6-2011

Foreign Direct Investment Response Following Intellectual Property Rights Reform

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By

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Submitted in partial fulfillment
of the requirements for
Honors in the Department of Economics

Union College

June, 2011

Abstract

LUNDQUIST, SAMUEL G. Foreign Direct Investment Response Following Intellectual Property Rights Reform.
Department of Economics, June 2011.

Over the past several decades, Foreign Direct Investment (FDI) flows across the globe have increased markedly. During this same period, a large number of countries have strengthened their Intellectual Property Rights (IPRs) regimes in response to global legislative changes such as the Agreement of Trade-Related Aspects of IPRs or domestic policy initiatives. In this thesis, I empirically investigate the impact of IPR reform on FDI activity. I use a panel data set that consist of FDI flows from Germany and US into 15 host countries over a 24 year time period. As a proxy for IPR regime change I use the patent reform dummy developed by Branstetter et al. (2006, QJE). I use a difference-in-difference regression approach, accounting for fixed country effects and fixed time effects. I also control for GDP per-capita, GDP, real-exchange rate and trade openness. The results imply that following IPR reform there is a statistically significant and quantitatively substantial increase in FDI inflows. The findings are robust under a number of different specifications. In addition, I find that richer countries receive higher levels of FDI inflows following IPR reform using U.S parent data. However, following IPR reform, with German parent data indicates that richer countries receive *lower* levels of FDI.

Acknowledgements:

I would like to especially thank my thesis advisor, Professor Fuat Sener for the dedication of his time and expertise which were vital for the completion of this project. In the past several months, Professor Sener's, assistance has substantially increased my economic expertise in addition to my writing ability. Without his assistance this project would not have been possible. I would also like to thank Professor Lewis Davis and Professor Eshragh Motahar for the insightful comments and suggestions during my oral examination.

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1. Introduction

Throughout modern history, intellectual creations have played a pivotal role in the development of the world economy. These intellectual creations have facilitated the creation of new technologies, advanced the quality of existing products, increased productivity, and improved the quality of life for society. These intellectual assets—or intellectual property (IP) — are pieces of information or ideas that have the potential to yield economic value if they are put into use in a marketplace (Maskus, 2000). Over the past few decades, IP has become increasingly protected through expanded Intellectual Property Rights (IPRs). This movement towards stronger IPRs was expedited through international treaties and agreements, most notably the Agreement of Trade Related Aspects of Intellectual Property Rights (TRIPS) passed by the WTO in 1995. During the TRIPS negotiations, heated debate occurred between developing and developed countries regarding the potential ramifications of proposed IPR reform. Many developing nations opposed strengthening their IPR structures, fearing their ability to acquire and use more sophisticated technologies from developed nations would be impeded. On the other hand, developed nations argued that stronger IPRs would motivate foreign firms to increase investments through Foreign Direct Investment (FDI) and thereby accelerate technological transfer to these developing countries. The controversial passage of the TRIPS agreement has motivated a rich theoretical and empirical literature regarding the effects of IPR reform on FDI. However, to date, this literature has yielded somewhat ambiguous and conflicting findings.

This thesis builds on previous literature in an effort to more accurately gauge the response of FDI activity following significant and well defined IPR reform. To accomplish this, a difference-in-differences empirical approach is used to estimate the effect of IPR reform on

FDI activity using U.S and German FDI outflows into 15 host countries across a 24 year period.[1] A patent reform dummy—established by Branstetter (2006)—serves as a proxy for IPR reform. The following variables act as controls: GDP per-capita, GDP, exchange rate and trade openness. Country and time fixed effect variables are also used to isolate idiosyncrasies within countries and individual years. In addition, this paper analyzes whether FDI activity is more responsive in high income countries following reform. To accomplish this, two interaction terms are included which estimate the response of FDI relative to income, following IPR reform.

The results from this study indicate, following IPR reform, there is a statistically significant increase in FDI activity in the 15 sample countries, and these results are robust under a number of different specifications. The results estimating FDI response depending on host country income level are somewhat ambiguous. More specifically, the results using U.S FDI outflows indicate that high income host countries receive an extra kick of FDI following reform. However, these results are not robust for all specifications. On the other hand, when German FDI outflows are examined, high income host countries receive less FDI following reform.

1.1 TRIPS Agreement Overview

IPR reform was the main concern of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) enacted under the Uruguay rounds of multilateral negations by the WTO in 1995. The initial motivation for the agreement arose due to the "widely varying standards in the protection and enforcement of intellectual property rights and the lack of a multilateral framework of principles, rules and disciplines dealing with international trade in

[1] The list of host countries and reform years is provided in Table 1 of the Appendix

counterfeit goods have been a growing source of tension in international economic relations" (WTO). The goal of the TRIPs agreement was to establish a more uniform international system of IPRs. The provisions of the agreement set a minimum standard for the protection (and the enforcement) of intellectual properties. Most notably, the agreement requires WTO member nations to: grant patents to a broad array of innovations for a minimum of twenty years, treat foreign and domestic applications the same, and create new standards of enforcement—that provide civil and criminal penalties for infringement (WTO).

1.2 IPRs in the Global Economy

IPRs grant owners of certain intellectual property (IP) exclusive rights to intangible assets. Intellectual property includes: music, literary, and artistic work; discoveries and inventions; and words, phrases and symbols (Boldrin and Levine, 2002). IP is protected by various mechanisms including patents, copyrights, trademarks and industrial design rights which vary in terms of their duration of protection and the breadth of protection.

Since the passage of TRIPS in 1995 significant convergence of IPR structures has occurred among developed and developing nations. From 1990 through 2005, the strength of IPRs increased by 29.5% for all countries.[2] However, this figure is somewhat misleading because the majority of the increase in IPR strength came from middle to low income countries—excluding least developed nations (LDNs).[3] For instance, in the ten years following the passage of TRIPS, South Korea increased its IPR measure from 3.89 to 4.33, while Mexico

[2]Figure calculated using the Park (2008) patent index. For a more complete explanation of the patent index see section 3.4 of the methodology chapter for a more complete explanation.
[3] LDNs have until July 2013 to meet the requirements outlined in TRIPS. See the WTO press release from November 29th 2005, http://www.wto.org/english/news e/pres05 e/pr424 e.htm. LDNs are defined by the United Nations as any country with a three year average GNI below 905 USD.

increased its measure from 3.14 to 3.88. Middle income countries such as these have been able to more effectively implement stronger IPR structures due to their greater *capacity* to adjust their systems (Park, 2008). Unlike lower income countries, middle income countries generally have more extensive resources available to implement stronger IPR systems. Also, these middle income countries may have a greater *willingness* to adopt stronger IPR regimes (Park, 2008). Grossman and Lai (2004) find that the incentive for stronger IPRs is greater in countries with larger market size and innovative capacity which increase the net marginal benefits of IPR reform. As middle income countries continue to grow, along with increased demand from developed countries for stronger international IPR protection, it appears IPRs are likely to continue to expand in scope and scale in the coming future (Sener, 2006).

The proliferation of IPRs has not been favored by all parties. The TRIPS agreement along with other recent legislation to strengthen IPRs has engendered a heated debate regarding the relative merits of IPRs. Proponents of stronger IPRs argue that IPR reform accelerates innovation in the world economy and facilitates growth in developing nations (Dinopoulos and Segerstrom, 2010). Developing nations, they argue benefit from increased technological transfer from developed nations (the North) to developing nations (the South) through increased foreign direct investment (FDI) by multinational enterprises (MNEs). According to Branstetter, Fisman, Foley, and Saggi (2010), stronger IPRs could lead MNEs to expand the scope and scale of their operations, manufacture tech-intensive goods, and shift the production of existing goods to IPR reformed countries. Proponents believe these benefits offset the costs of instituting stronger IPRs. These costs arise from the fact that the South had poor or ineffective IPR structures prior to TRIPS which lacked the institutional mechanisms required to adequately meet criteria outlined in the agreement. Implementation of TRIPs requires significant monetary outlays for these

countries to build necessary infrastructure, purchase necessary equipment, train staff, and establish a working system that is both, secure and enforceable for (Finger, 2000). Most developed nations already had satisfactory IPR systems hitherto TRIPS. Therefore, developing nations incurred a disproportionate amount of the costs resulting from TRIPS.

However, stronger IPRs—argue opponents of reform—create implicit costs resulting from reduced competition in markets and less innovation. The South relies on technological diffusions from the North to increase innovation and facilitate economic growth. As a result, more stringent IPR structures put an increased economic burden on these countries because they must pay higher prices from licensing agreements to use patented technologies. Consequently, IPR reform leads to a transfer of rents from consumers and producers in the South to patent holders in the North. McCalman (2001) found that transfers of wealth caused by the passage of TRIPS benefit the United States, Germany, Italy, France, Sweden, and Switzerland, and negatively affect all other countries.

A significant portion of the findings in the theoretical literature indicates that stronger IPRs are never in the interest of the South. Stronger IPR enforcement in the South causes a reduction in imitation by Southern firms. When Northern firms are prohibited from shifting production to the South via FDI, stronger IPRs in the South lead to a reduction in Northern innovation.[4] Reduced innovation in the North reduces global welfare because the portfolio of available products declines (Branstetter, 2010). On the other hand, if Northern firms succesfully shift production to the South, reduced imitation—following the implementation of stronger IPRs

[4] Further explanation of these findings is provided in the literature review, specifically Glass and Saggi (2002) and Dinopoulos and Sergerstrom (2007) on pages 11-12 and 14 respectively.

in the South—causes more FDI, but harms Southern welfare because MNE produced products are more expensive than Southern imitators.[5]

Boldrin and Levine (2002) argue "'intellectual property' has come to mean not only the right to own and sell ideas, but also the right to regulate their use." Excessive IP protection can lead to "IP inefficiency" (Boldrin and Levine, 2002). This inefficiency results due to the fact that many patents are often held by firms as "defensive legal bargaining tools" against competition (Boldrin and Levine, 2002). Firms holding defensive patents can impede rival firms from creating higher quality products that are cheaper to produce. This harms consumers because they are forced to pay higher prices for inferior products. A noteworthy example is the agriculture industry where defensive patents are frequently used. In this industry, firms often use defensive patents to protect various types of modified seeds.[6] Consequently, farmers in developing countries are required by law to pay licensing fees in order to use these more productive seeds.

1.3 FDI in the Global Economy

In the past several decades, the world economy has become significantly more inter-connected. One consequence of this inter-connection is increased activity in foreign markets through FDI. FDI is the process by which a corporation, government, or individual makes a long term investment in a country outside of their domestic market (OECD ILibrary). However, FDI is not simply a monetary outlay, and can take on several different forms including: an acquisition of a foreign firm, building infrastructure, joint-ventures, and technology transfers (Graham and Spaulding, 2006).

[5] A more thorough discussion of the theoretical literature is provided in section 2.1 of the literature review chapter on pages 10 through 16.
[6] See Boldrin and Levine (2002) for a more thorough discussion

FDI provides a vital source external capital and is an important vehicle for economic growth for many countries. Countries receiving inward FDI benefit in a few ways. First, inward FDI can lead to increased exports. Branstetter (2010) finds that increased MNE activity led to an increase in exports of new goods. Furthermore, FDI accelerates technological transfer from the North to the South, which can boost the South's innovative capacity. However, the benefits of FDI do not necessarily accumulate instantaneously and evenly across countries (OECD, 2002). In the theoretical literature, increased FDI flows to the South are often accompanied by a decline in Southern imitation. The relative magnitudes of these competing forms of technology transfer determine the change in innovation in the South. Consequently, FDI may benefit one party more than the other.

In the recent years, FDI has increased dramatically in the global economy. From 1980 to 2008, FDI inflows in the world economy increased by over 150% or, approximately 5.2% per year (OECD ILibrary). Although FDI inflows to developing nations are still less than developed nations, inflows worldwide are beginning to become more dispersed. From 1980 to 2008 developing countries' share in total FDI inflows increased from 26% to 37% (OECD ILibrary). Figure 1 displays a graphical representation of the increases in FDI inflows in developed and developing countries from 1990 through 2007.

However, FDI has not been evenly dispersed across countries and regions. Figures 2 depict outward U.S. and German FDI into the 15 host countries examined in the empirical analysis of this paper. Figure 2 illustrates that FDI flows are not evenly dispersed across the sample countries. In addition, FDI inflows appear to be changing at different rates overtime between countries. For example, from 2002 through 2008 FDI inflows in China, Japan, and Brazil increase steadily, while FDI inflows in Argentina and the Philippines remain relatively

constant. Figure 2 also indicates that there are also significant changes in FDI inflows within countries. For example, FDI inflows in Mexico increase slightly from 1985 to 1995; however, from 1996 through 2008 FDI inflows increase more rapidly.

Figure 3 provides a correlation matrix of IPR strength and inward FDI per capita for the 15 sample countries. Examining Figure 3, there is a relatively strong positive correlation between inward FDI and IPR strength. However, correlation does not necessarily imply causation. Therefore, a more rigorous analysis of this relationship is executed in the following sections of this paper to determine the response FDI following IPR reform episodes in these 15 host countries.

