# ESSAYS ON CROSS-BORDER MERGERS AND ACQUISITIONS, TECHNOLOGY, AND FRICTIONAL COSTS

by

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DISSERTATION ABSTRACT

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Title: Essays on Cross-Border Mergers and Acquisitions, Technology, and Frictional Costs

Foreign direct investment (FDI) has played a major role in the increasing economic globalization of the past couple decades. Cross-border mergers and acquisitions (M&A) is the major source of FDI, particularly for developed countries accounting for as much as two-thirds of FDI. Yet, studies on such cross-border M&A activities are scant in the literature.

This dissertation aims at explaining the relationship between cross-border M&A, technology, and frictional costs using both theoretical and empirical analyses. In chapter II, I conduct empirical analysis to determine the relationship between exchange rates and acquisition FDI. I find that depreciation of the host country's currency leads to an increase in acquisition FDI into high-R&D sectors for U.S. inbound acquisition FDI from multiple country sources, but not for inbound acquisition FDI for other various developed countries. In chapter III, I develop an equilibrium model of cross-border M&A and show that the model predicts that firms from a larger country are more likely to acquire in a smaller country when M&A activity is driven by a technology-seeking motive, but the opposite is true when it is driven by a market-seeking motive. I also find empirical

evidence that cross-border M&A activity exhibits behavior consistent with this prediction. In chapter IV, I empirically examine the relevance of heterogeneous sector-specific frictional costs using detailed data on worldwide M&A activity. Results show that cultural distance, tradeability, and regulation play an important role in determining heterogeneous frictional costs across different sectors.

This dissertation includes unpublished co-authored material.

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I dedicate this to my parents for their unconditional support and love. Thank you always for guiding me with your knowledge and wisdom.

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# CHAPTER I

# INTRODUCTION

Foreign direct investment (FDI) has been growing fast in an increasingly globalized world and many theoretical and empirical papers in the trade literature have focused on FDI to understand globalization. Cross-border mergers and acquisitions (M&A) activity is the main driver of FDI patterns across the world, particularly between developed countries, which account for the majority of worldwide FDI activities. Numbers from the United Nation's Conference on Trade and Development estimate that cross-border M&As account for roughly two-thirds to three-quarters of worldwide FDI. Despite its importance for FDI, cross-border M&A activity has received very little specific focus in the international economics literature.

This dissertation aims at explaining the relationship between cross-border M&A, technology, and frictional costs using both theoretical and empirical analyses. In chapter II, I conduct an empirical analysis to determine the relationship between exchange rates and acquisition FDI. Blonigen (1997) proposes a link between exchange rates and FDI motivated to acquire complementary assets (i.e., asset-seeking acquisition FDI). However, previous studies have only examined this hypothesis with acquisition FDI data from country sources that are mostly U.S. inbound. Here, I examine the hypothesis using the acquisition FDI data from multiple country sources that are inbound for various countries. I find evidence in support of this hypothesis for U.S. inbound acquisition FDI from multiple country sources, but not inbound acquisition FDI for other various developed countries.

In chapter III, I develop and estimate a model of cross-border M&A and focus on the technology-seeking explanation. In particular, I develop an equilibrium model of exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking cross-border M&A with heterogeneous firms. The model predicts that firms from a larger country are more likely to acquire targets in a smaller country when M&A activity is driven by a technology-seeking motive, but the opposite is true when it is driven by a market-seeking motive. Using detailed data on worldwide M&A activity from 1985-2007, I find empirical evidence that cross-border M&A activity exhibits behavior consistent with this prediction.

In chapter IV, I work with Bruce Blonigen and empirically examine the relevance of heterogeneous sector-specific frictional costs. While there has been significant research done to explore the determinants (and frictions) of foreign direct investment (FDI), past literature primarily focuses on country-wide FDI flows and very little has been done to examine sectoral heterogeneity in FDI patterns. However, statistics suggest that there is evidence of sectoral heterogeneity in FDI patterns. For example, the majority of FDI is in goods-producing sectors, especially the manufacturing sector, and undertaken primarily among developed countries, yet manufacturing accounts for a very small share of total production activity in these same developed countries compared to services-producing sectors. Here, we empirically examine the relevance of heterogeneous sector-specific frictional costs using detailed data on worldwide M&A activity. The results show that cultural distance, tradeability, and regulation play on important role in determining heterogeneous frictional costs across different sectors. In chapter V, I present conclusions and possible future research directions.

# CHAPTER II

# NEW EVIDENCE ON THE LINK BETWEEN EXCHANGE RATES AND ASSET-SEEKING ACQUISITION FDI

## 1. INTRODUCTION

Blonigen (1997) proposes a link between exchange rates and FDI when FDI is motivated to acquire a complementary asset (e.g. technology), commonly referred to as asset-seeking acquisition FDI. He develops a model where the assets acquired in an acquisition are easily transferrable within the firm and, thus, able to generate returns in any currency. Thus, a depreciation of a host country's currency lowers the purchase price of the target firm for foreign acquirers, but does not affect the expected returns. As a result, the depreciation of a host country's currency should increase asset-seeking acquisition FDI into that host country. Using data on Japanese and German acquisition FDI patterns into the U.S., and using high R&D sectors as an indicator of sectors where asset-seeking acquisition FDI is likely to be taking place, Blonigen finds strong empirical support for his hypothesis.

This chapter examines whether Blonigen's hypothesis generalizes beyond the specific sample he examines. There are a number of reasons why it may not. First, the U.S. is widely regarded as world's leading marketplace for ideas and technology. So asset-seeking acquisition FDI into U.S. is likely to be prevalent and thus Blonigen's hypothesis is much more likely to hold. But asset-seeking acquisition FDI may be a fairly insignificant for other inbound markets. Second, Blonigen's hypothesis depends on the assumption that product markets are segmented, such that the domestic firms in the host country could not generate similar returns in the foreign country where the currency has appreciated. This assumption may not hold as well for countries besides Germany and Japan. Third, Blonigen's data span a time period (1975-1992) that is now quite dated, and the effect may have been specific to the time period he considered.

I examine a sample of cross-country mergers and acquisitions (M&As) for five of the top investing countries in the world: Australia, Canada, Japan, the United Kingdom, and the United States, over the period 1989-2007. The sample thus includes data on a greater set of countries investing in the U.S., as well as data on inbound acquisition FDI into countries other than the U.S. My analysis finds that the evidence for Blonigen's hypothesis is mainly driven by U.S. inbound acquisition FDI from other foreign countries. Support for Blonigen's hypothesis could not be found when U.S. inbound acquisition FDI was excluded and only inbound acquisition FDI into other foreign countries were considered for estimation. This is most likely because the U.S. is the world's leading marketplace for ideas and technology. For example, the U.S. leads the world in R&D expenditures. It had the highest R&D expenditure in the world in 2007 (National Science Board 2010). So asset-seeking acquisition FDI into U.S. is likely to be prevalent and thus Blonigen's hypothesis is much more likely to hold. Another possibility is that the U.S. market is more open to foreign firms and foreign investments compared to other countries like Japan. The Japanese market has been particularly insulated from foreign import penetration and FDI (see Bela Balassa (1986); Robert Z. Lawrence (1991, 1993); Dennis J. Encarnation (1992); Marcus Noland (1997)). It is likely that this seclusion is preventing asset-seeking acquisition FDI into Japan and therefore not finding evidence for Blonigen's hypothesis.

There have been only few subsequent studies that re-examine Blonigen's hypothesis. Guo and Trivedi (2002) re-examines robustness of Blonigen's result using Blonigen's data and finite mixture panel models. They show that Blonigen's hypothesis is robust to alternative econometric models. Georgopoulos (2008) tests Blonigen's hypothesis using the acquisition FDI data between U.S. and Canada and finds evidence supporting Blonigen's theory. However, unlike this chapter, it does not consider other various countries' inbound acquisition FDI from multiple country sources. De Vita and Abbott (2007) also test the exchange rate effect using FDI (that includes greenfield and acquisition FDI) into U.K. from different country sources. They don't find support for Blonigen's hypothesis. However, it isn't an exact test of Blonigen's hypothesis because Blonigen assumes that his hypothesis only holds for acquisition FDI that are asset seeking.

There are also other studies that use relative wage effects (Caves 1989) and relative wealth effects (Froot and Stein 1991) to explain the link between exchange rates and FDI. However, these studies only focus on the price of the asset and do not provide an explanation for the more relevant factor; i.e. the rate of return.

The rest of the chapter proceeds as follows. Section 2 describes the empirical specification. Section 3 presents the data, variable construction, and some descriptive statistics. Section 4 presents the estimation results for the effects of exchange rates on numbers of acquisitions, while the last section concludes.

## 2. EMPIRICAL SPECIFICATION

Blonigen's hypothesis suggests that depreciation of the host country's currency leads to an increase in asset-seeking acquisition FDI into that host country. To test this on my data, I follow Blonigen (1997) for specification of the estimation equation:

$$MA_{ijkt} = f(\ln exch_{ijt}, domeacq_{ikt}, realgdpg_{jt}, stockmarket_{jt}, \alpha_{ijk}) \qquad (1)$$

where $MA_{ijkt}$, the dependent variable, is the number of acquisitions into country *i* from country *j* in industry *k* at time *t*; $\ln exch_{ijt}$ is the logged real exchange rate between country *i* and country *j* at time *t*; $domeacq_{ikt}$ is the number of domestic acquisitions by other domestic firms in country *i* at time *t* in industry *k*; $realgdpg_{jt}$ is the real Gross Domestic Product (GDP) growth rate in country *j* at time *t*; $stockmarket_{jt}$ is the growth rate of the stock price index in country *j* at time *t*; $\alpha_{ijk}$ is the country pair fixed effects between country *i* and *j* and industry fixed effects interacted (i.e. country pair and industry interacted fixed effects). I also add a time trend in my regression.

I do not include a variable representing a sectoral import tariff as Blonigen (1997) did because it is unavailable at this level of disaggregation for observations where the host country is not the United States. However, the regression results for the portion of the sample where this variable can be included show that the main coefficient is not sensitive to inclusion or exclusion of the tariff variable. Blonigen's (1997) analysis also found this regressor to be statistically insignificant. For similar data availability issues, I am not able to include a variable to capture the share of value added in an industry. However, assuming that relative industry growth rates remain fairly constant over the years of my sample, this will be captured by industry fixed effects.

