan overidentification tests usually will be more efficient and preferred than the one step Sargan test with the presence of heteroscadasticity. This paper will report both one-step and two-step results from dynamic system GMM.

4.3 Data

4.3.1 IPR Measurements

Several indices have emerged for the measurement of IPR protection with increasing academic and policy-oriented interest in IPR. The first such index was developed by Rapp and Rozek in 1990. They rated the patent laws of 157 countries on a scale from 0 to 5. As a measure for the strength of IPR protection, however, the index is incomplete because it ignores other types of IPR other than patent, such as trademark and

copyright. It also does not take into consideration the enforcement of a country's patent laws.

Subsequently, Ginarte and Park (1997) constructed a more elaborate ranking that significantly expanded the work by Rapp and Rozek (1990). Their index has become one of the most widely used indices in evaluating patent laws on the books. Later, Ginarte and Park's patent index has been extended to more recent years in Park (2008). This paper will apply this index as measure of IPR protection to be comparable with other relevant studies.

To consider all types of IPR and address how the law on paper has performed in practice, Lee and Mansfield (1996) compiled another index of IPR protection for 16 developing countries and newly industrialized countries by calculating shares of U.S. firms who reported that their host country IPR regimes were too weak to allow investment, technology transfer, or licensing. Similarly, Seyoum (1996) measures IPR protection in a scale of 0-3 through a survey sent to IPR practitioners. Sherwood (1997) proposes a third measure of IPR protection that combined personal knowledge and experience with professional interviews, which however is regarded as subjective by some researchers (Primo Braga and Fink, 1998).

Other sources of comprehensive IPR indices include Lesser (2002), Horst (2006), the World Economic Forum's (WEF) Global Competitiveness Reports, and the Economic Freedom of the World Annual Report (EFW, 1980-2006). They are all based on both laws on the books and enforcement. This paper uses both EFW's IPR index and Park (2008) patent index as measure for the protection, and compares results.

4.3.2 Other Data Sources

Data for U.S. exports in FAS Value[3] are from the U.S. Department of Commerce and the U.S. International Trade Commission websites. U.S. FDI and licenses data were obtained from the Bureau of Economic Analysis' (BEA) online databank. FDI can be measured as affiliates' sales, value added, and FDI position on a historical-cost basis in U.S. dollar value, and this paper selects the third measurement.

Independent variables regarding host countries apart from IPR will be GDP, geographical distance, exchange rate, U.S. foreign affiliate received tax rate, and openness to international transactions. Host country's GDP at current price in U.S. dollars came from World Bank to measure foreign market size. Geographic distance is the great circle distance between capital cities from Haveman's international trade website[4]. Exchange rates (local currency per USD) are obtained from CEIC database. Tax refers to corporate income tax rates in host countries as a percentage of taxes of affiliates to their sales, which was calculated from BEA's U.S. Direct Investment Abroad: Results from Annual Surveys. Measure for openness to international transactions was found in EFW Annual Report, it counts openness to not only international trade but also capital flows[5].

In addition to the above variables that can be obtained directly from other sources, this paper also constructs another important variable, host countries' imitative

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[3] FAS value stands for free alongside ship value. The value of a commodity at the port of exportation, generally including the purchase price plus all relevant charges incurred alongside the carrier at the port of the exporting country.

[4] Please see:
http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt

[5] This variable has been measured by combining the following factors: taxes on international trade (including Revenue from taxes on international trade as a percentage of exports and imports, mean tariff rate, and standard deviation of tariff rates), regulatory trade barriers (non-tariff trade barriers and compliance cost of importing and exporting), size of the trade sector relative to expected, black-market exchange rates, and international capital market controls (including foreign ownership/investment restrictions and capital controls).

ability that may affect exports, FDI, and licenses and the relationship between them and IPR protection. The imitative ability implies a country's capability of learning and copying new technologies from other countries. This paper estimates the host countries' imitative abilities by combining several logged indicators. The higher the score the stronger the imitative ability. These indicators are total government education expenditure, education enrollment, research and development researchers, technicians and equivalent staff numbers, patent applications, patents in force, railways traffic passengers and freight, literacy rates aged 15-24, education primary completion rate, telephone lines and cellular subscribers per 100 population, internet users per 100 population and personal computers per 100 population[6]. All these indicators are statistics published by UN Statistics and UNESCO (years covered are varied for each indicator). Table 2 summaries the original dataset's statistics before logarithm transformation.

5. Empirical Results

This paper asks: (1) what is the general effect of IPR on U.S. exports and FDI (Hypothesis 1); (2) while IPR getting stronger, does FDI increase more than exports, i.e. strong IPR shifts international transactions from exports to FDI (Hypothesis 2); (3) how will countries' imitative ability affect the above relationships (hypothesis 3 and 4).

First, in Equation (1) this paper finds statistically significant negative impact of IPR on export while positive on FDI in both one-step and two-step estimations, which is mostly consistent from past literature. This implies that in exports market, market power effect dominates market expansion effect, but this is the opposite for FDI (hypothesis 1). The result could also indicate that stronger IPR confers a location advantage which increases more U.S. FDI relative to exports (hypothesis 2).