The rest of the thesis is organized as follows. Chapter 2 examines the related theoretical and empirical literature. Chapter 3 explains the data and outlines the methodology used for the empirical study. Chapter 4 displays the empirical results. Finally, Chapter 5 provides a few concluding remarks and policy recommendations.

2. Literature Review

2.1 Theoretical Literature

The theoretical literature mostly utilizes North-South production cycle models to investigate the impact of IPR reform on FDI, innovation, and imitation. In the model, there are two countries: the North and the South where the former is analogous to a developed nation while the later is analogous to a developing nation. Northern firms undertake R&D to create new *or* better products, while southern firms undertake imitation of Northern products. When R&D efforts are successful in the North, a product is developed and innovation increases. Firms in the North that are successful with their R&D efforts, first produce their product in the North and then attempt to find ways to shift production to the South, where production costs are lower. The transition of production from the North to the South is known as "technology transfer". Successful technology transfer from the North to the South leads to multinationalization—Northern firms become MNEs —where Northern firms shift full or partial production to the South through FDI. Production can also shift to the South when a Southern firm successfully imitates a Northern product. When innovation increases further in the North, production shifts back to North and the cycle starts over. This product cycle methodology is first modeled in Vernon (1966) and further refined by Segerstrom et al. (1990), Grossman and Helpman (1991) and others.

In the product cycle literature, multinationalization is usually both costly and risky. Despite these risks, technology transfer through multinationalization can also be beneficial for Northern firms because production costs are lower in the South. Both northern firms and MNEs

are subject to the risk that their product will be imitated by southern firms.[7] This risk of imitation however, is reduced when IPRs are strengthened in the South. Glass and Saggi (2002) describe this reduced risk as an "imitation tax" levied on Southern firms.

The North-South production cycle model take on two basic forms: quality-ladders and variety expansion.

a. Quality-Ladders Model

Quality-ladders models investigate the interplay between Northern innovation and Southern imitation, where R&D in the North aims to improve the quality of an existing product. In this model, once a superior product has been created, the old product becomes obsolete and production shifts back to the North. The quality-ladders literature offers mixed results for the effect of IPR reform on FDI.

Glass and Saggi (2002) incorporate a North-South quality-ladders model in which imitation, innovation, and FDI are all endogenous, which is the first paper to incorporate these specifications. The authors' findings reveal that when stronger IPRs are incorporated in the South, FDI decreases. Their findings indicate that Northern firms have no additional incentive to become MNEs because the risk of their product being imitated is the same in the North as the South following IPR reform.

In this model, "technology spillover"—or the transfer of technology from the North to the South—occurs through two outlets: FDI and imitation. Glass and Saggi's (2002) findings reveal that stronger IPRs in the South create a "resource wasting effect" and a "disincentive for

[7] In a few of the theoretical models, such as Dinopoulos and Segerstrom (2010) only MNEs can be imitated by Southern firms.

imitation" which deters FDI, and leads to a contraction of imitation in the South. Imitation in the South is deterred following reform because the stronger IPRs have the effect of making imitation more costly. Imitation is more costly following reform because Southern firms have to alter their products so they are not as distinguishable; pay licensing fees; or incorporate reverse engineering to imitate Northern products. All of these examples require additional time and resources for imitation. As a result, imitation is more expensive; leading to a decline in production in the South. Production in the South declines due to the increased cost of imitation which leaves fewer resources available for production. This causes the "resource wasting effect"—akin to a contraction in Southern labor supply. This also leads to a reduction in FDI. With less production in the South, the North must divert some of its resources away from innovation (R&D) to production. This results in further "resource wasting" because the North has a comparative advantage in innovation. With less workers conducting R&D, innovation and FDI decline.

Sener (2006) develops a quality-ladders model to investigate the effect of an exogenous increase in Southern IPRs on endogenous innovation, imitation, and FDI. Like Glass and Saggi (2002), Sener (2006) also finds that stronger IPRs in the South lead to a reduction in innovation, imitation and FDI. The author's model differs from previous literature in a few ways. First, at the steady-state equilibrium in the model, innovation, imitation and multinationalization are constant despite the existence of population growth. This prevents the model from being subject to scale effect critiques highlighted by Jones (1995). Second, the model predicts the steady-state rate of innovation to be a function of the proportion of resources designated to R&D. Sener's (2006) model also differs from Glass and Saggi (2002) and others because his model incorporates fragmented production. Fragmented production allows MNEs to offshore an endogenously chosen portion of production to the South. So, unlike Glass and Saggi (2002)—where all MNE

production either shifts to the South or remains in the North—Sener (2006) allows for some portion of MNE production to remain in the North and some to move to the South. Finally, Sener (2006) incorporates rent protection activities building on the work of Dinopoulos and Syropoulos (2006).

Rent protection activities allow Northern firms that successfully innovate to "safeguard" their innovations (Sener, 2006). These safeguards enable Northern firms to extend the duration of monopoly control of the market. In the Sener's (2006) model, Northern innovators conduct two types of rent protection: *innovation-deterring activities* and *imitation-deterring activities*. *Innovation-deterring activities* attempt to thwart successful innovation of other Northern firms, while *imitation-deterring activities* are aimed at reducing imitation from Southern Firms.

Sener (2006) investigates the effect of MNE activity by examining both, the aggregate rate of FDI and the proportion of multinational industries. The results from his model indicate that following IPR reform in the South, the proportion of multinational industries increases, but the aggregate rate of FDI declines. At the equilibrium following reform, Sener (2006) finds that the proportion of Northern industries declines but, the proportion of Northern industries *and* MNEs increases. This increase, leads to a decline in the fraction of aggregate Southern industries. The reduction in Southern industries produces a decline in imitation. However, the author's findings also indicate that the fraction of production that occurs in the South *within* MNEs increases following reform. So, established MNEs expand production in the South following reform.

Building on previous literature, Dinopoulos and Segerstrom (2010) develop a North-South quality-ladders model. Unlike previous quality-ladders models, Dinopoulos and Segerstrom's (2010) model has no imitation by Southern firms. Consequently, all technology transfer occurs through FDI. The authors' model demonstrates that an exogenous increase in Southern IPR leads to an increase in FDI. Furthermore, the authors' results indicate that Southern IPR reform leads to a temporary increase in Northern innovation as well as a permanent decrease in the North-South wage gap.

Dinopoulos and Segerstrom (2010) contrast these results with their previous findings in Dinopoulos and Segerstrom, (2007) where *all* technological transfer from the North to the South occurs through imitation. The results from Dinopoulos and Segerstrom (2007) yield the opposite results of their current study. Following an increase in IPR protection, there is a permanent increase in the North-South wage gap; a temporary decrease in Northern innovation; and a permanent decrease in Southern imitation. If technological transfer occurs through imitation only, stronger IPRs inhibit technological transfer because imitation of Northern products is more difficult and expensive. With less imitation taking place, a greater proportion of production occurs in the North, hindering the ability of Northern firms to innovate through R&D.

These polar findings highlight the importance of the method of technological transfer. In the real world, technological transfer occurs through both imitation and FDI. So the effects of IPR reform hinge on the relative importance of each method of technological transfer.

b. Variety Expansion Model

In North-South variety expansion production models, Northern innovators conduct R&D in effort to create new varieties of products, in contrast to quality-ladders models, where R&D attempts to create a higher quality product. The theoretical literature incorporating variety expansion models indicates—conclusively—that an exogenous increase in Southern IPRs leads to increased FDI flows.

Helpman (1993) is the first to use a variety expansion model to investigate the effects of stronger IPRs on FDI flows. The author's model incorporates endogenous FDI with exogenous imitation and innovation. The results elucidate that following IPR reform in the South, multinationalization increases. Lai (1998) furthers Helpman's (1993) study by allowing for endogenous FDI *and* innovation while keeping imitation exogenous. Lai's (1998) model, like Helpman (1993), finds that IPR reform in the South causes an increase in MNE activity and FDI.

Using a North-South variety expansion model, Branstetter's et al. (2009) findings are consistent with Helpman (1993) and Lai (1998). Their results show that imitation in the South decreases following IPR reform, however, the increases in FDI (via MNEs) is greater than this decline in imitation. Consequently, the South's share in global manufacturing increases because the increased production from MNEs more than compensates for the decline in Southern imitative production. The South's increased share in global manufacturing indicates that net production shifts from North to South freeing up more resources in the North to conduct R&D. With more resources available for R&D, innovation increases. Higher rates of innovation facilitate increased global welfare.

The findings in Gustafsson and Segerstrom (2010) are also consistent with previous variety expansion literature. Like previous variety expansion literature, Gustafsson and Segerstrom (2010) find that IPR reform leads to faster technology transfer within MNEs and higher consumer welfare in both the North and South in the long-run. The authors' model adds to the previous literature by incorporating costly technology transfer. The authors also remove the effects of country size on technology transfer and long-term growth which alleviates potential scale effects.

2.2 Empirical Literature

The empirical analysis in this paper is most closely associated with the work of Branstetter et al. (2006, 2010). Branstetter et al. (2006, 2010) conduct an empirical difference-in-differences analysis in an effort to determine the response of U.S. based MNEs and domestic industrial production following significant and well defined IPR reform in 16 countries from 1982 through 1999. The authors' create a patent reform dummy as a proxy for IPR reform that equals zero prior to the year of reform and one following reform.[8] This patent reform dummy is used in the same manner for the empirical analysis in this paper.

Branstetter et al. (2006, 2010) first examine the response of technology transfer from parent firms to affiliates following IPR reform. Using surveys of MNE managers, the authors find that technology transfer within MNEs "is sensitive to the perceived strength of IPR structure" (Branstetter et al., 2010, pg. 13). When MNEs transfer sensitive technologies to their affiliates, they must often instruct skilled local labor on how the technology works. This creates a

[8] See section 3.3 of the methodology chapter for a more complete description of the Branstetter (2006) (2010) patent reform dummy.

potential risk for MNEs because local workers can leave the firm with the technological knowledge and join a local firm. If IPRs are weak, MNEs can do little to prevent local labor from exploiting this technology. However, if IPRs are strong, MNEs can prevent this barratry by preventing other firms from using their patented materials. From this intuition, Branstetter et al. (2006, 2010) suggest that following IPR reform, the value of technological flows is greater under stricter IPR regimes.

To measure the value of technological flows, the authors use the volume of intra-firm royalty payments (payments made by affiliates in a host country to their parent corporation for the right to use parent intangible assets) for intangible assets as a proxy for technology transfer. The authors then conduct a difference-in-differences regression analysis. The dependent variable is log affiliate royalty payments and the key independent variable is the patent reform dummy described above. The authors control for a few country and time fixed effects. In addition, Branstetter et al. (2006, 2010) also control for a number of host country characteristics including: corporate tax rate, withholding tax rate, inward FDI restrictions, capital controls, trade openness, and GDP per capita.

The authors' results estimate that intra-firm royalty payments increase by 16% following reform. Not surprisingly, these results are greatest for U.S. MNEs that make frequent use of patents prior to reform. This makes intuitive sense because the potential value of technology flows is greater for these firms. Branstetter et al. (2006, 2010) find that these firms are most often technologically intensive firms. For these tech-intensive firms, there is a 34% increase in affiliate royalty payments. The authors' note however, that an increase in royalty payments could be due to an increase in the price charged for the technology from royalty payments. So, the authors conduct a second specification that measures the value of technology flows.

Branstetter et al. (2006, 2010) next analyze the response of affiliate R&D spending following IPR reform to confirm their results in the first specification. R&D conducted by affiliates in developing countries (the majority of the authors' sample are developing countries) is mostly concerned with absorbing parent country technology and its modification for local markets. (Branstettter et al., 2010, pg. 10) Consequently, changes in affiliate R&D in these countries is a good proxy for technology transfer. Following IPR reform, the authors' results estimate that R&D spending by affiliates increases by 9% for all firms and by 34% for tech intensive firms.

Branstetter et al. (2010) extend their previous analysis by examining disaggregated U.S. trade statistics. Building on previous research, the authors construct an annual calculation of the number of initial export episodes.[9] The authors find that initial exports to the U.S. increase noticeably following reform. This increase, the authors suggest, lead to an expansion of the range of goods and services being produced by MNEs and other non-imitative firms in reforming countries dominates the decline in indigenous innovation following reform. This notion further strengthens the authors' previous theoretical findings that IPR reform expands Southern industrial production.[10] The empirical results estimate a 27% increase in exports to the U.S. from host countries following reform. U.S. exports from tech intensive firms are even more responsive to IPR reform, increasing by 32%. The authors' findings, in total, illustrate a statistically significant and quantitatively substantial increase in MNE activity and domestic industrial production following IPR reform.