The dependent variable is count data. Thus, I follow Blonigen in estimating equation (1) using a fixed-effect negative binomial specification.

## 3. DATA, VARIABLE CONSTRUCTION, AND SOURCES

My dependent variable, the number of firms acquired by foreign firms at each three-digit Standard Industrial Classification (SIC) level is constructed from the M&A data from Thomson's SDC Platinum, which provides data on firms acquired by foreign and domestic firms in different countries. This data set has monthly information on percentage of shares of firms acquired by foreign firms as well as domestic firms. If the percentage of shares acquired by an acquiring firm is 10% or more, I consider this as an "acquisition".[1] The SDC Platinum also provides SIC codes for each acquired firms, which I use to disaggregate the data into industries at the three-digit SIC level. It also indicates the home country of the target firm and the acquiring firm. Thus I am able to create my dependent variable data at the three-digit industry level for each country pair at each year ranging from 1989 to 2007. As mentioned earlier, the countries I consider in my analysis are the top investing countries in the world: Australia, Canada, Japan, the United Kingdom, and the United States.[2]

One of my explanatory variables, the number of domestic firms acquired by other domestic firms, is constructed in a similar way. This is an appropriate control variable since it will capture many of the other aspects of a favorable environment for acquisition

[1] This is because 10% or more is considered as acquisition in United States. The regression results still hold when 50% or 100% is used instead as the threshold level.

[2] These are relevant choices for my analysis since they are the top investing countries and most investments occur between them.

that are not related to exchange rates. I expect the coefficient on this variable to be positive.

My main explanatory variable, the logged annual real exchange rate, is constructed using the nominal exchange rates data from the Pacific Exchange Rate Service and GDP deflators from United States Department of Agriculture (USDA).[3] I use logarithms of the individual exchange rates, so that the percentage changes in exchange rates for different countries are comparable, allowing me to formulate parsimonious models, which permits me to take advantage of the panel nature of the data. The nominal exchange rate is denominated in domestic currency per foreign currency. Thus, an increase in the exchange rate variable represents a real depreciation of the domestic currency relative to the foreign currency. Therefore, a positive correlation between the exchange rate variable and the asset-seeking acquisitions by foreign firms is expected, which is consistent with Blonigen's hypothesis.

Following Blonigen (1997), I separate the high R&D industries and low R&D industries by using the R&D expenditures as a percentage of sales data obtained from National Science Foundation, where high R&D industries are those where R&D expenditures as a percentage of sales are at or above the mean of the manufacturing sector. These high R&D sectors should proxy for sectors where asset-seeking acquisition FDI is prominent and, thus, the Blonigen hypothesis predicts that the exchange rate effect should only prevail for these sectors or, at least, be significantly larger in magnitude. The industries that are categorized as high R&D industries according to this measure are reported at the bottom of Table 2 and 3.

[3] Pacific exchange rate service: http://fx.sauder.ubc.ca/, USDA: http://www.ers.usda.gov/data/

Annual real GDP growth rates are also obtained from the USDA website. The real GDP growth rates for each foreign country are included to control for demand side factors. If the foreign countries' economies grew over the years, they will naturally have higher demand for M&A. Thus, I expect the coefficient on this variable to be positive.

To capture the wealth effects from the stock market, I construct a stock market variable using the annual growth rates of each foreign country's representative stock price index. The data are obtained from Yahoo Finance and the Tokyo Stock Exchange Group, Inc.[4] I expect a positive correlation between the dependent variable and the stock market variable. The descriptive statistics are reported in Table 1.

Table 1. Descriptive statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| # of acquisitions by foreign firms | 52440 | 0.1185164 | 0.5379338 | 0 | 14 |
| Logged exchange rate | 52440 | 4.99e-10 | 2.896331 | -5.532526 | 5.532526 |
| Domestic acquisition | 52440 | 3.43135 | 9.244897 | 0 | 154 |
| Real GDP Growth rate | 52440 | 2.599263 | 1.580583 | -2.1 | 5.5 |
| Stock Market | 52440 | 7.147114 | 16.90054 | -39.82619 | 58.43752 |

## 4. ESTIMATION RESULTS

Table 2 provides regression results from estimating equation (1) using a fixed-effect negative binomial specification. The first column of results runs the full sample of observations without consideration of whether a sector is a high-R&D or low-R&D sector. The coefficient on the real exchange rate variable has a positive sign and is statistically significant at 10%. This implies that depreciation of the real exchange rate overall leads to increase in acquisitions by foreign firms in the manufacturing sector. The domestic

[4] Yahoo Finance: http://finance.yahoo.com/, Tokyo Stock Exchange Group: http://www.tse.or.jp/english/index.html

acquisitions variable and real GDP growth rate variable have expected signs and are statistically significant. The stock market variable has the wrong sign, but is not statistically significant.

Table 2. Determinants of number of Foreign Acquisitions in manufacturing sector, 1989-2007

| Variables | Manufacturing Negative binomial fixed effects | High R&D Manufacturing[a] Negative binomial fixed effects | Low R&D Manufacturing Negative binomial fixed effects |
|---|---|---|---|
| Logged exchange rate | 0.129* | 0.193** | 0.144 |
| | (0.068) | (0.081) | (0.113) |
| Domestic acquisition | 0.009*** | 0.009*** | 0.010*** |
| | (0.001) | (0.001) | (0.003) |
| Real GDP Growth rate | 0.142*** | 0.142*** | 0.142*** |
| | (0.011) | (0.016) | (0.016) |
| Stock Market | -0.001 | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.001) |
| Time trend | 0.003 | 0.016*** | -0.009** |
| | (0.003) | (0.004) | (0.004) |
| Constant | 0.779*** | 0.882*** | 0.671*** |
| | (0.121) | (0.185) | (0.162) |
| Observations | 19684 | 6346 | 13338 |

Standard errors in parentheses. * denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.
[a]High R&D industries are SIC 281-289, 351-359, 365-367, 371-372, 376, and 381-389; low R&D industries are all other manufacturing industries

Columns 2 and 3 of Table 2 provide results when one splits the sample between high-R&D and low-R&D manufacturing industries. The results support Blonigen's hypothesis with a positive and statistically-significant real exchange rate effect for high-R&D manufacturing industries, but an insignificant effect for low-R&D manufacturing industries. The real exchange rate effect for high-R&D industries has also increased in magnitude compared to the first column result. The effects of the number of domestic acquisitions, real GDP growth rate, and the stock market have identical effects across the high-R&D and low-R&D samples. The time trend variable is the only control variable that varies across the two samples and suggests that M&A FDI activity was increasing for high-R&D industries over this time period, while it was generally decreasing for low-R&D industries.

Table 3. Determinants of number of Foreign Acquisitions in manufacturing sector, 1989-2007

| Variables | High R&D Manufacturing[a] (U.S. inbound acquisition only) | High R&D Manufacturing[a] (U.S. inbound acquisition excluded) |
|---|---|---|
| | Negative binomial fixed effects | Negative binomial fixed effects |
| Logged exchange rate | 0.183** | -0.196 |
| | (0.092) | (0.136) |
| Domestic acquisition | 0.01*** | 0.034*** |
| | (0.002) | (0.007) |
| Real GDP Growth rate | 0.15*** | 0.134*** |
| | (0.021) | (0.023) |
| Stock Market | -0.002 | -0.0002 |
| | (0.002) | (0.002) |
| Time trend | -0.007 | 0.029*** |
| | (0.006) | (0.005) |
| Constant | 1.018*** | 0.774*** |
| | (0.276) | (0.265) |
| Observations | 1957 | 4389 |

Standard errors in parentheses. * denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.
[a]High R&D industries are SIC 281-289, 351-359, 365-367, 371-372, 376, and 381-389; low R&D industries are all other manufacturing industries

I also estimate equation (1) using different subsamples to see whether the results are robust across all subsamples and not just driven by U.S. inbound acquisition FDI. First, I estimate equation (1) using only U.S. inbound acquisition FDI from Australia, Canada, Japan, and United Kingdom. Table 3, column 1 presents the results. The coefficient on the logged exchange rate is positive and significant for high R&D industries, consistent with Blonigen's hypothesis. However, when I estimate equation (1) for the subsample where U.S. inbound acquisition data are excluded and only have inbound acquisition data for Australia, Canada, Japan, and United Kingdom, the coefficient on the logged exchange rate for high R&D industries is not significant and has the wrong sign.[5] Coefficients on other variables are similar as before. Table 3, column 2 presents the results.

This suggests that Blonigen's hypothesis only prevails for U.S. inbound acquisition FDI. This is most likely because the U.S. is the world's leading marketplace for ideas and technology. So asset-seeking acquisition FDI into U.S. is likely to be prevalent and thus Blonigen's hypothesis is much likely to hold. The U.S. has served as the undeniable leader in new technology and innovation over the past 40 years. It is the birthplace of the personal computer and the Internet. And it has given the world major innovations in the Information Technology (IT) industry. Although other nations are catching up to U.S. in terms of new technology and innovation, the U.S. is still undoubtedly the world's leader. Statistics show that the U.S. has the highest R&D expenditure in the world, which accounted for 33% of the total world R&D expenditure in 2007 (National Science Board 2010). Therefore, it isn't very surprising that firms in other nations are engaging in asset-seeking acquisition FDI into U.S. to gain access to new ideas and technology.

Another possible reason that Blonigen's hypothesis only holds for the U.S. is because the U.S. market is more open to foreign firms and foreign investments compared

[5] I also re-estimate the equation separately for each of the four countries. I still get the same result for each country (i.e. coefficient on the logged exchange rate is insignificant for high R&D industries).

to other countries like Japan. Japan's R&D expenditure accounted for 13% of the total world R&D expenditure in 2007, making it the second-largest R&D spending country in the world (National Science Board 2010). However, the reason that I don't find evidence for Blonigen's hypothesis for acquisition FDI into Japan is because Japanese market has been particularly insulated from foreign import penetration and FDI (see Bela Balassa (1986); Robert Z. Lawrence (1991, 1993); Dennis J. Encarnation (1992); Marcus Noland (1997)). It is not clear whether Japan's seclusion is due to artificial barriers by the government or cultural and institutional differences with respect to other western countries. But it is likely that this isolation is preventing asset-seeking acquisition FDI into Japan and therefore prevents finding evidence for Blonigen's hypothesis.