[6] The number of complaints about imitation for each sample countries can be another indicator in measuring imitative abilities of them. But because of data availability, we did not include it here for now.

Second, in Equation (2) this paper distinguishes countries with strong imitative ability from countries with weak imitative ability. As expected, results from both exports and FDI equations confirm the previous obtained negative and positive IPR effects respectively. Particularly, we finds for countries with weak imitative ability, the strengthening of IPR protection would decrease their received U.S. exports, while no such statistically significant negative effect for countries with strong imitative ability. Yet, countries' imitative ability difference does not matter much for the positive effect of IPR on FDI, though the coefficient is slightly larger for IPR's effect for countries with strong imitative ability. This indicates that multinational firms would more likely to produce in countries with strong imitative ability given better IPR protection in all countries. These results are mostly consistent with our hypotheses 3 and 4.

The other factors included in the model have also shown some significant influence on U.S. international trade and investment. Large host country market size (GDP) has strong positive impacts on both kinds of international transactions, especially for exports. Exchange rate (local currency per USD) has a negative coefficient for exports and a positive for FDI, as expected. Foreign countries' openness could slightly encourage both their received U.S. export and FDI. Tax has a negative effect on U.S. FDI. Table 3 and Table 4 report regression results using IPR index from EFW. Similar results are obtained using patent index from Park (2008), but IPR's negative effect on exports is statistically insignificant.

6. Conclusion

There is an ongoing debate among analysts regarding the extent to which stronger IPR actually stimulate international transactions. This paper addresses this issue by evaluating how foreign intellectual property rights (IPR) protection affects how U.S. firms serve overseas markets through exports and foreign direct investment (FDI). Using

panel data from 53 countries over 1994-2006, the empirical analysis was based on a dynamic system GMM modeling framework. Similar to Smith (2001), the analysis explicitly investigated how the interaction between IPR protection and imitative abilities in of the host countries impacts international trade and investment.

Overall, the empirical results suggest that IPR has a weak negative effect on U.S. exports, but a statistically significant positive effect on U.S. FDI. In addition, the results also indicated that less US exports flow to countries with weak imitative ability after they strengthen IPR protection. The study also finds that other important variables (foreign market size, exchange rate, openness, and affiliates' received taxes) play a significant role in explaining the variations in U.S. exports and FDI. The empirical evidence from this study has some policy implications for international commerce. Specifically, foreign countries, especially those with strong imitative ability, can to attract more international transactions from U.S. strengthening their IPR protection. However, countries with weak imitative ability may not receive much economic benefits from adopting more stringent IPR regimes.

APPENDIX

A.1 List of Countries

Argentina	Greece	Panama
Australia	Honduras	Peru
Austria	Hong Kong	Philippines
Belgium	Hungary	Poland
Brazil	India	Portugal
Canada	Indonesia	Russia
Chile	Ireland	Singapore
China	Israel	South Africa
Colombia	Italy	Spain
Costa Rica	Japan	Sweden
Czech Republic	Korea	Switzerland
Denmark	Luxembourg	Taiwan
Dominican Republic	Malaysia	Thailand
Ecuador	Mexico	Turkey
Egypt	Netherlands	United Arab Emirates *
Finland	New Zealand	United Kingdom
France	Nigeria	Venezuela
Germany	Norway	

Note: *United Arab Emirates is not included in regressions using Park (2008) patent index.

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Table 1. Predicted Signs of Major Coefficients

Variable	Abbreviation	Exports	FDI
Market Size	**GDP**	**Positive**	**Positive**
Distance	**DIST**	**Negative**	**Negative**
Intellectual Property Rights	**PAT**	**(1)**	**(2)**
Strong Imitative Abilities Dummy	**DUMSI**	**Negative**	**(3)**
Imitative Ability (Continuous Measure)	**IMI**	**Negative**	**(3)**
PAT*Weak Imitative Abilities	**PATWI**	**Negative**	**(2)**
PAT*Strong Imitative Abilities	**PATSI**	**Positive**	**Positive**
Exchange Rate (Local Currency to USD)	**EXR**	**Negative**	**Positive**
Openness to International Transactions	**OPEN**	**Positive**	**Positive**
Foreign Affiliates' Corporate Tax Rate	**TAX**	**Excluded**	**Negative**

Note: (1) denotes that the sign will be positive if market expansion effect dominates market power effects, otherwise it will be negative or zero. (2) denotes that apart from the interaction between market expansion and power effects, positive effect of IPR enhanced location advantage should also be considered. (3) denotes that negative effect of countries' strong imitative abilities by itself may be offset by the countries' quality labor that could smoothen international production for FDI.