[9] This figure is calculated as the number of 10-digit commodities for which recorded U.S. imports from a given Host country exceed zero for the first time in the data. See Branstetter (2010) pgs. 3-4 for more details.
[10] See Branstetter et al. (2009)

Schneider (2005) examines the effect of IPRs, FDI, and high-tech trade on a country's growth and innovation rates. To conduct this empirical analysis, the author uses a panel data set of 47 developed and developing countries in four, five year periods from 1970 through 1990. The author's first specification regress the change in innovation growth against IPR strength, FDI inflows, human capital levels, infrastructure levels, and R&D expenditures. The results estimate that FDI inflows do not have a statistically significant effect on innovation growth. In the first specification, the results also show that IPR protection has a statistically significant effect on innovation growth; however, this impact is only significant for developed countries and may even negatively affect innovation in developing countries. These results suggest that the growth in innovation in the North following reform dominates the decline in imitation in the South following reform. Consequently, foreign firms (the North) benefit at the expense of local firms (the South).

In the second specification, Schneider (2005) examines the effect of IPR strength, FDI inflows, physical capital stock, innovation rate, and growth rate of high-tech imports on the growth rate of GDP per capita (economic growth). The author's findings estimate that IPR strength has a statistically significant impact on GDP per capita growth for all countries. These findings are consistent with previous empirical literature such as Gould and Gruben (1996) which also find a positive and statistically significant impact of IPR strength on growth. The results indicate that countries stand to benefit from IPR reform because they experience higher subsequent growth rates. Finally, the author's results estimate that FDI inflows positively impact GDP per capita growth in developed countries *only*. This implies that FDI inflows lead to economic growth only in countries that have achieved a minimum threshold of economic well-

being (i.e. the North). Consequently, according to Schneider's (2005) findings, increased FDI inflows to the South do not increase the South's economic growth rate.

Smarzynska (2004) examines the composition of firm-level FDI inflows following IPR reform in 24 former Soviet Union countries from 1989 through 1994. The author's data set allows for a unique natural experiment because under Soviet rule, these countries were almost completely closed to FDI. In the first specification, Smarzynska (2004) regresses FDI against IPR strength. As a measure of IPR strength, the author uses the patent reform index created by Ginarte and Park (1997).[11] In addition, the author also controls for firm and country specific explanatory variables. The results indicate that firms are likely to invest in countries with stronger IPRs and these results are especially significant for firms in high technology sectors. These firms stand to benefit most from reform because they tend to hold a higher number of patents.

In her second specification, Smarynska (2004) tests whether FDI inflows following reform are manufacturing or distributing intensive. To test this inquiry, the author constructs a FDI dummy variable that equals one in the case that FDI is from manufacturing and zero otherwise. The author uses the same controls as the first specification. The results from specification two find that when IPRs are weak, firms tend to undertake projects that focus on distribution. Conversely, when IPRs are strong, firms are more likely to invest in projects that focus on manufacturing. Firms conduct manufacturing when IPRs are strong because more sensitive materials are transmitted to affiliates. Consequently, a stronger IPR regime better ensures that these materials will not be imitated.

[11] For a detailed explanation of the Park (1997), see section 3.3 of the Methodology chapter

3. Methodology

3.1. Data

The empirical analysis in this paper utilizes cross-country data from 15 host countries over a period of 24 years—from 1985-2008 found in Table 1.[12] The panel data is pooled to include all countries in each specification to increase sample size. Regressions 1-3 in specification 1 incorporate unbalanced pooled data because the data for some of the countries is not complete (see footnote 10). In regression 4 of specification 1, these countries are dropped to create a balanced pool to check for robustness.

a. Foreign Direct Investment

As a measure for FDI, U.S. and German outward FDI data, measured in millions of U.S. dollars is compiled for each of the fifteen sample countries. The FDI data is provided by the United States and Germany as reported in the OECD International Direct Investment Database.[13] To illustrate the percentage change in FDI rather than the magnitude, the FDI data is logged. To increase the robustness of the results two parent countries FDI outflows are examined. The United States and Germany are the two parent countries chosen for a two reasons. First, both of these countries had significant outward FDI to each of the 15 host countries prior to IPR reform.

[12] See Table 1 for list of countries. U.S. data range is from 1985 through 2008 for all host countries examined excluding: Colombia and Venezuela (no 1985-1989 data); Indonesia (no 2002-2004 data); and Portugal (no 1989 data). Germany Data range is from 1985-2008 for all host countries excluding Columbia (No 2002 data) and the Philippines (no 2006-2008 data). These years were either not reported or were confidential.

[13] <http://www.oecd- ilibrary.org/finance-and-investment/data/oecd-international-direct-investment-statistics_idi-data-en>.

Second, Germany and the United States are the only two countries in the OECD that adequately reported their FDI statistics in all 15 of the host countries examined.

b. Patent reform dummy

To measure IPR reform, the patent reform dummy created by Branstetter et al. (2006, 2010) is used. As mentioned in earlier, the value of the dummy takes a value of 0 prior to the year of reform and a value of 1 following reform (including the year of reform). Their sample includes 16 countries that experienced a significant patent reform episode in 1982 through1999. In this paper, the same 16 countries as Branstetter et al. (2006, 2010) are analyzed with the exception of Taiwan because appropriate FDI data was not available for Taiwan. The list of countries and their year of reform are all listed in Table 1. Branstetter et al. (2006) classified each reform based on whether or not the country strengthened or expanded patent rights based on five criteria:

1: An expansion of the range of goods eligible for patent protection
2: An expansion in the effective scope of patent protection
3: An increase in the length of patent protection
4: An improvement in the enforcement of patent rights
5: An improvement in the administration of the patent system

Expansion of patentable products. According to Branstetter et al. (2006), most of the reforms in the sample extended the scope of patent reforms in pharmaceuticals, agro-chemicals, veterinarian drugs, and food stuffs. In addition, most of the host countries examined does not have universal healthcare systems that control the price and availability of pharmaceutical drugs (Branstetter, 2006, A.2.1). Consequently, patent holders should have greater incentive to invest (through FDI) in host countries with stronger product patent protection.

Expansion in Scope of Patent Protection. Increases in the scope of a single patent are common among the host countries in the sample (Branstetter et al., 2006, A.2.1). These increases in scope take on a few different forms. Branstetter et al. (2006) indicate that some of the sample countries began using the concept of "infringement through equivalence" which states that anything that is functionally equivalent to a patented invention or idea is infringing on that patent (Branstetter et al., 2006, A.2.1). Without infringement through equivalence firms can avoid infringement by making only minute changes to patented products, even though the product still serve the same purpose as the patented one.[14] An expansion in scope of patent protection gives patent holders more control and freedom which should lead to higher FDI flows in countries that expand patent scope.

Increase in the length of patent protection. Branstetter et al. (2006) finds that increase in patent length for sample countries was common, generally increasing to twenty years from the date of application. These increases in patent length affect all varieties of inventions. However, Branstetter et al. (2006) inquires that extended patent length may not affect inventions in areas like information technology where innovation is quite rapid. Consequently, inventions in these industries are likely to become obsolete quickly and well before patents expire. However, for patents covering inventions for things like pharmaceutical drugs which require long clinical trials and significant R&D, extended patent length is likely to be very beneficial. Therefore, MNEs should have greater incentive to invest in countries that have extended the length of patent protection.

Increase in patent rights enforcement. The aforementioned changes in patents rights are rather useless if they are not effectively enforced. Branstetter et al. (2006) examines several

[14] See section A2 of the appendix in Branstetter et al. (2006) for more discussion on the expansion in patent protection scope.

factors to determine if enforcement improved expanded to include: "the establishment of stronger penalties for patent infringement, reversal of the burden of proof in patent infringement lawsuits from the patent holder to the alleged infringer, changes in judicial guidelines for determining infringement that favored patent holders, the establishment of specialized courts or regulatory bodies to handle patent disputes, and the expansion of legal remedies available to the patent holder when the relevant legal authority determined that infringement had taken place." These enforcement reforms are common in most of the sample countries.[15] All of these changes in patent rights enforcement increase the likelihood that patent holders can successfully defend their invention against infringement. So, MNEs should have greater incentive to invest in these countries.[16]

Improvement in patent rights administration. Better administrative capabilities increase the efficiency of the patent process and help to ensure that enforcement of patent rights is effective. Improved administrative capabilities occur through a variety of ways in the sample countries including: the establishment of a new administration to operate the patent system, an increase in resources to higher more administrators, and the abolition of procedures that increased inefficiency (Branstetter et al., 2006, A.2.1). Table 2 indicates whether each of the 15 reform episodes implement significant changes in these five areas.[17]

These 15 host countries are included in Branstetter's et al. (2006) analysis because they all experienced a significant patent reform during the period of study (see Table 2). In addition,

[15] Branstetter (2006) note, based on substantial anecdotal evidence, enforcement in China and Argentina may not be as strong as it is stated. So, Branstetter (2006) and this paper include specifications without these countries to test for robustness.

[16] Although Branstetter (2006) does note that litigation costs are also much higher following these enforcement reforms. Therefore, the net change in FDI could be ambiguous depending on the expected costs from these litigations. See Branstetter (2006) Appendix section A.2.1 for further discussion.

[17] See section A-3 of the Appendix in Branstetter (2006) for a comprehensive overview of individual patent reform episodes in each of the 15 host countries in the sample.

these countries all had significant levels of U.S. MNE affiliate activity prior to reform. As is illustrated in Table 2, the sample countries have a high degree of homogeneity in regard to the nature of their patent reform, with 15 out of 16 experiencing a strengthening/increase in at least 4 of the 5 criteria stated above.

The Branstetter et al. (2006) reform dummy is not the only method available to measure IPR reform. Ginarte and Park (1997) created an IPR index that measures the strength and scope of patent protection. This index is updated to include more recent data in Park (2008). The index is the un-weighted sum of five separate scores for: coverage, membership in international treaties, duration of protection, enforcement mechanisms, and restrictions (Park 2008, pg. 1). One benefit of the Park (2008) index is that it can measure changes in strength of IPR reform explicitly. Although the Park (2008) index gives an absolute measure of the strength of IPRs it has a number of short-comings for panel-data analysis. First, the Park (2008) index data is compiled into five year averages so, yearly data cannot be examined. As a result, gradual IPR reform cannot be effectively measured. In addition, the averaged data significantly limits the number of observations which could affect the robustness of the results. Furthermore, fixed effects cannot be effectively used using this measure.

The most noteworthy short-coming regarding the Park (2008) index however, is that it does not include a measure for effective enforcement. The Park (2008) index relies on the reporting of enforcement techniques from host countries which are often manipulated. So—when using the Park (2008) index—a country with a strong IPR score but does not effectively enforce their IPR regime produces an artificially high IPR score. With this artificially high IPR score, results are likely to be understated.

It should be acknowledged that the patent reform dummy methodology does have a few trivial shortcomings. For example, if a country reforms its patent system gradually over the course of a few years, the nuances of this change may not be fully estimated in the results. However, in Branstetter et al. (2006, 2010), the author's test for these possibilities by consulting alternate reform years for some of the sample countries based on studies by Maskus (2000) and Qian (2004) and find their results are robust under these specifications. In addition, this is also the case for the Park (2008) index. Another short-coming of the Branstetter (2006) reform dummy is the degree to which countries strengthen or expand their patent system is also lost when using a dummy variable. However, because the patent reforms in the sample countries are fairly homogenous (see Table 2) the relative strength of reform is likely to be similar among this sample. Finally, the Branstetter et al. (2006, 2010) reform dummy enables country fixed effects to be used which control for time invariant and country specific omitted variables that are hard to measure; that are correlated with the strength of IPR in the cross-section; and variables omitted from the study (Branstetter et al., 2010, pg. 19).

c. Control Variables

In the empirical analysis four control variables—log GDP, log GDP per capita, trade openness and log real exchange rate—are included which are likely to have an effect on host country FDI inflows. Table 4 provides a list of the control variables, along with a brief description, the expected coefficient, and the data source from which the variables are derived.

The expected interpretation for the log GDP coefficient is positive. Jaumotte's (2004) empirical analysis finds that greater market size (i.e. GDP) leads to a statistically significant

increase in FDI. The intuition behind this is that countries with larger gross domestic products are likely to have more diversified economies which afford MNEs more potential investment options.

Log GDP per capita and FDI are expected to have a positive relationship. High income countries are likely to receive greater inflows of FDI for a few reasons. First, Schneider's (2005) results indicate that FDI is often constrained through lack of infrastructure in developing countries. This makes intuitive sense because better infrastructure is likely to enable more efficient transportation of goods which increases the efficiency of investment. A second reason why the expected coefficient for GDP per capita is positive is because the work force in high income countries is likely to be more educated compared to low income countries. Schneider (2005), following the work of Stern et al. (2000) views GDP per capita as a proxy for a country's individual stock of knowledge. In accordance with this notion, Noorbakhsh, Paloni and Youssef (2001) find that greater availability of local skilled labor leads to an increase in inward FDI. With a greater abundance of skilled workers MNEs can more effectively train local workers often times at a lower cost than importing foreign skilled labor.