## 5. CONCLUSIONS

Blonigen (1997) proposes a link between exchange rates and FDI when FDI is motivated to acquire a complementary asset, but only a few subsequent studies have re-examined Blonigen's hypothesis. In this chapter, I re-examine Blonigen's hypothesis using the acquisition FDI data from multiple country sources that are inbound for various countries. The result provide evidence that Blonigen's (1997) hypothesized link between exchange rates and asset-seeking acquisition FDI is a general result for inbound U.S. acquisition FDI from a variety of country sources, but not for inbound in other developed countries. This is an important qualification of the Blonigen's hypothesis that merits future research, as it suggests very different roles for developed countries in the international M&A market.

The results from this chapter have potential policy implications for U.S. policy makers concerning takeovers of domestic firms by foreign firms. The U.S. government has always been concerned with foreign firms acquiring U.S. firms for technology. In the 1980's, the U.S. was mainly concerned with the Japanese firms, and now it's the Chinese firms that may engage in acquisition FDI to gain access to U.S. technology. Since this chapter suggests that asset-seeking acquisition FDI is much more prevalent in the U.S. than in other countries, the results from this chapter can assist the policy makers in formulating policies to reduce takeovers of U.S. firms by foreign firms, especially when U.S. currency depreciates.

## CHAPTER III

## CROSS-BORDER MERGERS AND ACQUISITIONS WITH HETEROGENEOUS FIRMS: TECHNOLOGY VS. MARKET MOTIVES

### 1. INTRODUCTION

Foreign direct investment (FDI) has played a major role in the increasing economic globalization of the past couple decades. Cross-border M&A is the major source of FDI, particularly for developed countries accounting for as much as two-thirds of FDI (World Investment Report 2007). Thus, understanding cross-border M&A plays a crucial role in understanding FDI and globalization.

Various motives can exist for firms to engage in cross-border M&A. Firms may engage in cross-border M&A to obtain market-specific expertise[6] of the host country in order to better serve the host country's consumers. Nocke and Yeaple (2007) build a theoretical model based on this motivation.[7] Firms may also engage in cross-border M&A for corporate control. This motive is the driving force behind the M&A model in Head and Ries (2008).

In this chapter, I contribute to the growing cross-border M&A literature by building a model where M&A activity is potentially motivated by technology. A technology-seeking motive is important in M&A activity, as evidence for this motive can be found from various empirical articles (mostly on domestic M&A) in other literatures. For example, studies on pharmaceutical firms in the industrial organization literature

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[6] This can be knowledge on local marketing strategies or distribution channel that is country-specific. This motivation is present in my model as well.

[7] Their basic theoretical framework is similar to Helpman, Melitz and Yeaple (2004) with heterogeneous firms, which is also the case for my model. This is a standard setup for foreign market entry models with heterogeneous firms.

show that firms engage in M&A when seeking patents for drugs, which is an important technology in pharmaceutical industry (see, for example Gans *et al* (2002) and Danzon *et al* (2004)). Other studies also show that there exists a high correlation between R&D expenditure in a firm or in an industry and M&A activities, and firms will use M&A to substitute "bought" technology for internally-produced technology (see, for example Blonigen and Taylor (2000), Blonigen (1997), and Kogut and Chang (1991)).

I extend a model introduced by Nocke and Yeaple (2007) to include a technology-seeking motive for cross-border M&A and develop a general equilibrium model of exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking cross-border M&A with heterogeneous firms. The model is developed from the firm entry model where there exists a competitive market for M&A, and firms engage in cross-border M&A for two reasons: (1) To gain a synergy effect[8] by obtaining a target firm's technology, which increases the acquirer's productivity, or, (2) to obtain a target firm's market-specific expertise, such as knowledge on local marketing strategies or distribution channel, which makes the acquirer's goods more desirable to consumers in the host country.[9] I term the first motive "technology-seeking" and the second motive "market-seeking" throughout the rest of the chapter.

I first show that there are distinct productivity cutoffs in the model that separate exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking

[8] Synergy is realized because the target firm from another country has a technology that is different from the acquirer. Empirical evidence of this effect can be found in the following articles (see, for example Morosini et al (1998), Vermeulen & Barkema (2001), and Gertsen et al (1998)) and (Branstetter (2000), Takechi (2006), and Guadalupe et al (2010)).

[9] This is similar to the cross-border M&A motive used by Nocke and Yeaple (2007).

cross-border M&A in equilibrium and show how different firm types sort into these foreign market access modes.

Second, I show that the model generates a sharp theoretical distinction between the two motives: Relative country size differences between the home and the host countries will have a different effect on technology-seeking cross-border M&A and market-seeking cross-border M&A. In particular, proportionately more firms engage in technology-seeking cross-border M&A, the bigger their home country's size is relative to the host country, whereas the opposite is true for market-seeking cross-border M&A. This provides me with an estimation strategy to identify the technology-seeking motive in the data. I provide evidence of this result by showing that cross-border M&A into high-R&D sectors[10] in the host country increases approximately by a factor of 1.13 as the relative size difference between the home and the host country (i.e. home country size minus host country size) increases, suggesting that the bigger the home country is relative to the host country, more firms from the home country engage in technology-seeking cross-border M&A into the smaller host country.

The rest of the chapter proceeds as follows. Section 2 describes the theoretical model. Section 3 analyzes the equilibrium of the model and determines the equilibrium pattern of the four foreign market entry modes (i.e. exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking cross-border M&A). Section 4 looks at how asymmetric country size affects the equilibrium using comparative statics to uncover the technology-seeking motive. Section 5 conducts an empirical analysis suggested by the comparative statics result and provides evidence of a

[10] M&As that take place in these sectors are likely to be technology-seeking since firms in these sectors are technology-intensive.

technology-seeking motive consistent with the model's prediction using worldwide cross-border M&A data. The last section presents conclusions.

## 2. THE MODEL

The model consists of two identical countries 1 and 2. The aggregate income level in both countries is denoted by *Y*. Labor is the only factor of production. The price of labor in each country is equal and normalized to one because a homogeneous and perfectly competitive product is produced in every country and traded freely.[11][12] The homogeneous product is produced with one unit of labor per unit of output. The model is developed from a firm entry model where there exists a competitive market for M&A. I seek the subgame perfect equilibrium of the game. The timing of the each stage is as follows:

> *Stage 1*: Potential entrants decide whether to enter the market or not in each country.
>
> *Stage 2*: Firms decide on how to serve the foreign market to maximize their profits by choosing from the following entry modes; 1) exporting, 2) greenfield FDI, 3) participate in the cross-border mergers and acquisitions market as buyers or sellers (either technology-seeking or market-seeking).
>
> *Stage 3*: Firms compete in the market as price setters and receive profits. Firms can discriminate between markets and set different prices for the two countries.

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[11] In fact, I already assume countries are identical thus wages are equal and homogeneous good may seem unnecessary. However, homogeneous good insures the wages are equal later when I do comparative statics where country sizes aren't identical.

[12] This model best represents horizontal FDI between developed countries but not vertical FDI since there are no wage differences between the two countries which firms can exploit.

### 2.1. Preferences

The representative consumer has CES preferences over varieties of each differentiated good and Cobb-Douglas preferences over the differentiated goods and the homogeneous good. The representative consumer spends $\alpha Y$ on the differentiated goods and $(1-\alpha)Y$ on the homogeneous good. Consumer's utility over the varieties of the differentiated goods and the homogeneous good can be written as:

$$U=[\int_{\omega\in\Omega} q(\omega)^{1-\rho} x(\omega)^{\rho} d\omega]^{\frac{\alpha}{\rho}} Z^{1-\alpha}\ ,\ \rho=\frac{\sigma-1}{\sigma},\ \sigma>1 \qquad (1)$$

where $x(\omega)$ and $q(\omega)$ are the level of consumption and the perceived quality of variety ω, respectively. The variable $Z$ is the level of consumption of the homogeneous good, and σ is the elasticity of substitution across varieties.

### 2.2. Entry

There is a continuum of atomless and *ex ante* identical potential entrants. They can only enter in their own country and are each endowed with the knowledge to produce a unique good. If an entrant decides not to enter, it obtains a payoff of zero. If it decides to enter the entrant must pay an entry fee of $F_e$. After the entrant enters, it receives a random draw of a technological capability $\tilde{m}$ from distribution $H$ with support $(0,\infty)$, and a market-specific expertise.[13] The market-specific expertise is not drawn from a distribution and the same market-specific expertise is given to all the entrants entering in the same country. This is different from Nocke and Yeaple (2007), where market-specific expertise is drawn from a step function. Assuming that it is not drawn from a

[13] Nocke and Yeaple (2007) used the terminology mobile capability for technological capability and non-mobile capability for market-specific expertise.

step function allows me to skip the domestic acquisition process. Results will still hold even if I assume that market-specific expertise is drawn from a step function. Also, since I am mainly interested in technology as an incentive for cross-border acquisition I only focus on the case where technological capability is drawn from a continuous distribution, unlike Nocke and Yeaple (2007).

### 2.3. Firms

Firms differ in their capabilities. There are two different capabilities that firms receive upon entry. The first is a technological capability. The efficiency of a firm's production technology is assumed to depend on this capability $\tilde{m}$. A firm's marginal cost $c(\tilde{m})$ is the inverse of $\tilde{m}$:

$$c(\tilde{m}) = \frac{1}{\tilde{m}} \tag{2}$$

The second capability is the market-specific expertise, such as knowledge of local marketing strategies or distribution channels that is country-specific. Firms receive market-specific expertise of their home country upon entry. This is country-specific and is not given to foreign firms. A market-specific expertise is more effective in its country of origin than abroad; that is, domestic firms have better marketing strategies for the domestic consumers than foreign firms. There is empirical evidence supporting this idea (see, Maurin *et al.*). This is reflected in $q(\omega)$, the perceived quality of the product. If the firm uses its market-specific expertise originating in country *i* for serving country *i* then its perceived quality in that country is $q^i = 1$. But if it uses this capability to serve country *j* then its perceived quality in country *j* is only $q^j = \delta$, where $\delta \in (0,1)$.