Table 2. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Exports (Million USD)	12970.87	26742.23	0.00	230257.00
FDI (Million USD)	23403.85	45329.23	68.00	375348.00
IPR Index by EFW	5.84	1.98	1.47	9.61
IPR Index by Park (2008)	3.70	0.81	1.18	4.70
Exchange Rate	318.99	1401.17	0.04	22727.00
Distance	8153.52	3816.46	733.89	16370.82
GDP (Million USD)	430523.24	742894.04	3432.36	5244246.29
Openness Index	7.45	0.96	4.31	9.78
Tax Rate	0.03	0.05	-0.05	0.48
Imitative Ability Index	49.31	5.51	29.99	62.69

Table 3. System GMM Estimation for Export

	Equation (1)		Equation (2)	
	One-Step	Two-Step	One-Step	Two-Step
LEXP	0.930 ***	0.937 ***	0.933 ***	0.963 ***
	0.022	*0.022*	*0.023*	*0.022*
GDP	0.174	0.228 ***	0.179	0.113 *
	0.117	*0.051*	*0.123*	*0.066*
DIST	-0.130	0.484 *	-0.110	-0.187
	0.119	*0.260*	*0.121*	*0.198*
PAT	-0.034 **	-0.022 ***		
	0.017	*0.007*		
PATSI			-0.018	0.002
			0.024	*0.009*
PATWI			-0.054 ***	-0.042 ***
			0.020	*0.011*
IMI	-0.981	0.523	-0.841	0.217
	0.766	*0.577*	*0.762*	*0.623*
DUMSI			-0.274	-0.258 ***
			0.171	*0.068*
EXR	-0.026	-0.135 ***	-0.031	-0.052
	0.025	*0.037*	*0.025*	*0.045*
OPEN	0.001 **	-0.003	0.001 *	0.001
	0.000	*0.002*	*0.000*	*0.001*
FDI	0.013	-0.028	0.007	-0.019
	0.034	*0.018*	*0.036*	*0.019*
AR(2)	No	No	No	No
Sargan	Valid	Valid	Valid	Valid

Note: *, **, *** indicate significance levels of 0.1, 0.05, and 0.01, respectively. Italianized numbers under coefficients are standard errors. DIST stands for geographical distance, IMI for imitative ability, EXR for exchange rate, OPEN for openness, and PAT for IPR protection in host countries. DUMSI is 0/1 dummy variable for strong imitative ability of host countries, DUMSI=1 if the countries' imitative ability score > sample countries' average, otherwise 0. DUMWI is 0/1 dummy variable for weak imitative ability of host countries, DUMWI =1 if the countries' DUMSI=0, otherwise 0. PATWI =PAT score*DUMWI and PATSI =PAT score*DUMSI. No AR(2) has been found. Sargan test of overidentification restriction have also been done, and the results suggest validity and no underidentification problem. PAT index is from EFW.

Table 4. System GMM Estimation for FDI

	Equation (1)		Equation (2)	
	One-Step	Two-Step	One-Step	Two-Step
LFDI	0.848 ***	0.914 ***	0.847 ***	0.773 ***
	0.070	*0.035*	*0.070*	*0.056*
GDP	-0.114	-0.068	-0.114	0.147 *
	0.102	*0.077*	*0.101*	*0.090*
DIST	0.178	0.049	0.176	-0.345
	0.246	*0.210*	*0.245*	*0.263*
PAT	0.088 **	0.048 ***		
	0.039	*0.014*		
PATSI			0.093 **	0.049 ***
			0.042	*0.017*
PATWI			0.079 **	0.042 **
			0.035	*0.017*
IMI	-0.195	-0.669	-0.144	0.963
	0.497	*0.603*	*0.547*	*0.811*
DUMSI			-0.077	-0.041
			0.142	*0.086*
EXR	-0.031	-0.036	-0.031	0.006
	0.034	*0.028*	*0.034*	*0.039*
OPEN	0.000	0.002 **	0.000	0.000
	0.000	*0.001*	*0.000*	*0.001*
TAX	-0.005	-0.005 **	-0.005	-0.005 *
	0.008	*0.002*	*0.008*	*0.003*
EXP	0.046	0.020	0.047	0.021
	0.030	*0.019*	*0.030*	*0.019*
AR(2)	No	No	No	No
Sargan	Valid	Valid	Valid	Valid

Note: *, **, *** indicate significance levels of 0.1, 0.05, and 0.01, respectively. Italianized numbers under coefficients are standard errors. DIST stands for geographical distance, IMI for imitative ability, EXR for exchange rate, OPEN for openness, and PAT for IPR protection in host countries. DUMSI is 0/1 dummy variable for strong imitative ability of host countries, DUMSI=1 if the countries' imitative ability score > sample countries' average, otherwise 0. DUMWI is 0/1 dummy variable for weak imitative ability of host countries, DUMWI =1 if the countries' DUMSI=0, otherwise 0. PATWI =PAT score*DUMWI and PATSI =PAT score*DUMSI. No AR(2) has been found. Sargan test of overidentification restriction have also been done, and the results suggest validity and no underidentification problem. PAT index is from EFW.