The expected sign of the trade openness coefficient is positive. The relationship between FDI and trade openness is somewhat complex because the determinants of FDI are likely to differ depending on the type of FDI. For example, Taylor's (2002) empirical findings indicate that trade openness and inward FDI are positively correlated, but only statistically significant at lower thresholds for FDI in the manufacturing sector. However, unlike Taylor (2002), the analysis in this paper uses aggregate FDI statistics so these discrepancies will not appear in the trade openness coefficient estimate. So, the estimated coefficient could potentially be insignificant. This is the case in Branstetter et al. (2006, 2010) because trade openness is not

robust under some specifications. Other studies however, have established a stronger correlation between FDI and trade openness at the aggregate level. Aizenman and Noy (2006) find that FDI activity is greater in countries with less trade restrictions. The intuition behind these findings is that countries more open to trade are likely to have more established ports and shipping infrastructure as well as fewer trade barriers.

The expected interpretation of the log real exchange rate coefficient is negative. Real exchange rate measures the amount of host country currency forgone for a single U.S. dollar (or single Euro for Germany). So, the expected coefficient for real exchange rate is likely to be negative because as host country currency depreciates in value relative to parent country currency (real exchange decreases), parent country currency becomes more valuable relative to host country currency. Consequently, each dollar of FDI invested in a host country is more valuable. Therefore, MNEs have a greater incentive to invest in these host countries. This intuition is supported by the findings in Branstetter et al. (2006, 2010) and others.

In addition to the variables mentioned above, country and time fixed effects are also included in the empirical analysis. These fixed effects isolate any idiosyncrasies that occur within host countries or in an individual year which are not captured by the other control variables.

d. Interaction Terms

To estimate FDI response depending on host country income, two alternative interaction terms are included in this analysis. The first interaction term combines the reform dummy variable with a high income dummy variable. The high income dummy takes the value 0 if a host

country is a low income country and takes the value 1 if a host country is a high income country. So, for example, a post IPR reform high income country will take on the value 1, while a post IPR reform low income country will take on the value 0. Table 4 provides a list of host countries separated into high and low income countries. Countries are designated as high or low income based on the 2009 World Bank threshold for high income countries. For the year 2009, the World Bank defines a high income country as a nation with a Gross National Income per capita of $12,196. Using this criterion, 8 of the sample countries are defined as high income and 7 are defined as low income countries. However, at the time of reform, some of these "high income" countries had significantly lower GDP per capita levels (in real terms). Taking this notion into account, three countries (Mexico, Chile and Turkey) are moved to the low income group. Therefore there are a total of 5 high income countries and 10 low income countries. [18] Regardless, the criterion for the high income interaction term is somewhat arbitrary so, the estimated results are likely to be relatively trivial. Therefore, a second, alternative interaction term is also included.

The second interaction term is used as an alternative specification to enhance the analysis and check for robustness. This interaction term combines the reform dummy and the log GDP per capita variable described in the previous section. Therefore, the interaction variable coefficient indicates the response of FDI—following IPR reform—depending on income. In other words, the interaction terms tests whether FDI response is higher or lower as host country income increases.

[18] High Income Countries include: Japan, Spain, Korea, Portugal, and Argentina. Low income countries include: Mexico, Chile, and Turkey Venezuela, Brazil, Columbia, Thailand, China, Indonesia, and The Philippines. See notes in Table 4 of the appendix for more details.

3.2. *Empirical Specifications*

In order to determine the effect of IPRs on host country inward FDI, a difference-in-differences regression analysis is used. In the first specification, outward U.S. FDI into the 15 sample countries found in Table 1 is used. [19] In the second specification, methodology remains the same except outward German FDI data is used. As mentioned above, 15 host countries are analyzed in both specifications. The third specification estimates the response of FDI depending on host country income following IPR reform using both alternative interaction terms. Host countries are examined across time and the basic empirical analysis tests whether FDI inflows change following IPR reform. The Branstetter et al. (2006) patent reform dummy—introduced above—captures the effect of IPR reform on host country FDI. So, the reform dummy coefficient (β_1) will indicate the change in FDI following reform. Equation 1 introduces the basic specification:

Equation 1:

$$\log FDI_{t,i,p} = \beta_0 + \beta_1 * Ref_{t,i} + \beta_2 * \log GDPpercap_{t,i} + \beta_3 * \log Exrate_{t,i} + \beta_4 * Openness_{t,i} + \Psi_i + \theta_t + \varepsilon_{t,i}$$

In equation 1, $Ref_{t,i}$ is the Branstetter et al. (2006, 2010) patent reform dummy, which is equal to 0 prior to the reform year and equal to 1 following reform (including year of reform) in country i at time, t. For example, Indonesia reformed in 1991, so from 1985-1990 the patent reform dummy equals 0 and from 1991-2008 the patent reform dummy equals 1. $LogGDPpercap_{t,i}$

[19] Note: some regressions drop some host countries from the data. For example, when running regressions to get balanced pool data for U.S. FDI, Columbia, Venezuela, Indonesia, and Portugal because these countries are missing a few observations.

stands for log host country GDP per capita. $LogExrate_{t,i}$ represents the log real exchange rate between host country i and parent country, p. $Openness_{t,i}$ stands for represents the trade openness index of host country i. In addition, t represents time in years, i represents host country, p indicates the parent country, Ψ_i captures the fixed effects for country i, θ_t captures the fixed time effects in year t and $\varepsilon_{t,i}$ is the error term. The descriptive statistics for specification 1 are listed in Table 5.

An examination of the descriptive statistics in Table 5 indicates United States FDI outflows to Japan in 2008 are approximately $101.9 billion which is the maximum for the sample. Maximum German FDI outflows are in Spain in 2008, receiving approximately $37.3 billion. Minimum outward FDI flows for Germany and the United States are $88 million—to Chile in 1985—and $10.8 million—to Thailand in 1986—respectively. Average FDI flows for the period are approximately $12.9 billion and $3 billion for the United States and Germany respectively.

The equation used in specification 3, takes the form of Equation 2 with the addition of the interaction variable. Two interaction variables are used to extend robustness. [20]

Equation 2:

$$logFDI_{t,i,p} = \beta_0 + \beta_1 * Ref_{t,i} + \beta_2 * Ref_{t,i} * logGDPpc_{t,i} + \beta_3 * logGDP_{t,i} + \beta_4 * Exrate_{t,i} + \beta_5 * Open_{t,i} + \Psi_i + \theta_t + \varepsilon_{t,i} \quad (Ref_{t,i} * HighIncome_{t,i})$$

Where $Ref_{t,i} * logGDPpercap_{t,i}$ and $Ref_{t,i} * HighIncome_{t,i}$ represents the interaction terms. $LogGDP_{t,i}$ represents the log GDP per capita in host country and all other variables remain the same as in equation 1.

[20] The two interaction terms are not both included in the model together included separately.

4: Empirical Results

4.1: Outward U.S. FDI Response Following IPR Reform

Table 6 shows the results when logged United States outward FDI is the dependent variable. The estimated magnitude of the change in FDI resulting from IPR reform— controlling for log GDP per capita, trade openness, and log real exchange rate— is captured by the reform dummy variable coefficient. Column 1 provides the results when no time or country fixed effects are used. The coefficient of the reform dummy is positive and statistically significant at 1%. The reform dummy coefficient indicates that FDI inflows increase by 108% following IPR reform. However, the "fit" of the model is not strong. The interpretation of the R-squared statistic is one way to determine whether the model effectively "fits" the data. The R-squared statistic indicates the extent to which the variability in the dependent variable is accounted for in the model.[21] The R-Squared is 0.49 in column 1 indicating that approximately 49% of the variation in FDI is explained by the variation in the independent variables. Consequently, about half of the variation in FDI is unexplained by the model. To improve the fit of the model, fixed effects are added. Column 2 provides the results with the reform dummy and fixed country and time effects but the other controls are dropped. However, an R-squared of 0.21 indicates that these variables, by themselves, only explain about 21% of the variation in FDI.

Column 4 provides the results for the estimated change in U.S. FDI outflows resulting from IPR reform, when log GDP per capita, trade openness, log real exchange rate and fixed country and time effects are controlled for. The estimated coefficient of the reform dummy is

[21] Halcoussis, 2005. PG. 57

positive, and statistically significant at 10%. The reform dummy coefficient indicates that FDI flows increase by approximately 12% following reform controlling for all other independent factors. These results indicate that IPR reform causes a fairly significant response in FDI. So, for example, following IPR reform in Japan in 1986, FDI inflows from the U.S are estimated to increase by $221 million due to IPR reform. The dependent variable is measured in log form so the estimated reform dummy coefficient indicates that a semi-elastic interpretation. The control variable coefficients are all statistically significant at various thresholds and are consistent with their expected interpretations. The R-squared statistic is 0.94 indicating that about 94% of the variation in FDI is explained by the independent variables in the model. The significant increase in the R-squared term—from 0.49 to 0.94—when fixed country and time effects are combined with the control variables indicates that the majority of the variation in FDI is now explained by the data.

The results from specification 1 are robust under a few tests. In column 5, coefficients are not significantly changed when Columbia, Venezuela, Indonesia, and Portugal are dropped from the analysis. These countries are dropped because the data sets for these countries are not complete (see footnote 10). Consequently, when these countries are dropped from the observed data a balanced pool can be examined. The results in column 5 indicate that all independent variables coefficients are consistent with their expected interpretations and statistically significant at 1%. In addition, the reform dummy coefficient increases to 0.25 and is significant at 1%. There is a large variation in the results from specification 1. However, the results in columns 4 and 5 are the most effective because they provide the best fit, and therefore are likely to be more accurate estimations. As an alternative specification, German outward FDI flows are analyzed to test for robustness.

4.2 Outward German FDI Response following IPR Reform

Table 7 provides the results when log German FDI outflows is the dependent variable. The results in columns 1-4 are quantitatively similar to those found in the previous specification. Column 4 provides the results when all control variables and fixed country and time effects are included. In column 4, the estimated coefficient of the reform dummy is 0.23, statistically significant at 5%, and has a semi-elastic interpretation. The estimated coefficient for the reform dummy indicates that FDI inflows in host country i are expected to increase by 23% due to IPR reform in host country i. This is similar to the results estimated under the same specifications for U.S. FDI. Log GDP per capita and trade openness also had a statistically significant effect—at 1%—on FDI. Interestingly however, the estimated coefficient for log GDP per capita has a negative interpretation. In other words, wealthier countries are expected to receive less FDI holding all other independent variables constant.

4.3 FDI Response Relative to Host Country Income

Table 8 lists the results for the response of FDI due to reform when interaction terms are included. The estimated interpretation of the interaction term coefficient which combines the reform dummy and the high income dummy indicates the additional amount of FDI inflows a high income country receives following reform. Columns 1-3 provide the results using this interaction term where log U.S. FDI outflows is the dependent variable. Column 1 shows the results when no fixed time effects are used. In column 1, the estimated coefficient for the interaction term is 0.34, statistically significant at 5%, and has a semi-elastic interpretation. The interaction term coefficient indicates high income countries receive an extra kick of FDI following reform. More specifically, high income countries receive an additional 34% increase in FDI flows following reform.

However, when time fixed effects are included in column 2, the coefficient for the interaction term declines to 0.18 and statistical significance is falls to 10%. But, the R-squared statistic increases from 0.84 to 0.93. These results remain relatively unchanged when normal pool data is used. Interestingly, the results in column 2 and 3 indicate that the coefficient for the reform dummy (by itself) is not significant. The reform dummy coefficient—when the interaction is included—still continues to illustrate the response on FDI for all host countries. Consequently, the results in columns 2-3 estimate that there is not a statistically significant response in FDI following reform for all the sample countries. However, high income countries receive an extra kick of FDI. When the alternative interaction term is introduced in column 4, the interaction coefficient loses its statistical significance as well. This calls into question the robustness of the results. To check further for robustness Germany FDI outflows are also

examined to determine whether these results are consistent in countries other than the United States.

Columns 5-7 in Table 8 present the results when Log German FDI outflows are the dependent variable. Column 5 provides the results when no fixed time effects are used and column 6 when fixed time effects are added. The estimated interaction coefficients in columns 5 and 6 are -0.36 and -0.58 respectively, and both coefficients are also statistically significant at 5% and 1% threshold. These results estimate that high income countries are actually negatively affected in terms of FDI response following reform. As indicated in column 7, these results continue to be robust with the alternative interaction term. Although the alternative interaction term is lower (in absolute value terms) than in the previous example, it remains negative and statistically significant at 1%. In addition, the fit of the model in column 7 remains the same as in column 6, with an R-squared of 0.94.

The results for FDI based on income looking at both the U.S. and Germany produce inconclusive findings. These differing responses could be due to differing preferences of MNEs in the two countries. In addition, they also could result due to the arbitrary nature of the interaction terms which can potentially cause a selection bias to occur. This selection bias may occur because the sample countries are not grouped in an arbitrary fashion. Therefore, the results could potential differ depending on the criteria used. To this author's knowledge no other similar studies incorporate a similar methodology so a comparative analysis cannot be undertaken. However, these explanations are not thoroughly examined in this paper, so a definitive inquiry cannot be made.