2.3.1. *Additional frictional costs*

There are other frictional costs incurred by a foreign firm when selling its products across borders. These are the same frictional costs also imposed by Nocke and Yeaple (2007) in their model. First, there is a fixed coordination cost $F_c$ associated with managing production in country *i* while using a market-specific expertise originating from country *j* to serve country *i*. This coordination cost can be avoided if production takes place only in country *i* and the firm uses a country *i*'s market-specific expertise or if production takes place in both countries and the firm uses a market-specific expertise from each country. Second, iceberg-type transportation costs are incurred for shipping output across borders: $\tau > 1$ units need to be shipped for one unit to arrive in the foreign country. Thus, if the good is produced in country *i* and then shipped to country *j*, the marginal cost of serving country *j* is $\tau c(\tilde{m})$. For notational convenience, I define the following transformations of $\tilde{m}$ and $\tau$ : $m \equiv \tilde{m}^{\sigma-1}$ and $T \equiv \tau^{-(\sigma-1)}$, with $T$<1.

## 2.4. Foreign market access

All firms serve their home market entirely from local production, but the way they serve the foreign market can differ depending on their productivities. Firms have the choice of serving the foreign market by exporting, greenfield FDI, or by participating in the international M&A market. A firm may choose greenfield FDI to avoid the iceberg-type transportation cost, but it must incur a fixed cost $F_c$. A firm can avoid this fixed cost by exporting, but in this case it must incur the iceberg-type transportation cost. Alternatively, a firm can engage in cross-border M&A to serve the foreign market by purchasing a target firm. There are two possible motives for cross-border M&A; (1) To gain a synergy effect by obtaining a target firm's technological capability, or, (2) to obtain a target firm's market-specific expertise.

2.4.1. *Technology-seeking M&A*

If a firm acquires a target firm from another country, the target firm's technological capability is transferred directly to the acquiring firm upon acquisition and synergy is realized. The synergy is realized because the target firm from another country has a technology that is different from the acquirer that gives a different perspective.[14] Specifically, the merged firm's marginal cost becomes:

$$c(\tilde{m}) = \frac{1}{\tilde{m} \times \tilde{g}} \tag{3}$$

where, $\tilde{g} > 1$ reflects the synergy gain from the merger. Note that the realized synergy parameter, $\tilde{g}$, is constant and doesn't depend on the target's technological capability. This simplifies the calculations, though Appendix A shows that I get the same results if I assume that $\tilde{g}$ increases as target's $\tilde{m}$ increases. For notational convenience, I define the following transformation of $\tilde{g}$: $g = \tilde{g}^{\sigma-1}$. Note $g$ >1. Synergy effect is not present in Nocke and Yeaple's (2007) model. This is something I newly introduce to the literature to analyze technology-seeking cross-border M&A.

[14] The target's technological capability does not have to be necessarily more efficient than the acquirer, for the synergy to be realized. If the target's technological capability gives a different perspective on producing the product unknown to the acquirer, this could be enough for the synergy effect to be realized. There are also articles that support this idea (see Appendix A). More detailed discussion on this is in the Appendix A.

2.4.2. *Market-seeking M&A*

Market-seeking M&A is motivated by a firm's desire to increase the perceived quality of its good in the foreign country by obtaining the foreign country's market-specific expertise and to avoid the fixed coordination cost $F_c$. However, the acquirer can access the market-specific expertise of the target firm only after paying a fixed integration cost (*IC*) in addition to the target firm's purchase price (I assume $IC > F_c$). Such costs may arise, for example, if the acquirer and the target come from very different cultural backgrounds and the acquirer then has difficulties in integrating the target's market-specific expertise. The integration cost of cross-border M&A due to cultural differences is the subject of an extensive literature (See, for example, Finkelstein (1999), Zhu and Huang (2007), Drogendijk and Slangen (2006)).[15]

2.4.3. *Equilibrium price in M&A market*

There exists a perfectly competitive M&A market where entrants can be bought and sold. In this model, target firms' prices are equal because no matter what target firms' types are, they all give the same synergy effect and the same market-specific expertise to the foreign acquirer; i.e. target firms' values are identical to potential acquirers.[16] Thus, there only exists one equilibrium price, which I'll denote as *Q*. This price is determined by the supply of the target firms and the demand of the target firms by foreign acquirers.

[15] More detailed discussion on this and a descriptive statistical evidence of *IC* is in the Appendix A. *IC* is not present in Nocke and Yeaple's (2007) model.

[16] This is similar to Nocke and Yeaple (2007).

2.4.4. *Summary of foreign market access modes and associated costs*

Depending on the firm's choice of foreign market entry mode, associated costs can be summarized as follows:

1. Exporting: No fixed cost, but incurs iceberg type transportation cost.
2. Greenfield FDI: Incurs a fixed coordination cost $F_c$, but no transportation cost.
3. Technology-seeking cross-border M&A: Incurs a fixed purchase cost $Q$ and a fixed coordination cost $F_c$, but no transportation cost.
4. Market-seeking cross-border M&A: Incurs a fixed purchase cost $Q$ and a fixed integration cost *IC*, but no fixed coordination cost $F_c$ and no transportation cost.

## 3. THE INTERNATIONAL ORGANIZATION OF PRODUCTION

In this section, I analyze the equilibrium of the model and determine how firms select into different foreign market entry modes (i.e. exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking cross-border M&A) in equilibrium. I start by deriving the gross profits of firms at the third stage.

Solving the representative consumer's utility maximization problem, I obtain the following demand function for any variety ω in country *k*:

$$x^k(\omega) = \alpha Y (P^k)^{\sigma-1} q^k(\omega) p^k(\omega)^{-\sigma} \tag{4}$$

where $p^k(\omega)$ is the price of variety ω in country *k*, and

$$P^k = [\int_{\omega\in\Omega} q^k(\omega) p^k(\omega)^{1-\sigma} d\omega]^{1/1-\sigma} \tag{5}$$

the aggregate price index for the varieties produced in country *k*. Since countries are symmetric, the price indices in the two countries are the same: i.e. $P^1 = P^2 = P$.

Let $\hat{c}^k(\omega)$ denote the marginal cost of selling variety ω in country *k*, including the iceberg-type transportation cost. Since this is monopolistic competition and firms can price discriminate between countries, profit maximization then implies that the price of variety ω $p^k(\omega)$ is equal to $\hat{c}^k(\omega)/\rho$. Hence, the gross profit of a firm selling variety ω in country *k* is given by,

$$Sq^k(\omega)(\hat{c}^k(\omega))^{1-\sigma} \tag{6}$$

where,

$$S = \frac{\alpha Y}{\sigma(\rho P)^{1-\sigma}} \tag{7}$$

Now, by using (6) and by associating the fixed costs incurred for each foreign entry mode, I derive the following total profits generated from domestic and foreign countries depending on the firm's entry mode:

| | Total Profit |
|---|---|
| Exporting | $\pi_x(m) = (1+T\delta)Sm$ |
| Greenfield FDI | $\pi_f(m) = (1+\delta)Sm - F_c$ |
| Technology-seeking cross-border M&A | $\pi_g(m) = (1+\delta)Smg - Q - F_c$ |
| Market-seeking cross-border M&A | $\pi_a(m) = 2Smg - Q - IC$ |

In the second stage, firms decide on the entry mode that maximizes their total profits. This depends on their technological capability *m*, because total profit is increasing in *m,* but at different rates (i.e. different slopes) for each entry mode. In fact, if I take the partial derivative of the profits with respect to *m*, I can order the slopes as; $0 < \pi'_x(m) < \pi'_f(m) < \pi'_g(m) < \pi'_a(m)$, and therefore, I obtain the following result.

**Proposition 1.** *In equilibrium there exist four thresholds,* $0 < m_s < m_x < m_g < m_a$ *such that, firms with a technological capability between* $(0, m_s)$ *sell themselves in the cross-border M&A market, firms with a technological capability between* $[m_s, m_x)$ *export, firms with a technological capability between* $[m_x, m_g)$ *engage in greenfield FDI, firms with a* *technological capability between* $[m_g, m_a)$ *engage in technology-seeking cross-border M&A, firms with technological capability between* $[m_a, \infty)$ *engage in market- seeking cross border M&A.*

Graphical illustration of Proposition 1 is shown in figure 1. Each curve represents the profit functions ( $\pi_x(m), \pi_f(m), \pi_g(m), \pi_a(m)$ ) and the horizontal line is the target firm's price *Q*. The bolded section of the curve indicates that the corresponding entry mode (or becoming a target at price *Q*) gives the firm the highest total profit given the firm's current technological capability *m*. Therefore, firms are partitioned into five different subsets according to their technological capability: 1) become a target and earn *Q* (if it can't generate a profit higher than *Q* from other entry modes), 2) become an exporter and earn $\pi_x(m)$, 3) engage in greenfield FDI and earn $\pi_f(m)$, 4) engage in technology-seeking cross-border M&A and earn $\pi_g(m)$, 5) engage in market-seeking cross-border M&A and earn $\pi_a(m)$. Firms sort into these five cases depending on their technological capability.

Also, the four thresholds are shown in the figure, each of which occurs at the intersections of the curves.