5. Conclusion

Applying the models created in the theoretical literature to a real world setting, and building on previous empirical work by Branstetter et al. (2006, 2010), this thesis attempts to show how FDI activity responds to significant and well defined patent reforms in 15 sample countries. The findings from this paper reveal that following the implementation of IPR reform, FDI increases in a statistically significant manner in the sample countries. Furthermore, these findings are robust under a number of different specifications. However, FDI inflows are not uniform across all host countries examined. It appears that some countries may possibly benefit more from reform depending on their level of income. However, these results are mixed depending on the parent country examined and in some cases insignificant. Therefore, income level of the recipient country may not have a statistically significant on FDI inflows.

The results from this paper indicate that IPR reform leads to a subsequent growth in inward FDI for the host countries examined. However, this paper does not examine the effect of IPR reform on domestic firms. So, the results do not suggest that just because inward FDI increases, does not mean that one can extrapolate that welfare also increases in these countries. It could be the case that increased FDI following reform is offset by a decline in domestic imitation which negatively affects Southern firms at the expense of MNEs. This is highlighted in the theoretical literature by the duality of technology transfer between innovation (through FDI) and imitation. So, in essence technology transfer from the North to the South depends on the magnitude of increased FDI vs. decreased imitation. If increased FDI more than compensates for the decline in imitation in the South following reform, than overall welfare increases and vice versa. When constructing potential policies regarding IPRs in an international setting, policy makers must consider this trade-off between innovation and imitation incentives following IPR

reform. Policy makers must also consider the cost of implementing IPR reform which falls disproportionately on developing countries.[22] Therefore, policy may want to consider the possibility of transferring some of these costs to applicable developed nations.

The results in this paper are consistent with the findings of Branstetter et al. (2006, 2010) which examine the response of U.S. MNE activity—at the firm level—following patent reform in the same host countries examined in this analysis. This thesis differs slightly from Branstetter's et al. (2006, 2010) because it takes a more macro approach by analyzing aggregate FDI activity rather than industry level data. Branstetter's et al. (2006, 2010) findings indicate that technology transfer increases following host country IPR reform. The empirical analysis in this paper is similar in this regard, but applies a more macro approach by looking at the response of aggregate U.S. and German FDI activity following host country IPR reform. This paper also extends the sample of the Branstetter et al. (2006, 2010) analysis to include German parent data. The results from this paper and Branstetter et al. (2006, 2010) indicate an increase in technology transfer occurs following IPR reform. However, neither this paper, nor Branstetter et al. (2006, 2010) examines the imitative response of domestic firms following reform. Therefore, the results—from this paper and Branstetter et al. (2006, 2010)—only indicate a gross increase in technology transfer.

This study can be extended in a number of ways. First, this paper, as previously mentioned, does not examine the response of domestic imitative firms; therefore, conclusions cannot be drawn regarding the net effect of technology transfer. Further studies in the future could include a measure for the effect of IPR reform on these firms as well. In addition, the

[22] See Park, 2008

sample size for both host and parent countries could be enlarged to determine whether the findings in this paper are applicable to a larger group of countries.

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World Trade Organization, "Part 2 —Standards concerning the availability, scope and use of Intellectual Property Rights; Sections 5 and 6", *Agreement on Trade Related Aspects of Intellectual Property Rights*

Appendix

Figure 1: FDI Inflows from 1980 through 2007

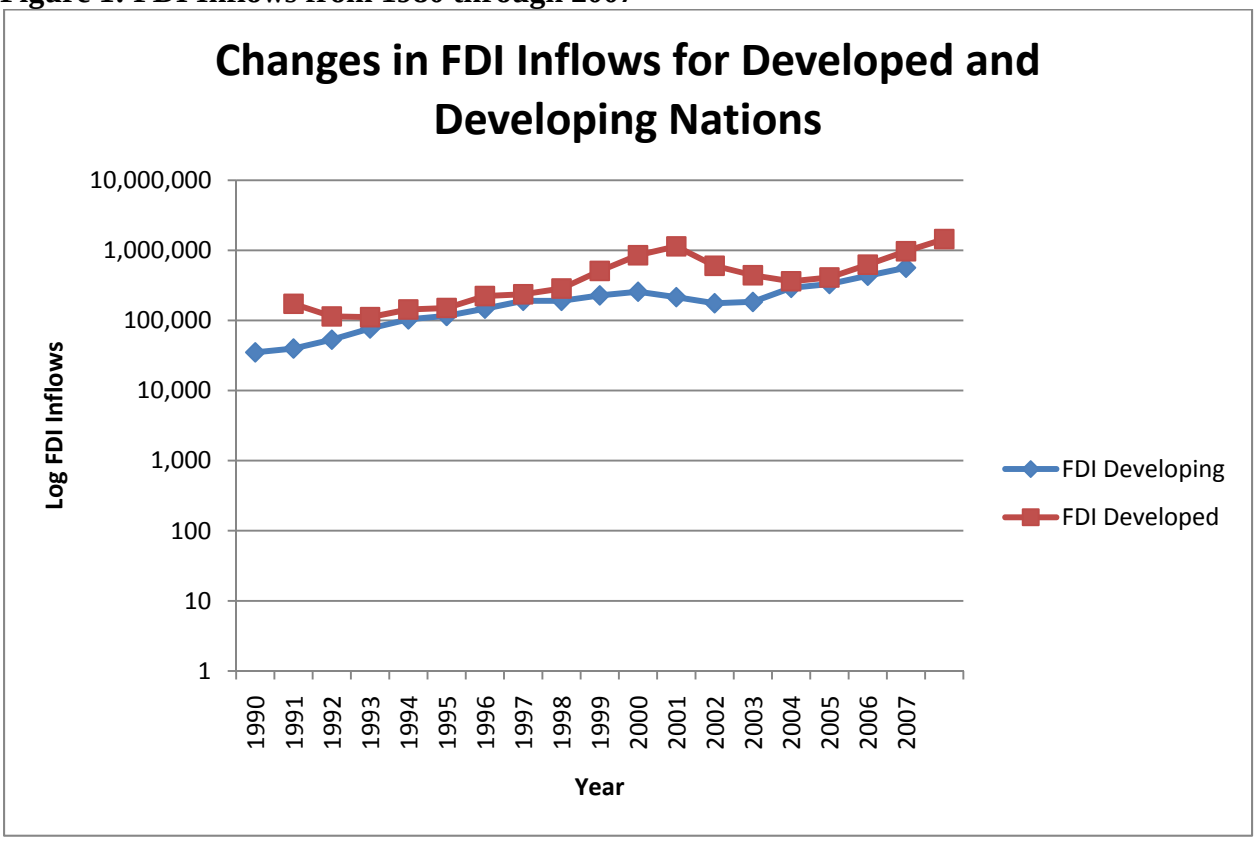


Figure 2: US and German Outward FDI to the 15 Host Countries (IPR reform year represented by vertical lines

Figure 2.1

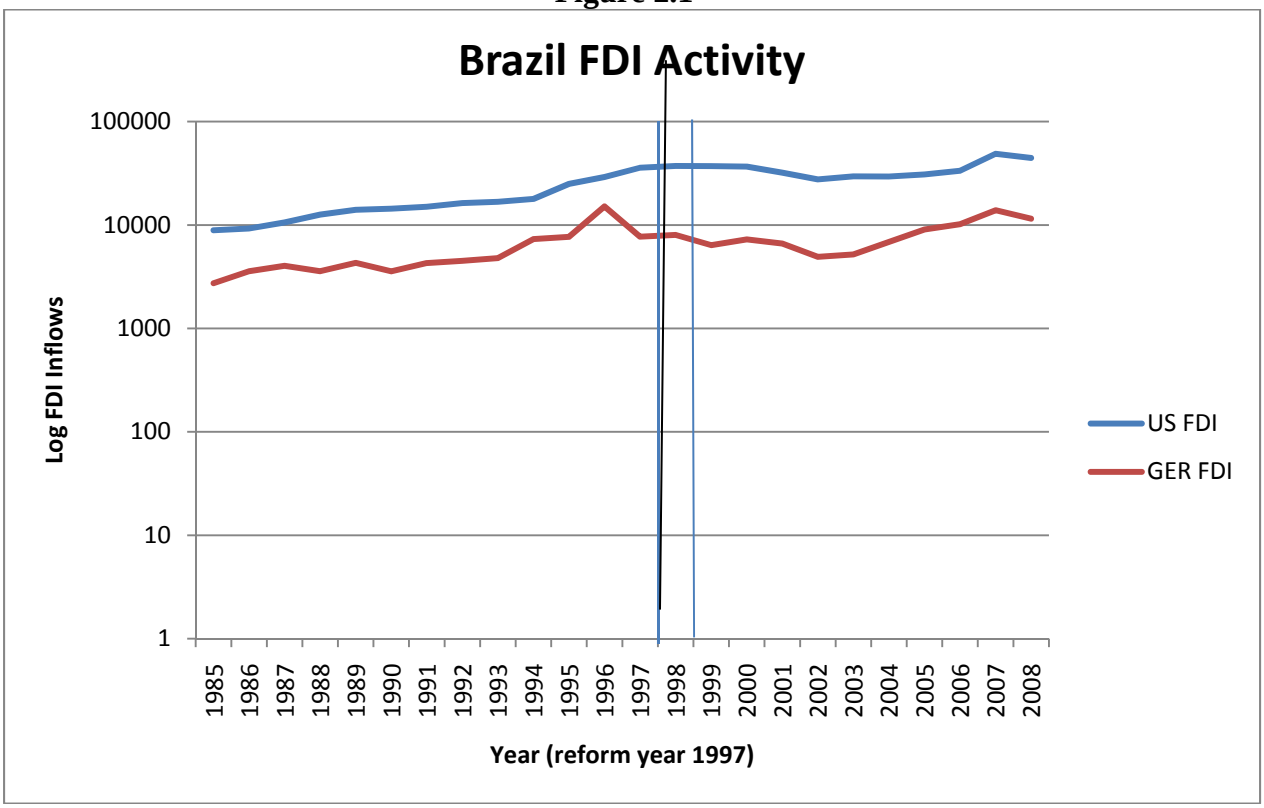


Figure 2.2

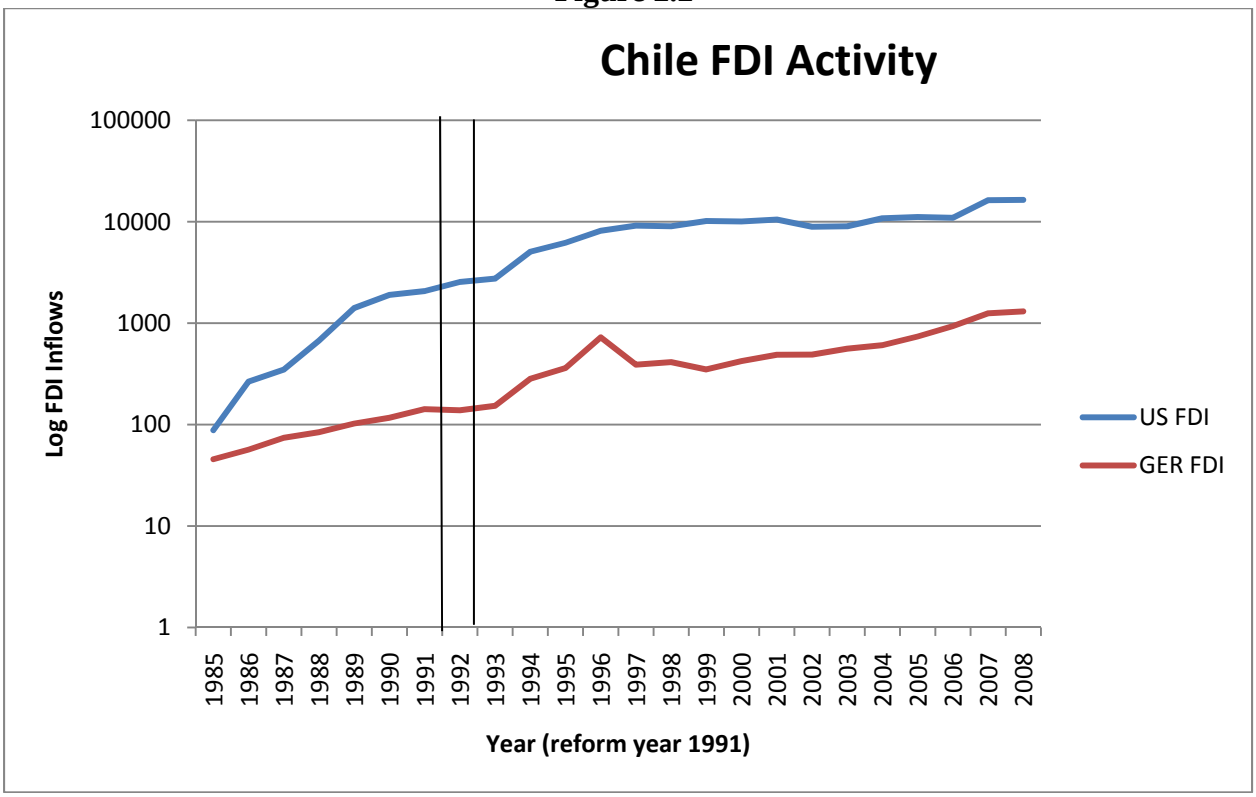


Figure 2.3

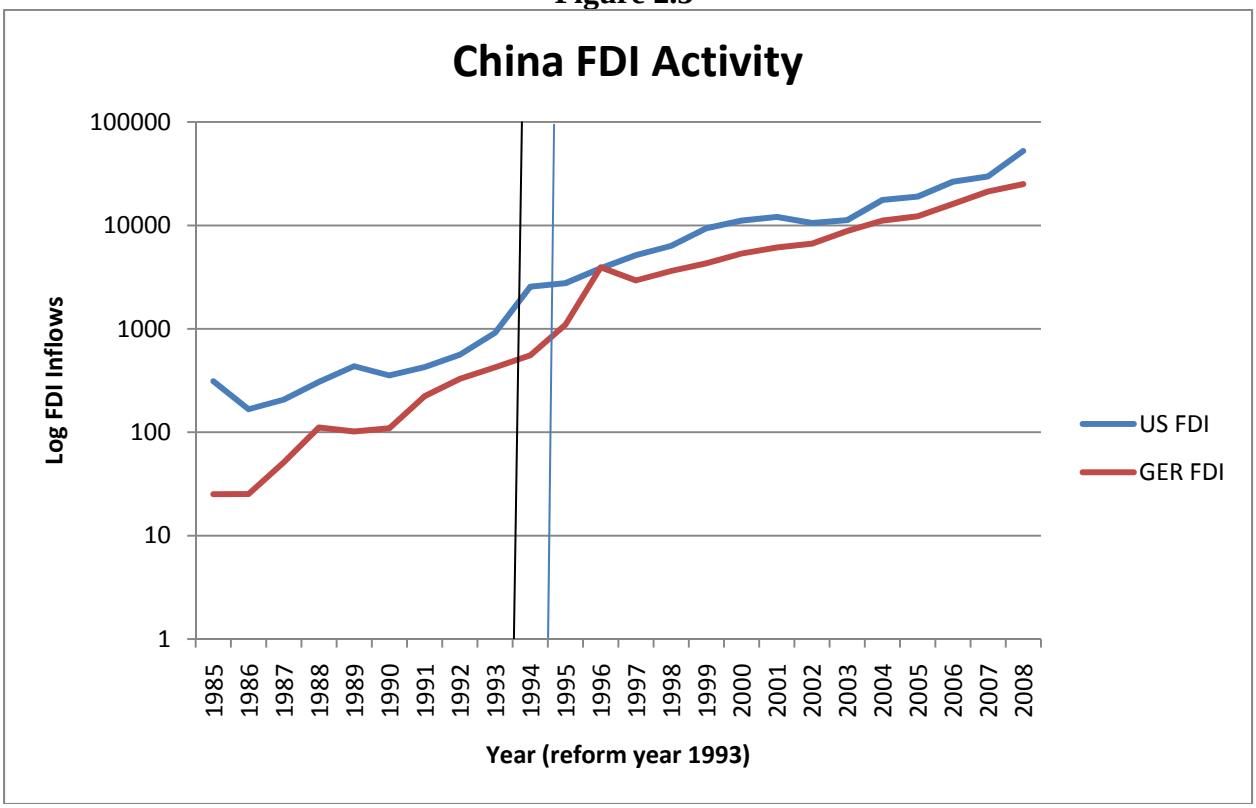


Figure 2.4

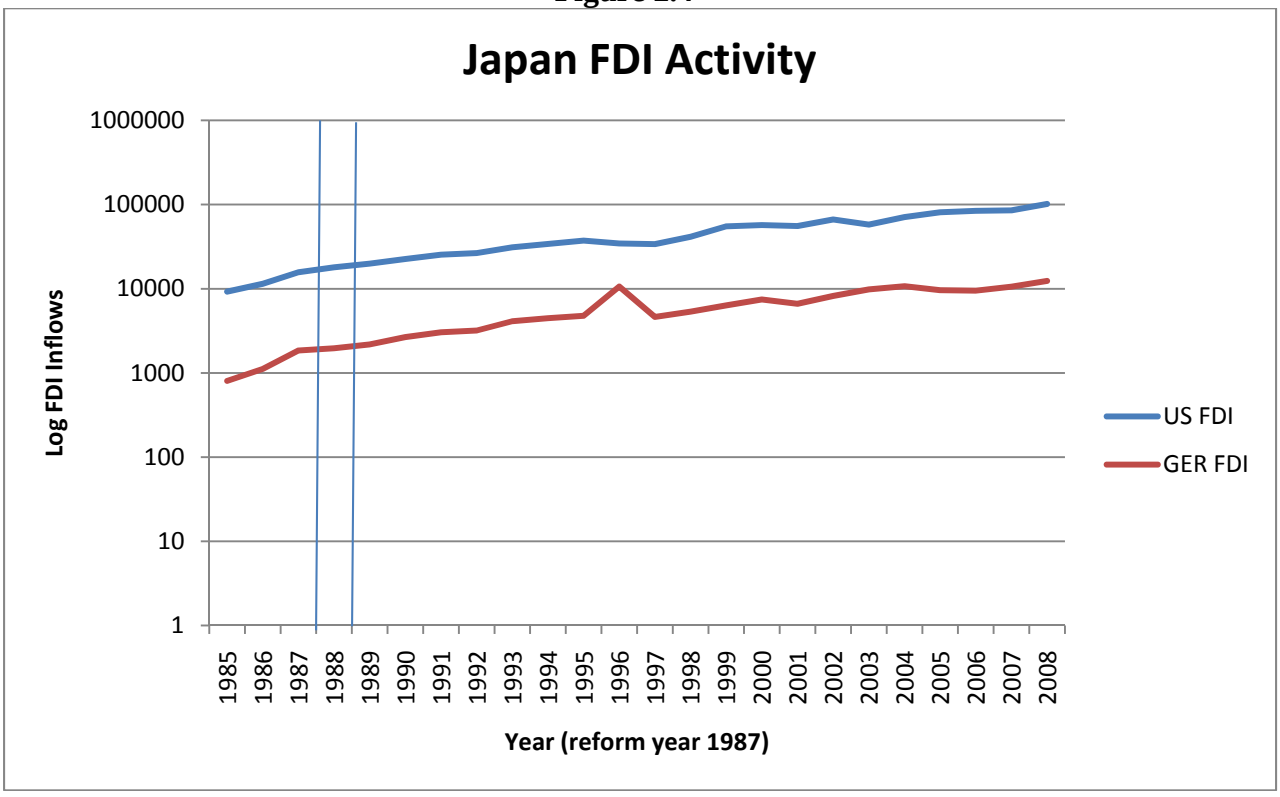


Figure 2.5

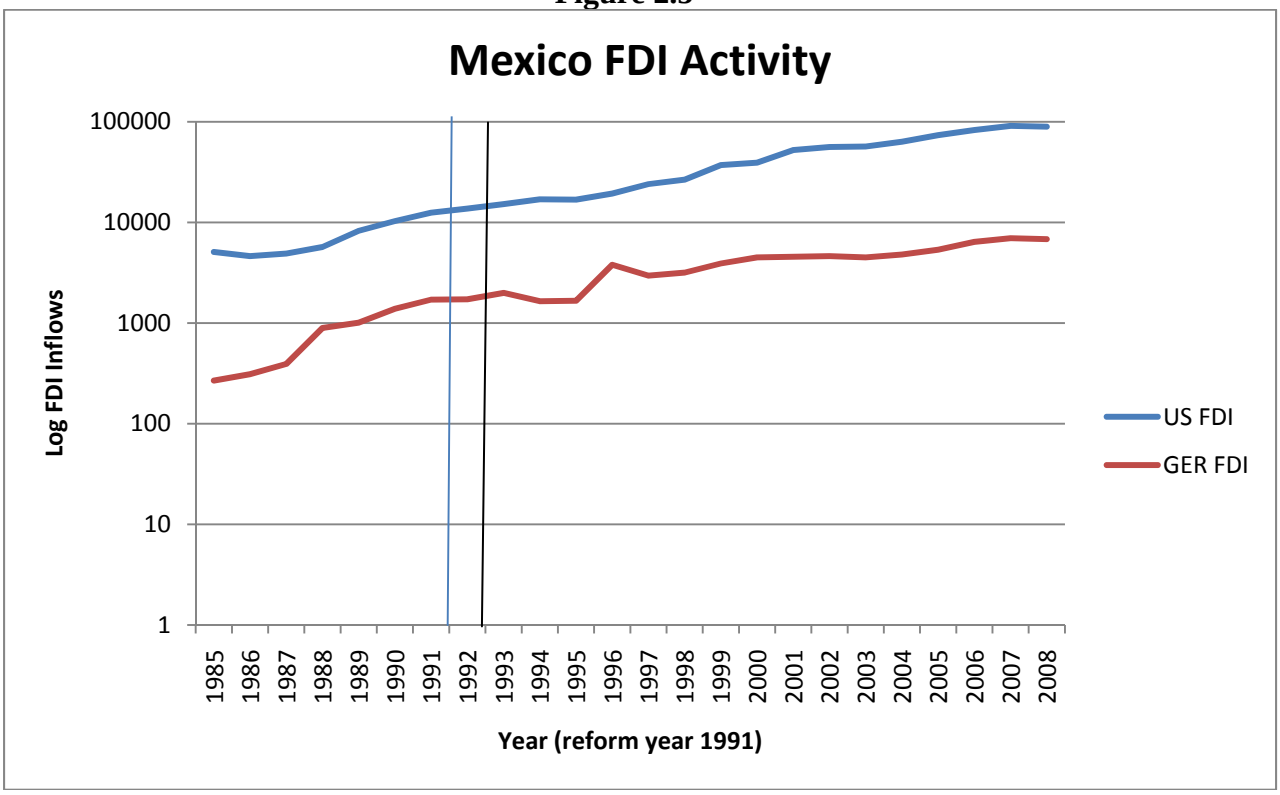


Figure 2.6