The values of the four thresholds are as follows:

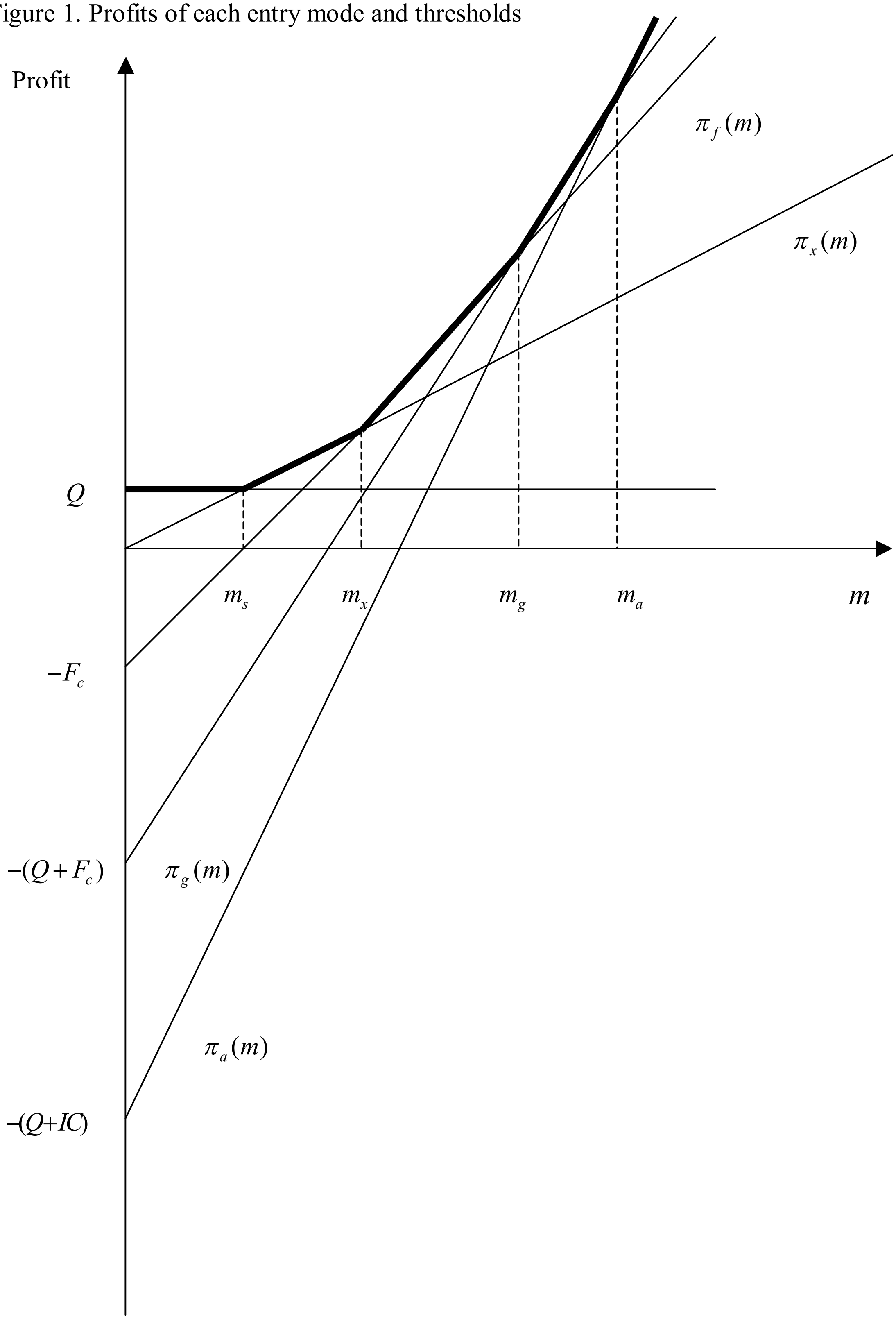
Equate $\pi_x(m)$ and *Q*,
$$m_s = \frac{Q}{(1+T\delta)S} \tag{8}$$

Equate $\pi_x(m)$ and $\pi_f(m)$,
$$m_x = \frac{F_c}{S\delta(1-T)} \tag{9}$$

Equate $\pi_f(m)$ and $\pi_g(m)$,
$$m_g = \frac{Q}{(1+\delta)(g-1)S} \tag{10}$$

Equating $\pi_g(m)$ and $\pi_a(m)$,
$$m_a = \frac{IC - F_c}{S(1-\delta)g} \tag{11}$$

Figure 1. Profits of each entry mode and thresholds



In the first stage, free entry of *ex ante* identical entrants implies that the expected value of a new entrant is equal to zero: i.e.,

$$\int_0^\infty V(m)dH(m) - F_e = 0 \tag{12}$$

where *V(m)* is the value of a firm after entering the market, which depends on the profit it generates.

Lastly for the merger market to clear, the mass of target firms must be equal to the mass of acquirers. Let *E* be the mass of entrants in both countries (*E* is same in both countries because they are identical). Then the mass of targets, $EH(m_s)$ must equal the mass of acquirers, $E(1-H(m_g))$. This simplifies to:

$$H(m_s) + H(m_g) = 1 \tag{13}$$

## 4. ASYMMETRIC COUNTRY SIZE AND M&A ACTIVITY

In this section, I analyze how asymmetric country size between the two countries in my model can affect the equilibrium thresholds, especially $m_g$ and $m_a$. I undertake this comparative static exercise to provide me with a sharp prediction about how M&A activity varies with the separate cross-border M&A motives; i.e. technology-seeking versus market-seeking motives. The effect of asymmetric country size on the market-seeking motive is similar to Nocke and Yeaple (2004) in my model. However, asymmetric country size has an opposite effect on M&A activity motivated by technology-seeking.

The motivation behind acquiring market-specific expertise from a country is to raise demand for a firm's good in that country. On the other hand, the motivation behind acquiring technological capability is to get a synergy effect, which is independent of access to the foreign market. Thus, if we have two countries with different sizes, intuitively firms from the smaller country will be relatively more interested in the market-specific expertise of the larger country and less interested in the technological capability because the profit increase from accessing the larger country's market is relatively large. On the other hand, firms from the larger country will be relatively more interested in the technological capability of the smaller country and less interested in the market-specific expertise because the relative profit increase from accessing the smaller country's market is small. Using comparative statics I show separation of the two cross-border M&A motives consistent with this intuition.

To address how country size differences affect the equilibrium outcome, I consider a change in country sizes that maintains global income so that $dY^k = -dY^l > 0$. Then I use the following lemma from Nocke and Yeaple (2004) to analyze how this change in income affects the endogenous variables in my model.

**Lemma 1** *Suppose the two countries are initially of the same size, i.e.* $Y^1 = Y^2$*, and consider a small change in country sizes such that* $dY^k = -dY^l$*. Then, the change in any endogenous variable u has the same absolute value in the two countries, but is of opposite sign:* $du^k = -du^l$.

Proof of Lemma 1 is in the Appendix B.

By applying Lemma 1, I can derive the following proposition.

**Proposition 2**. *Suppose the two countries are initially of the same size, i.e.* $Y^1 = Y^2$*, and consider a small increase in the size of country k and a small decrease in the size of country* $l \neq k$ *such that* $dY^k = -dY^l > 0$.

*Then,* $dm_s^k = -dm_s^l < 0$, $dm_x^k = -dm_x^l > 0$, $dm_g^k = -dm_g^l < 0$, and $dm_a^k = -dm_a^l > 0$.

Proof of Proposition 2 is in the Appendix B.[17]

Figure 2. Directions of the thresholds' movements as countries become asymmetric

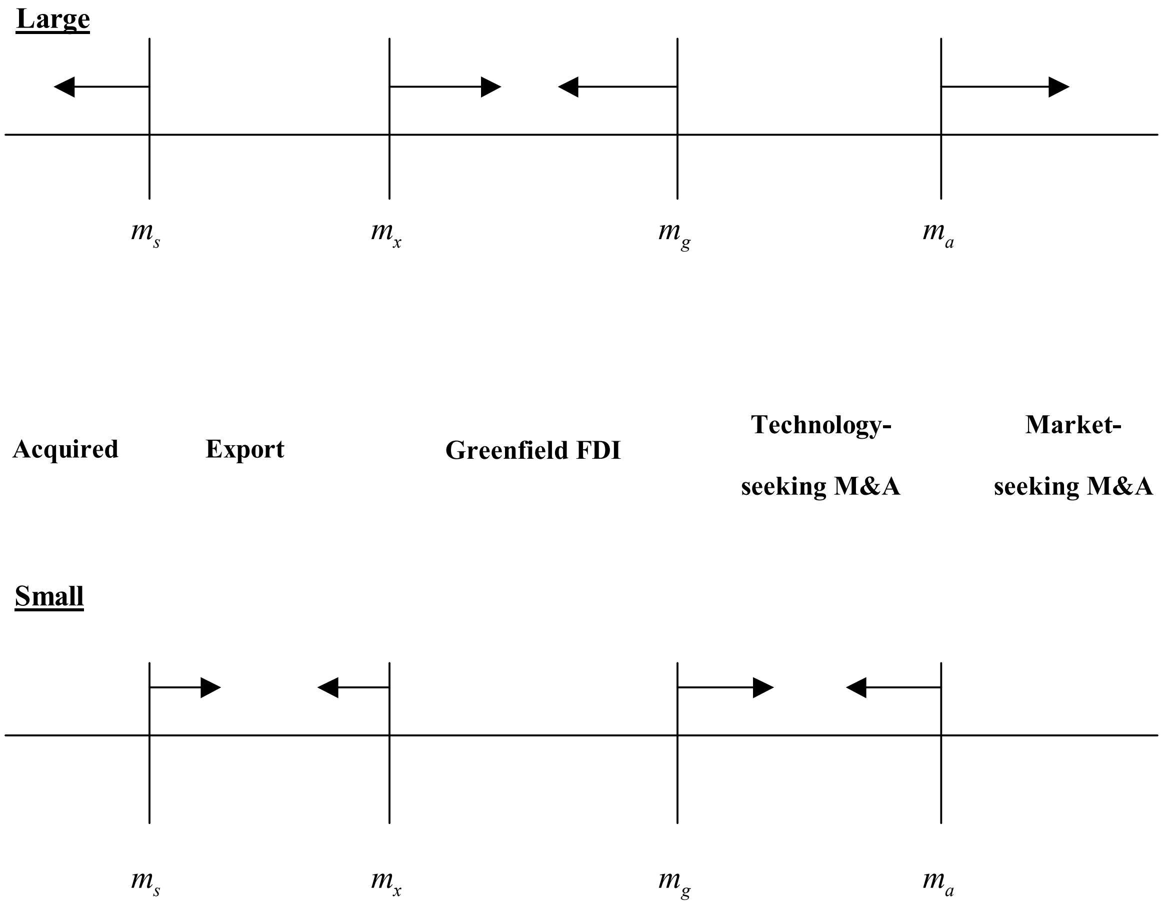



Figure 2 illustrates the movements of the thresholds from their initial points as country size changes (the arrows indicate the direction of the movements from their initial points). Since, $dm_g^k = -dm_g^l < 0$ and $dm_a^k = -dm_a^l > 0$, the threshold $m_g$ falls and the threshold $m_a$ rises in country *k* (the larger country), implying that proportionately more firms in country *k* are now engaging in cross-border M&A to obtain the synergy

[17] Note, this proposition is true conditional on the fact that the acquisition price *Q* that firms has to pay does not change as much when countries' sizes change. I will illustrate this in detail in my proof in the appendix.

effect and proportionately less firms are engaging in market-seeking cross-border M&A. The opposite is true in country *l* (the smaller country) since the threshold $m_g$ went up and the threshold $m_a$ went down.