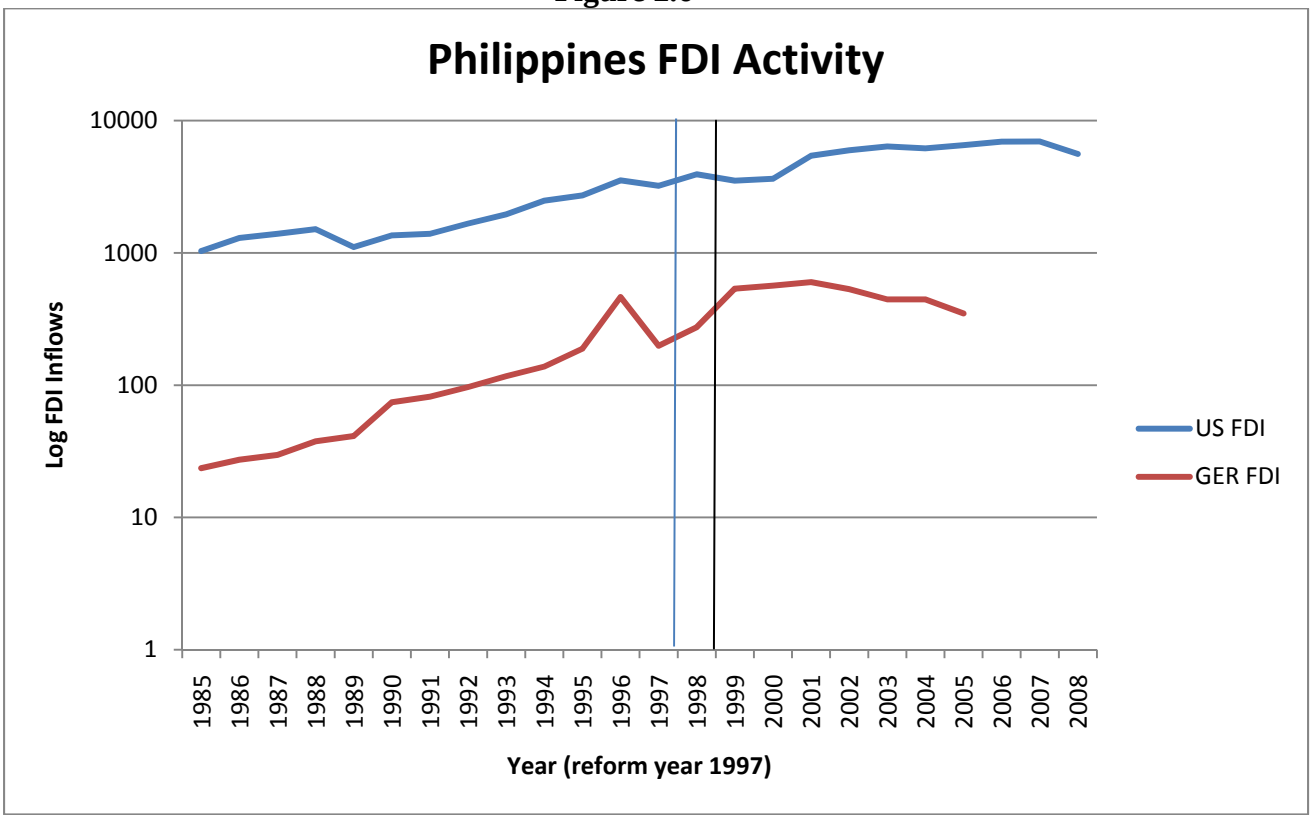


Figure 2.7

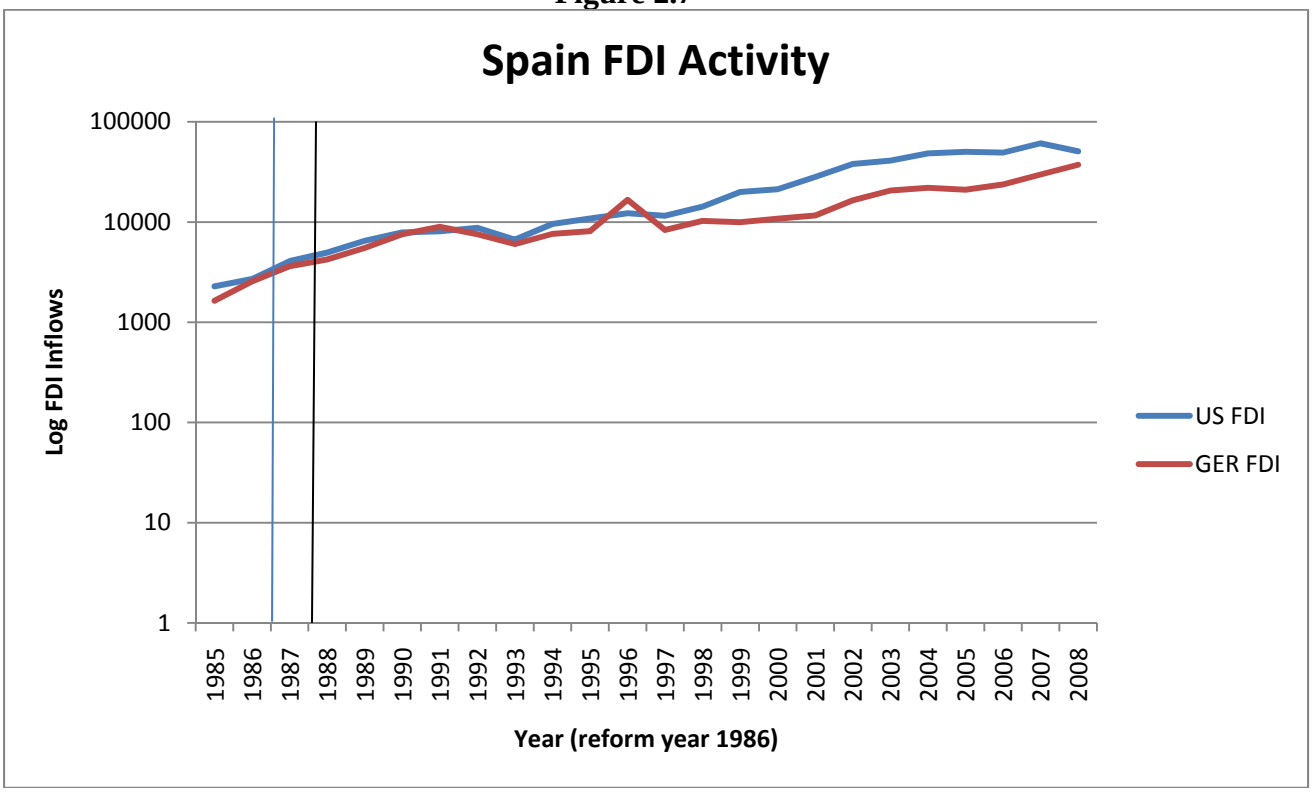


Figure 2.8

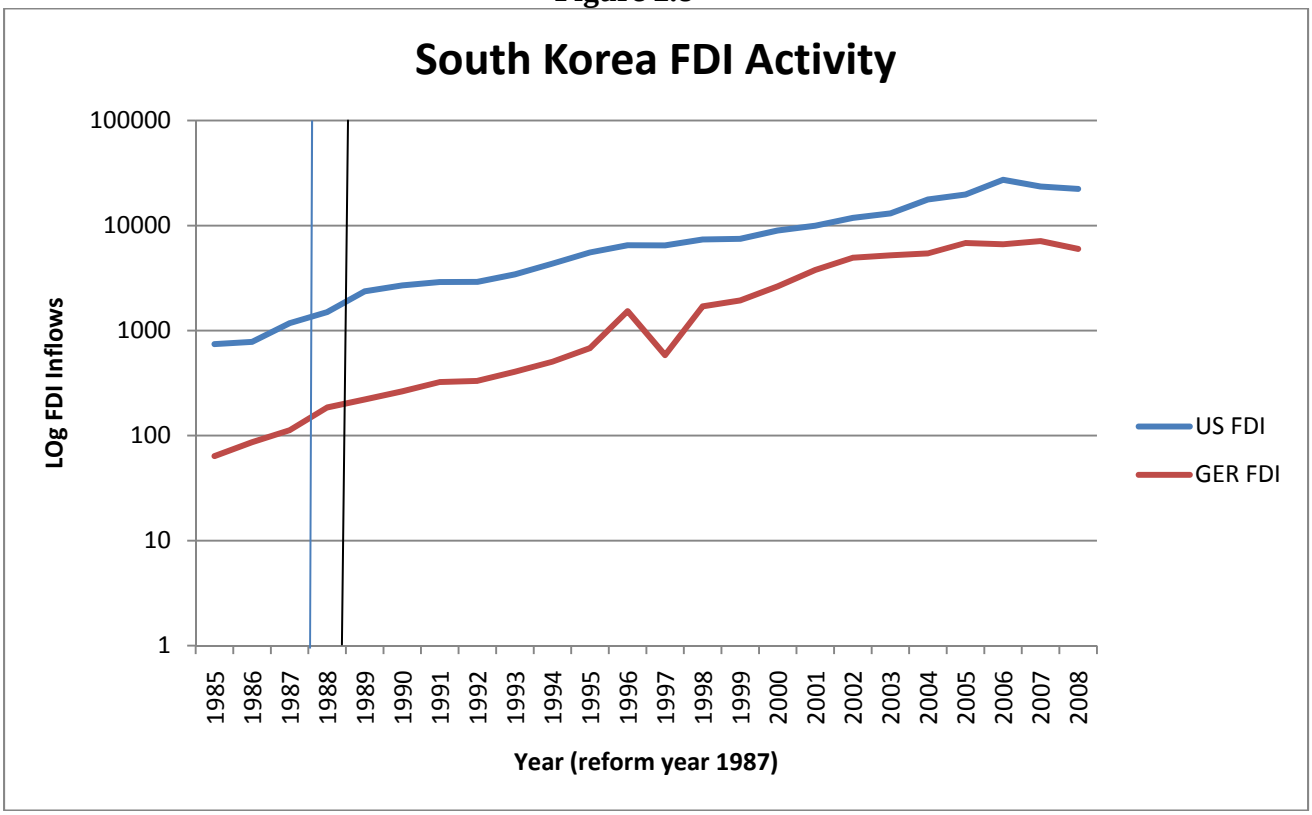


Figure 2.9

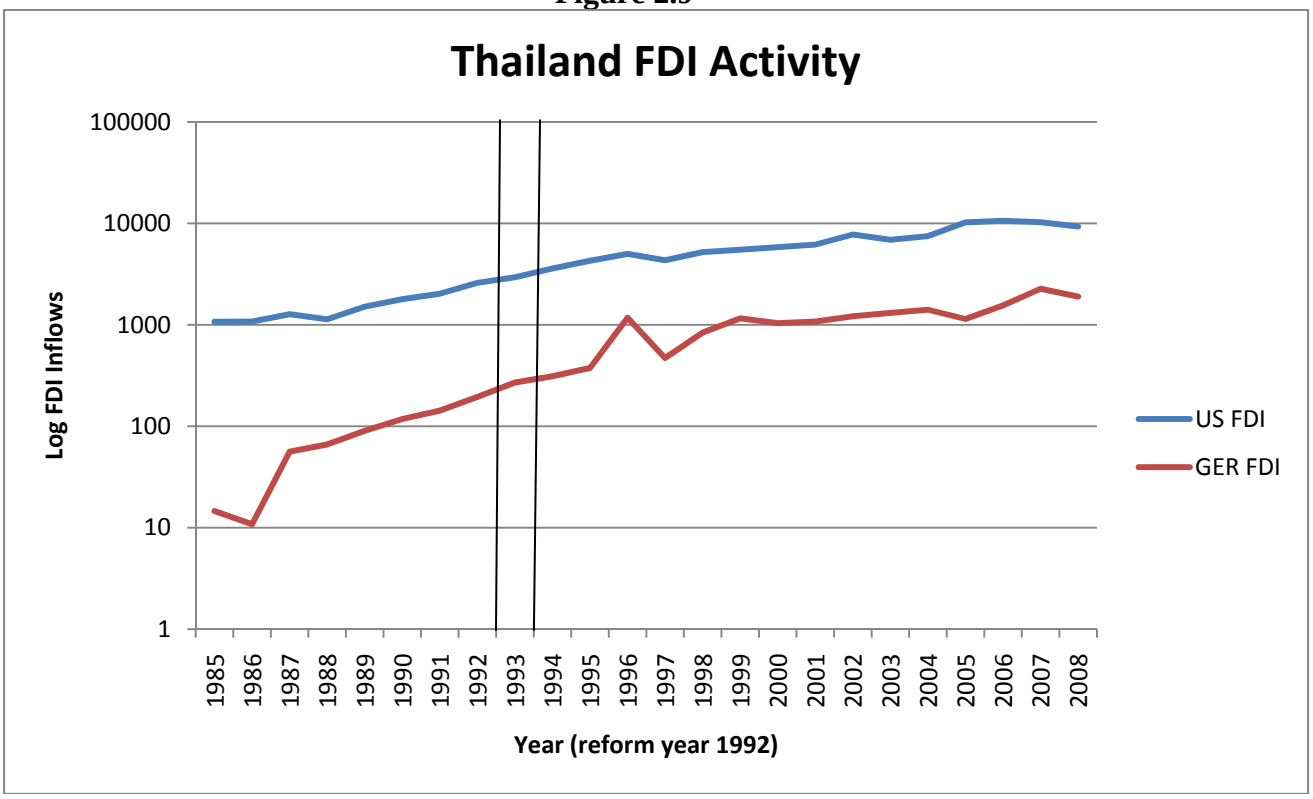
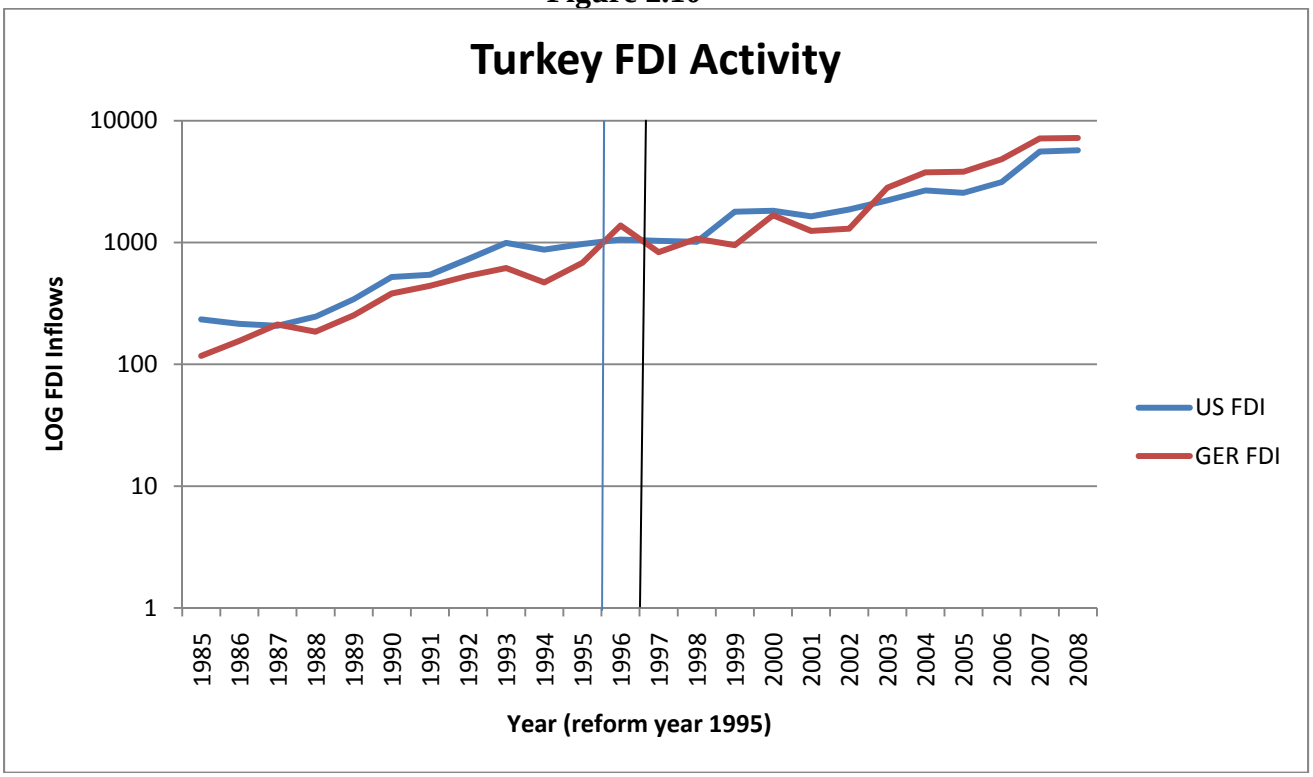
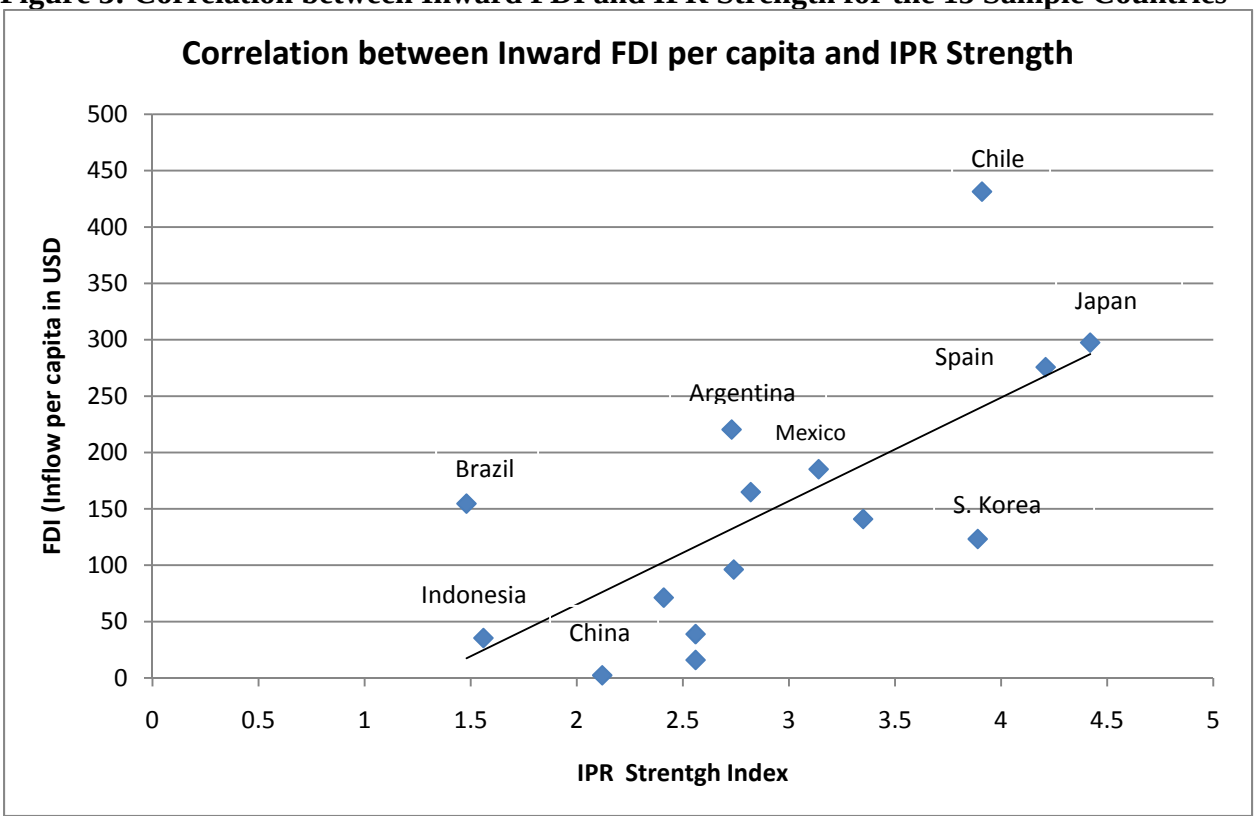


Figure 2.10



Note: All data for Figures 2.1 through 2.11 is retrieved from OECD International Direct Investment data base.

Figure 3: Correlation between Inward FDI and IPR Strength for the 15 Sample Countries



Notes: IPR strength is measured using the Park (2008) index and is the five year average for the year 2000. Inward FDI is measured in per capita terms in real 2000 U.S. dollars. U.S. parent FDI data only is used.

Table 1: List of Host Countries by year of Patent Reform

Country	Year of Reform
Argentina	1996
Brazil	1997
Chile	1991
China	1993
Columbia	1994
Indonesia	1991
Japan	1987
Mexico	1991
Philippines	1997
Portugal	1992
South Korea	1987
Spain	1986
Thailand	1992
Turkey	1995
Venezuela	1994

Source: Branstetter (2006)

Table 2: Characteristics of Patent Reform Episodes

Country	Expansion of Eligible Inventions	Expansion of Patent Scope	Expansion of Patent Length	Improvement in Patent Enforcement	Improvement in Patent Administration
Argentina	X	X			
Brazil	X	X	X	X	X
Chile	X		X	X	X
China	X	X	X	X	
Columbia	X	X	X	X	X
Indonesia	X	X	X	X	X
Japan	X	X	X	X	X
Mexico	X	X		X	X
Philippines	X	X	X	X	X
Portugal	X	X	X		X
South Korea	X	X	X	X	X
Spain	X	X		X	X
Thailand	X	X	X	X	
Turkey	X		X	X	X
Venezuela	X	X	X	X	X

Source: Branstetter (2006)

Table 3: Control Variables

Variable	Description	Source	Expected Coefficient Interpretation
Log $GDP_{t,i}$	the logged GDP of host country i at time=t	World Bank Development Indicators & Global Finance Database	(+)
Log GDP per $capita_{t,i}$	the logged GDP of host country i at time=t	World Bank Development Indicators & Global Finance Database	(+)
Trade $Openness_{t,i}$	The balance of payments in host country i at time =t. Calculated: Trade openness=(exports-imports)/GDP	World Bank Development Indicators & Global Finance Database	(+)
Log Real Exchange $Rate_{t,i}$	The average yearly real exchange rate between host country i and parent country (U.S or Germany)	World Bank Development Indicators & Global Finance Database	(-)

Table 4: High Income Dummy variable: High and Low Income Countries

High Income	GDP per capita
Japan	32,443
Spain	32,545
Korea	27,168
Portugal	24,021
Argentina	14,559
Low Income	
Mexico*	14,337
Chile*	14,331
Turkey*	13,905
Venezuela	12,341
Brazil	10,427
Columbia	8,870
Thailand	8,004
China	6,838
Indonesia	4,205
Philippines	3,546

Notes: GDP per capita is listed in 2009 nominal USD. * indicates that these countries are included as low income countries despite 'high income' status according to World Bank criteria. The reason for this is because at the time of IPR reform, these countries had significantly lower income levels in real terms. For example, Mexico's GDP per capita in the year of reform is $5080 in real 2000 USD; Chile: $3252; and Turkey: $3571. GDP per capita figures listed are retrieved from the World Bank Development Indicators database.

Table 5: Descriptive statistics

Variable	Minimum	Maximum	Average	ST Dev
U.S. outward FDI (in millions)	88.00	101918.00	12956.75	17878.10
Log U.S.FDI	4.48	11.53	8.67	1.37
German outward FDI (in millions)	10.82	37318.42	3027.45	4737.10
Log German FDI	2.38	10.53	6.90	1.68
GDP (in millions)	29213.48	5201146.06	585982.40	1109022.30
Log GDP	10.28	15.47	12.42	1.15
GDP per capita	289.68	40707.00	7135.31	8630.13
Log GDP per capita	5.67	10.61	8.31	1.09
Log real exchange rate	-19.89	9.24	1.82	4.29
Trade Openness	-0.154	0.286	0.0045	0.064

Table 6: United States FDI Response following IPR Reform

Dependent Variable:	**Log United States FDI Outflows**				
	1	2	3	4	5
Reform Dummy	1.08 [0.137]***	2.71 (0.232)***	1.01 [0.105]***	0.12 [0.081]*	0.19 [0.074]***
LOG GDP Per Capita	0.19 [0.128]*		0.12 [0.145]	1.93 [0.456]***	2.69 [0.216]***
Trade Openness	0.63 [0.008]***		0.59 [0.009]***	-0.84 [0.365]**	-1.18 [0.146]***
Log Real Exchange Rate	1.35 [0.850]		0.79 [0.575]	-0.77 [0.399]*	-1.98 [0.447]***
Fixed Country Effects	No	Yes	Yes	Yes	Yes
Fixed Time Effects	No	Yes	No	Yes	Yes
Included Observations (1985-2008)	24	24	24	24	24
Cross Sections (15 countries)	15	15	15	15	11
Total Pool Observations	344	344	344	344	264
Balanced Pool	No	No	No	No	Yes
R-Squared	0.49	0.21	0.83	0.94	0.96

Note: Standard errors in brackets. *= statistically significant at 10%. **= statistically significant at 5% ***=statistically significant at 1%

Table 7: German FDI Response Following IPR Reform

Dependent Variable:	**Log Germany FDI Outflows**			
	1	2	3	4
Reform Dummy	1.25	2.70	1.60	0.23
	[0.152]***	[0.362]***	[0.139]***	[0.101]**
Log GDP Per Capita	0.34		0.18	-0.58
	[0.148]**		[0.194]	[0.112]***
Trade Openness	0.48		0.50	0.78
	[0.009]***		[0.012]***	[0.012]***
Log Real Exchange Rate	-3.62		-1.77	0.24
	[0.919]***		[0.781]**	[0.451]
Fixed Country Effects	No	Yes	Yes	Yes
Fixed Time Effects	No	Yes	No	Yes
Included Observations (1985-2008)	24	24	24	24
Cross Sections (15 host countries)	15	15	15	15
Total Pool Observations	356	356	356	356
Balanced Pool	No	No	No	No
R-Squared	0.55	0.39	0.79	0.94

Note: Standard errors in brackets. *= Statistically significant at 10%. **Statistically significant at 5%. ***Statistically significant at 1%.

Table 8: FDI Response Relative to Income Following IPR Reform

Dependent Variable:	Log U.S FDI Outflows				Log German FDI Outflows		
Sample:	All Reforms	All Reforms	Normal Pool†	All Reforms	All Reforms	All Reforms	All Reforms
	1	2	3	4	5	6	7
Reform Dummy	1.02	-0.01	0.05	0.04	1.61	0.23	1.81
	[0.103]***	[0.090]	[0.108]	[0.412]	[0.124]***	[0.101]**	[0.468]***
Reform Dummy*High Income Dummy	0.34	0.18	0.25		-0.36	-0.58	
	[0.149]**	[0.105]*	[0.124]**		[0.182]**	[0.112]***	
Reform Dummy*Log GDP Per capita				0.002			-0.23
				[0.051]			[0.058]***
Log GDP	0.56	0.70	0.64	0.71	0.59	0.78	0.78
	[0.013]***	[0.013]***	[0.013]**	[0.013]***	[0.015]***	[0.015]***	[0.015]***
Trade Openness	0.13	-0.24	-0.22	-0.34	0.31	0.24	0.23
	[0.582]	[0.402]	[0.556]	[0.404]	[0.733]	[0.452]	[0.462]
Log Real Exchange Rate	0.04	-0.03	-0.03	-0.03	0.01	-0.08	-0.07
	[0.014]***	[0.010]***	[0.011]**	[0.010]***	[0.018]	[0.012]***	[0.012]***
Fixed Country Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Time Effects	No	Yes	Yes	Yes	No	Yes	Yes
Included Observations(1985-2008)	24	24	24	24	24	24	24
Cross Sections Included (15 countries)	15	15	11	15	15	15	15
Total Pool Observations	344	344	264	344	356	356	356
Balanced Pool	No	No	Yes	No	No	No	No
R-Squared	0.84	0.93	0.94	0.93	0.83	0.94	0.94

Note: Standard errors in brackets. *Statistically significant at 10%. **Statistically significant at 5%. ***Statistically significant at 1%. † denotes normal pool data where Columbia, Indonesia, Portugal, and Venezuela are dropped from the sample. The high income dummy in columns 1-3 and 6-7 are derived using the criterion for high income countries derived by the World Bank. Therefore, 8 high income countries that are included in these samples.