## 5. EMPIRICAL EVIDENCE

### 5.1. Specification

In this section, I conduct an empirical analysis to examine the hypothesis that asymmetric country size will have different impacts on M&A activity, depending on whether it is motivated by technology-seeking or market-seeking behavior.

Nocke and Yeaple (2004) shows that when only the market-seeking motive exists for cross-border M&A, proportionately more firms in the home country engage in cross-border M&A into the host country as the home country's size decreases relative to the host country. This indicates that the level of cross-border M&A deals is an inverse function of the size difference (i.e. home country size minus host country size):

$$MA_{ijt} = f(size_{jt} - size_{it}) \tag{14}$$

where *j* denotes the home country and *i* denotes the host country. The $MA_{ijt}$ variable is the cross-border M&A activity in country *i* from country *j* in time *t*, $size_{jt}$ is the size of country *j* at time *t*, and $size_{it}$ is the size of country *i* at time *t*. Then, $(size_{jt} - size_{it})$ should have a negative effect on $MA_{ijt}$, if acquisition of market-specific expertise is the only cross-border M&A motive.

In contrast, Proposition 2 in the previous section predicts that $(size_{jt} - size_{it})$ has a positive effect on $MA_{ijt}$ when a technology-seeking motive is driving cross-border M&A activity. As the home country's size increases relative to its host country, proportionately more firms from the home country engage in technology-seeking cross-border M&A into the host country.

To distinguish between these two contrasting predictions, I need to identify situations in which a technology-seeking motive is important vis-à-vis a market-seeking motive. To do this, I modify equation (14) to include an interaction term between the size difference variable and an indicator variable that takes a value of one when M&A deal is technology-seeking and zero when it isn't:

$$MA_{ijt} = f(tech(size_{jt} - size_{it}), (size_{jt} - size_{it})) \tag{15}$$

where the interaction term should have a positive effect on $MA_{ijt}$ if Proposition 2 is correct. The relationship between the interaction term and $MA_{ijt}$ from equation (15) provides an estimation strategy that I can take to the data to identify the evidence for Proposition 2's prediction when technology-seeking motive is present.

The following is the related estimating specification for equation (15):

$$MA_{ijkt} = \beta_{ikt} + \delta_1 tech(size_{jt} - size_{it}) + \delta_2 (size_{jt} - size_{it}) + \delta_3 tech + \varepsilon_{ijkt} \tag{16}$$

The dependent variable, $MA_{ijkt}$ is the number of firms acquired in country *i* in industry *k* by firms in country *j* in time *t*. My dependent variable is constructed at the four-digit SIC industry level from the mergers and acquisitions data at SDC Platinum. If an acquirer acquires 10% or more of the target's shares, I consider this as an acquisition.[18] The value of M&A deals cannot be used since they are not consistently available in the data. Since the dependent variable is count data, negative binomial estimation will be used.[19]

The size difference variable, $(size_{jt} - size_{it})$ is equal to the log of real $GDP_{jt}$ minus the log of real $GDP_{it}$, which captures the country size difference between the home and the host countries. Real GDP is used to measure country size because country size is represented by aggregate income in my model.

There is no way of knowing the true motivation behind the cross-border M&A that took place because firms don't report the exact reason for acquisition. However, R&D expenditures are a commonly used proxy for indicating the importance of technology in an industry and I use it here for this purpose as well.[20] Thus, I specify the indicator variable for technology-seeking motive, *tech*, as taking the value of "1" for industries with high R&D expenditures. Later, I explore other proxies for the *tech* variable.

I separate the high R&D industries and low R&D industries by using the R&D expenditures as a percentage of sales data obtained from National Science Foundation to construct *tech*, and categorize industries as high R&D industries if those industries

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[18] This is because 10% or more is considered as an acquisition in United States. The regression results are still the same when 50% or 100% is used instead as the threshold level.

[19] I use negative binomial model instead of poisson model because summary statistics suggests that dependent variable is over-dispersed (i.e. mean <variance).

[20] I also try using high-tech share to proxy for the importance of technology in an industry. I still get similar results. Discussion and results on this are in the robustness checks section.

have R&D expenditures as a percentage of sales that are at or above the mean of the manufacturing sector.[21]

The main variable of interest is the interaction term. Proposition 2 implies that technology-seeking cross-border M&A into host country will increase as relative size difference between the home and the host country increase. Thus, the main coefficient of interest is the coefficient on the interaction term and I expect the coefficient on it to be positive and significant. I include the size difference and *tech* variable separately in all my estimations to control for any independent effects of these variables on cross-border M&A activity.

Industry and time fixed effects, $\beta_{ikt}$ are included to capture any industry-specific favorable environment for acquisition at time $t$ in the host country $i$.[22] The $\varepsilon_{ijkt}$ denotes the error term.

5.1.1. *Additional control variables*

After providing initial baseline estimates of equation (16), I explore how robust my results are to including other control variables that can potentially affect cross-border M&A. Most of these control variables are taken from previous trade literature papers such as Di Giovanni (2005) and Head and Ries (2008), which estimate the determinants of cross-border M&A activity.

[21] This method has been used by Blonigen (1997) to separate high-tech industries from low-tech industries in manufacturing sector.

[22] Note that *tech* variable drops because of perfect multicollinearity with the fixed effects.

First, annual real GDP growth rate of the home country, $realgdpg_{jt}$, is included to control for demand side factors. I expect this variable to have a positive effect on the dependent variable.

Second, I include $\ln(exch_{ijt})$, a logged exchange rate between countries *i* and *j* at time *t*. This is a relevant control variable because Blonigen (1997) suggests that depreciation of the domestic currency can encourage inflow of asset seeking type acquisition FDI. The exchange rates are denominated in home country's currency per host country's currency. Thus, a decrease in this variable implies depreciation of the host country's currency. I log the exchange rates so that percentage changes in exchange rates for different country pairs are comparable. I expect this to have a negative effect on the dependent variable.

Third, I include stock market capitalization as a percentage of GDP of the home country, $stockcap_{jt}$, as a control variable because financial deepening (i.e. increase in the size of financial markets) of the home country can influence cross-border M&A, as suggested by Di Giovanni (2005). I expect this to have a positive effect on the dependent variable.

Fourth, I also include domestic credit provided to the private sector as a percentage of GDP of the home country, $credit_{jt}$, as a control variable. This is another variable suggested by Di Giovanni (2005) to account for the effect of financial deepening on cross-border M&A. I expect this to have a positive effect.

Fifth, I include the distance between the home and the host countries' capital cities (in miles), $distance_{ij}$, as a control variable. The gravity model suggests that there's less foreign direct investment when the distance between the home and the host countries increases. I expect this to be true for cross-border M&A activity as well. Thus, I expect this variable to have a negative effect on the dependent variable.

Sixth, I include the following dummy variables: common language usage dummy variable, $lang_{ij}$, directional dummy variables $ToColy_{ij}$, which indicates M&A to a former colony from its colonizer, and $FromColy_{ij}$, which indicates M&A from a colony to its colonizer. These variables are included to control for the cultural distance between the home and the host countries that can potentially affect the dependent variable. Empirical evidence from the trade literature suggests that cultural similarity between the home and the host countries increase foreign direct investment activities between the two countries. Thus, I expect these variables to have a positive effect on the dependent variables. The three dummy variables $lang_{ij}$, $ToColy_{ij}$, and $FromColy_{ij}$ have also been used in Head and Ries' (2008) paper to measure cultural distance.

Finally, I include a time-varying dummy variable, $rta_{ijt}$, that takes a value of one when the home and the host countries belong to a common regional trade agreement. Trade agreement variable has frequently been used in past FDI or cross-border M&A studies as a control variable (e.g. Di Giovanni (2005)).

The following is the estimating specification with additional controls included:

$$\begin{aligned} MA_{ijkt} = \beta_{ikt} &+ \delta_1 tech(size_{jt} - size_{it}) + \delta_2 (size_{jt} - size_{it}) + \delta_3 tech + \delta_4 realgdpg_{jt} \\ &+ \delta_5 \ln(exch_{ijt}) + \delta_6 stockcap_{jt} + \delta_7 credit_{jt} + \delta_8 distance_{ij} \\ &+ \delta_9 lang_{ij} + \delta_{10} ToColy_{ij} + \delta_{11} FromColy_{ij} + \delta_{12} rta_{ijt} + \varepsilon_{ijkt} \end{aligned} \tag{17}$$

## 5.2. Data

I use the mergers and acquisitions data from Thomson SDC Platinum (software which contains data on M&A, loans, equity etc), which has data on acquired firms by foreign and domestic firms in various countries to construct my dependent variable.[23] If the percentage of shares acquired by a foreign firm is 10% or more, I consider this as an acquisition. SDC Platinum also has SIC codes at the four-digit level for each acquired firm and provides the country of origin of the firms that are engaged in acquisition.

Using the data set, I create a M&A count dependent variable at the four-digit SIC industry level and form a panel data set that ranges from 1985 to 2007, for the OECD countries (except Slovakia).[24] I use OECD countries because more than 70% of FDI activities are among the developed countries. All countries in my sample are both host and home countries.

R&D expenditures as a percentage of sales data used for creating the high R&D industry dummy variable (*tech*) are obtained from the U.S. National Science Foundation. Annual real GDP growth rates are obtained from the United States Department of Agriculture (USDA) website.[25] Exchange rate data are obtained from the Pacific Exchange Rate Service.[26] The stock market capitalization to GDP and domestic credit to GDP data are obtained from the World Development Indicators database from the World Bank. The distance variable is constructed using the great

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[23] Further information on these data are at: http://www.thomsonreuters.com/products_services/financial/sdc

[24] M&A data for Slovakia is not included in SDC Platinum.

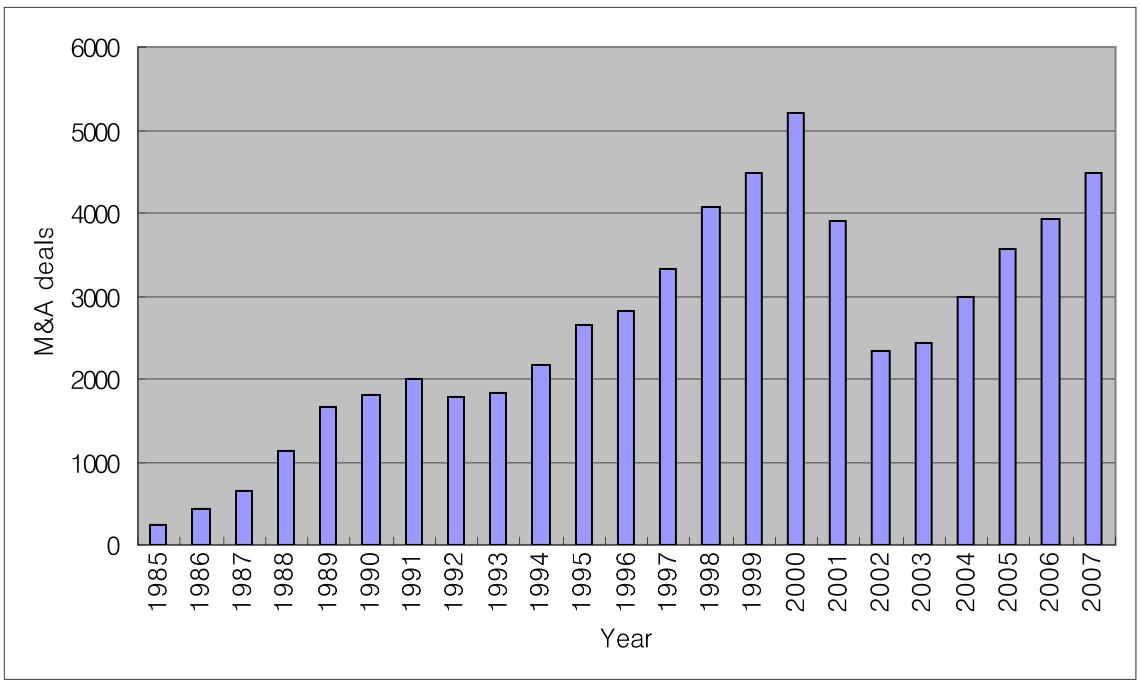
[25] Link to this data source: http://www.usda.gov/

[26] Link to this data source: http://fx.sauder.ubc.ca/

circle distance calculator[27]. The three dummy variables $lang_{ij}$, $ToColy_{ij}$, $FromColy_{ij}$ and the time-varying dummy variable, $rta_{ijt}$ are obtained from the *cepii.fr* website.

Figure 3 shows the cross-border M&A deals into OECD countries in my dataset from 1985 to 2007. Cross-border M&A deals have been growing steadily since 1985. Although M&A deals dropped in 2001 and 2002, they began to increase again in 2003 and this trend continued through the end of the sample in 2007. This trend is consistent with other sources, which highlight the growing trend of cross-border M&A over the past couple of decades. Table 4 shows the summary statistics of the variables.

Figure 3. Cross-border M&A Deals of the OECD Countries, 1985-2007




[27] Link to this calculator: http://www.marinewaypoints.com/learn/greatcircle.shtml

Table 4. Descriptive statistics 1985-2007

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| # of acquisition by foreign firms | 18769380 | 0.003 | 0.082 | 0 | 45 |
| Size difference (home minus host) | 18769380 | 0 | 2.068 | -6.798 | 6.798 |
| Home country's real GDP growth rate | 18769380 | 2.961 | 2.633 | -11.89 | 11.28 |
| Logged exchange rates | 15410670 | 5.62e-09 | 3.404 | -12.611 | 12.611 |
| Stock market capitalization to GDP | 15589560 | 65.755 | 56.202 | 0.188 | 479.742 |
| Domestic credit to GDP | 18234720 | 86.189 | 49.077 | 11.114 | 319.468 |
| Distance | 18769380 | 3330.293 | 3344.478 | 107.504 | 12327.05 |

### 5.3. Results

Regression results for equation (16) are provided in the first column of Table 5. The coefficient on the interaction term is positive and significant which is consistent with my prediction and suggests that cross-border M&A into host country's high R&D industries increases as relative size difference between the home and the host country increases. Assuming the *tech* dummy variable correctly proxies for the technology-seeking motive, this implies that the bigger the home country is relative to the host country, more firms in the home country engage in technology-seeking cross-border M&A into the smaller host country. Thus, this supports Proposition 2's prediction of technology-seeking motivated cross-border M&A behavior when country sizes are asymmetric.

Coefficient estimates in a negative binomial model are not straightforward to interpret. Incidence rate ratio interpretation is more commonly used for negative binomial models. The second column of Table 5 presents the incidence rate ratio for each coefficient. By using this ratio, the effect of the interaction term on the dependent variable can be interpreted as follows: one unit increase in the size difference variable increases the cross-border M&A in high R&D industries by a factor of 1.132.

Table 5. Country size difference and technology-seeking cross-border M&A

| Variables | Negative binomial | Incidence Rate Ratio | Negative binomial |
|---|---|---|---|
| Interaction of size difference and *tech* dummy | 0.124*** | 1.132*** | 0.150*** |
| | (0.008) | (0.009) | (0.009) |
| Size difference (home minus host) | 0.716*** | 2.046*** | 0.693*** |
| | (0.004) | (0.008) | (0.005) |
| *tech* dummy | - | - | - |
| | - | - | - |
| Home country's real GDP growth rate | - | - | 0.034*** |
| | - | - | (0.003) |
| Logged exchange rates | - | - | -0.142*** |
| | - | - | (0.003) |
| Stock market capitalization to GDP | - | - | 0.003*** |
| | - | - | (0.0001) |
| Domestic credit to GDP | - | - | 0.004*** |
| | - | - | (0.0002) |
| Distance | - | - | -0.0002*** |
| | - | - | (0.000004) |
| Language | - | - | 0.851*** |
| | - | - | (0.014) |
| To Colony | - | - | 0.495*** |
| | - | - | (0.020) |
| From Colony | - | - | 0.378*** |
| | - | - | (0.023) |
| RTA | - | - | 0.660*** |
| | - | - | (0.022) |
| Industry and Time FE | Yes | Yes | Yes |
| Observations | 1,034,264 | 1,034,264 | 892,083 |

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

An interesting observation is that the coefficient on the size difference variable is positive and significant; i.e. size difference has a positive effect on cross-border M&A activities overall. This is counter to what Nocke and Yeaple (2004) predicts where market-seeking is the sole motive for cross-border M&A, because in that case, size difference variable should have a negative effect on cross-border M&A. In fact, based on my prediction from Proposition 2, this indicates that the technology-seeking motive rather than market-seeking motive is much more prevalent in other industries as well. Also, considering that countries in my sample are all industrialized countries, this result can shed some light on the motive behind horizontal FDI. My result is counter to the common belief in FDI literature that firm's motive behind horizontal FDI is to access the foreign market. As a matter of fact, it suggests that technology-seeking motive is much more common than market-seeking motive.

Table 5, column 3, shows the regression results for equation (17), which includes additional control variables. My results are robust to additional control variables. The magnitude of the main coefficient (i.e. the interaction term) has not changed much compared to the baseline estimation, and it is still statistically significant and has a positive sign. The coefficient for the size difference variable is significant and similar in magnitude and has the same sign as the coefficient from the baseline estimation.

The coefficient on the annual real GDP growth rate of the home country has the positive sign and is significant. This suggests that as the home country grows it increases the demand for M&As into other countries, which is consistent with my expectation. The coefficients on the stock market capitalization variable and the domestic credit variable are both significant and positive. These results suggest that financial deepening (i.e. increase in the size of financial markets) in the home country increases the cross-border M&A activities. These results are consistent with Di Giovanni's (2005) results. The coefficient on the exchange rate variable is significant and has the expected negative sign as well. The coefficient on the distance variable is negative and significant, which suggests that increase in the distance between the home and the host countries decreases the M&A activities between the two countries. This result is consistent with the gravity model in the trade literature. The coefficient on the common language usage dummy variable is positive and significant, which suggests that common language usage increases the M&A activities between the home and the host countries. This result is similar to the gravity model, which states that cultural similarity between the two countries increases trade and FDI. The coefficient on the dummy variable To Colony and the coefficient on the dummy variable From Colony are positive and significant. These results again suggest that cultural similarity does have positive impact on the cross-border M&A activities. Finally, the coefficient on the common regional trade agreement (RTA) variable is positive and significant, which suggests that there are more cross-border M&A activities between the countries that are in the same trade agreement.

#### 5.3.1. *Robustness checks*

In this section, I discuss further robustness checks of the results. First, Blonigen has suggested that mergers and acquisitions data from SDC Platinum before 1990 are not very clean for some countries (e.g. Germany, France). Thus, I estimate equation (17) using the data from 1990 to 2007. The first column of table 6 shows the results. The coefficient on the interaction term is still significant and has the expected sign. The magnitude of the coefficient is also similar to the estimation coefficient in table 5. In fact, most coefficients on other variables also have the same signs as the estimation coefficients in table 5, and the magnitude is very similar as well.

Table 6. Country size difference and technology-seeking cross-border M&A

| Variables | 1990-2007 | High-tech share | Same target and acquirer SIC |
|---|---|---|---|
| | Negative binomial | Negative binomial | Negative binomial |
| Interaction of size difference and *tech* dummy | 0.148*** | 0.121*** | 0.228*** |
| | (0.009) | (0.009) | (0.016) |
| Size difference (home minus host) | 0.694*** | 0.702*** | 0.671*** |
| | (0.005) | (0.005) | (0.009) |
| *tech* dummy | - | - | - |
| | - | - | - |
| Home country's real GDP growth rate | 0.034*** | 0.034*** | 0.032*** |
| | (0.003) | (0.003) | (0.006) |
| Logged exchange rates | -0.139*** | -0.142*** | -0.118*** |
| | (0.003) | (0.003) | (0.005) |
| Stock market capitalization to GDP | 0.003*** | 0.003*** | 0.003*** |
| | (0.0001) | (0.0001) | (0.0002) |
| Domestic credit to GDP | 0.004*** | 0.004*** | 0.003*** |
| | (0.0002) | (0.0002) | (0.0003) |
| Distance | -0.0002*** | -0.0002*** | -0.0002*** |
| | (0.000005) | (0.000004) | (0.000008) |
| Language | 0.879*** | 0.848*** | 0.984*** |
| | (0.014) | (0.014) | (0.026) |
| To Colony | 0.469*** | 0.496*** | 0.457*** |
| | (0.020) | (0.020) | (0.037) |
| From Colony | 0.369*** | 0.376*** | 0.328*** |
| | (0.024) | (0.023) | (0.044) |
| RTA | 0.609*** | 0.659*** | 0.619*** |
| | (0.023) | (0.022) | (0.041) |
| Industry and Time FE | Yes | Yes | Yes |
| Observations | 855,216 | 892,083 | 292,886 |

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Second, I examine alternative measures to proxy for indicating the importance of the technology in an industry. I construct a high-tech share for each industry where high-tech share measures the share of assets in an industry that are considered high technology in nature. I follow Feenstra and Hanson's (1999) method in constructing the high-tech share. I categorize industries as high-tech industries if an industry's high-tech share is at or above the mean of the total industry high-tech share. Table 6, column two, shows estimation results of equation (17) using this alternative measure for *tech*. The coefficient for the interaction term is significant and has the expected sign. The magnitude is also quite similar to the coefficient in table 5. Most coefficients on other variables also have the same signs as the estimation coefficients in table 5, and the magnitude is very similar as well. This suggests that my results are robust to other measures of technology-seeking motive.

Third, the industries in my data set are classified by the SIC code of the target, but the target's SIC code and acquirer's SIC code are often not the same. Thus, one might question whether an acquisition of a target in a high R&D industry by an acquirer in a low R&D industry should be considered as technology-seeking. In order to make sure that I am really capturing technology-seeking motive with the *tech* dummy, I look at a subsample of cross-border M&A where the target's SIC code and acquirer's SIC code are the same. Table 6, column three, presents the results. The coefficient on the interaction term is significant and has the expected sign. In fact, the magnitude is slightly higher than the estimation coefficient from table 5. This is probably because cross-border M&As in high R&D industries are now less noisy and just include the technology-seeking motives. Thus, the result supports my prediction from the theory. Again, most coefficients on other variables have the same signs as the estimation coefficients in table 5, and the magnitude is very similar as well.

Fourth, I check to see whether my results are sensitive to the 10% threshold level I use to define an acquisition. I perform regressions on equation (17) using two different dependent variables constructed by using 50% and 100% as the threshold level. The main coefficient is still significant and has the expected sign for both cases. Thus, the result doesn't seem to be sensitive to threshold levels used to construct the dependent variable.

Fifth, I estimate equation (17) using the dataset that exclude U.S. inbound cross-border M&A. I conduct this robustness check because chapter II results suggest that technology-seeking M&A into U.S. is more prevalent than in other countries. I find that the main coefficient is still significant and has the expected sign.

Lastly, since I have panel data, the standard errors should be clustered. However, standard errors cannot be clustered in the negative binomial model for panel dataset in a way that is similar to standard regression models. Thus, I perform bootstrap with a cluster option instead on equation (17). I perform bootstrap estimation, with clustering on industry and country pair. Estimation results show that the main coefficient (i.e. the coefficient on the interaction term) is still significant at the 1% level.

## 6. CONCLUSIONS

Cross-border M&A has been growing fast over the past couple of decades and has been the major source of FDI. I build a model of cross-border M&A and provide empirical evidence of the model in this chapter to enhance our understanding of cross-border M&A.

There are two main contributions of this chapter. The first is the incorporation of the technology-seeking motive into a M&A model where technologies yield synergy gains. I show that there are distinct productivity cutoffs in the model that separate exporting, greenfield FDI, technology-seeking cross-border M&A, and market-seeking cross-border M&A in equilibrium and show how different firm types sort into these foreign market access modes.

Second, I show that the model generates a sharp theoretical distinction between the two cross-border M&A motives. In particular, proportionately more firms engage in technology-seeking cross-border M&A as their home country's size increase relative to the host country, whereas the opposite is true for market-seeking cross-border M&A. I use this prediction of the model to come up with an estimation strategy to identify the technology-seeking motive in the data. I provide evidence of this result by showing that the cross-border M&A into high-R&D sectors in the host country increases as the relative size difference between the home and the host country (i.e. home country size minus host country size) increases.

The primary focus of this chapter is to better understand cross-border M&A by building a theoretical model. However, some welfare and policy implications still can be drawn from the results of my model. When firms engage in technology-seeking cross-border M&A they reach a new level of productivity due to synergy gain. Thus, new differentiated products that are produced at a new productivity level are introduced to the economy. This can be interpreted as a welfare gain in a CES preference setting where there are gains from variety.

As for policy implications, there have been some concerns about hostile takeovers of domestic firms by foreign firms to acquire technology. Further development of my model could provide deeper understanding of these M&A activities by foreign firms and several issues that are of concern to the policy makers. Also, if we think solely from a "gains from variety" perspective, cross-border M&A may increase welfare of the consumers by increasing the number of products in the economy, which is an important implication for policy makers.

The theoretical model, I develop in this chapter is somewhat limited in the sense that it is a static model, whereas in the real world acquisition process, synergy realization and integrating market-specific expertise occur over a period of time. Thus, future research will look at developing dynamic models of M&A activity.

# CHAPTER IV

# HETEROGENEOUS FRICTIONAL COSTS: EVIDENCE FROM CROSS-BORDER MERGERS AND ACQUISITIONS

Bruce Blonigen contributed to this work by participating in the development of the theoretical model and the construction of the tradeability variable. I contributed to this work by developing the theoretical model, constructing variables for empirical analysis, and conducting empirical analysis. I also did all the writing.

## 1. INTRODUCTION

The growth of world foreign direct investment (FDI) over the past few decades has been rapid and has received significant attention. Despite this rapid growth in FDI, like other cross-border transactions, world FDI activity is less than one would expect in a frictionless world. In accordance with this, there has been significant research effort to explore the determinants (and frictions) that determine worldwide FDI patterns. Surprisingly, this prior literature on FDI determinants has done very little to examine sectoral heterogeneity in FDI patterns, focusing primarily on country-wide FDI flows and affiliate activity.

Perhaps the most surprising feature in this regard is that the majority of FDI is manufacturing and undertaken primarily amongst developed countries, yet manufacturing accounts for a very small (and rapidly declining) share of activity in these same developed countries. For example in the US, over 40% of value added by foreign affiliates operating in the US was in manufacturing in 2007 (Anderson and Zeile, BEA). However, total value added by manufacturing sector in the US only accounted for 12% of the GDP in 2007 (Gilmore et al, BEA). Likewise, almost 48% of value added in 2004 by

US affiliates operating in foreign countries was in manufacturing (Raymond et al. table 19.2 BEA).[28] While the share of manufacturing in FDI activity has been declining a fair amount over the past couple of decades, these high manufacturing shares beg a number of important questions, especially in light of the fact that so much of FDI activity is between developed countries where manufacturing activity is fairly low as a share of their economies and quickly shrinking.

First, what are the important differences that make FDI in non-manufacturing (i.e., service sectors) much more difficult than manufacturing? A number of possible candidates are in play. First, cultural dissimilarities or "cultural distance" may impact the ability of a foreign firm to operate in another country much more in service sectors than manufacturing sectors. Examples of such "culturally- and language-sensitive" non-manufacturing sectors include media, film, and advertising. Second, many services are non-tradeable, whereas virtually all of manufacturing is highly tradeable. Exporting may be an important source of information of foreign markets for firms, significantly reducing the fixed costs (and uncertainty) of the decision to engage in FDI. Thus, the FDI decision may involve a much higher information hurdle for a non-tradeable sector that cannot rely on prior exporting experience into the market. Third, many service sectors are connected with market features, such as natural monopolies or public goods characteristics, that lead governments to highly restrict FDI in these sectors or even have public ownership of the sector, effectively prohibiting FDI. Such sectors include some modes of transportation, utilities, some communication sectors, and even health services.

In this chapter, we contribute to the growing FDI and cross-border M&A literature by providing empirical evidence for heterogeneous sector-specific frictional

[28] Percentage was slightly higher for US affiliates operating in Europe (50%).

costs. In particular, we test our three hypotheses empirically and find that cultural distance, tradeability, and regulation all play an important role in determining heterogeneous frictional costs across different sectors. First, we show that cultural distance, measured by Kogut and Singh's cultural index, inhibits cross-border M&A activity more in services-producing sectors than in other sectors. We find that a one-unit increase in the Kogut and Singh's cultural index decreases the number of cross-border M&A by 0.0003 units in services-producing sectors. Second, we also show that tradeability, measured by the sum of exports and imports divided by shipments of the domestic firms in the industry, increases cross-border M&A activity in services-producing sectors. We find that a one-unit increase in the tradeability variable increases the number of cross-border M&A into services-producing sectors by 0.0002 units. Finally, we show that regulation, measured by the regulation indicator index from the OECD.stat, inhibits cross-border M&A activity. In particular, a one-unit increase in the regulation indicator index decreases the number of cross-border M&A by 0.00006. The data we use for this analysis are the cross-border M&A data from Thomson SDC Platinum database ranging from 1985-2007. There are three main reasons that we use cross-border M&A to study frictional costs in FDI. First, our theoretical motivation is about M&A for corporate control. Second, the cross-border M&A data from SDC Platinum are disaggregated at the four-digit SIC level. This is important because it allows us to conduct our analysis at the industry level and identify frictional costs at the industry level. Total FDI data are not available at this industry level on a consistent basis across countries. Third, according to the world investment report (UNCTAD 2000), two thirds of the FDI takes the form of cross-border M&A. Thus, by conducting empirical analysis with the cross-border M&A data, we are capturing a substantial component of the FDI pattern.

We also contribute to the growing literature, which uses the gravity equation to investigate the determinants of cross-border M&A (e.g. Di Giovanni (2005)). Head and Ries (2008) in their paper provide a micro-foundation for the gravity equation and its frictional costs when examining cross-border M&A by building a model with monitoring costs and provide empirical support for their model. In this chapter, we use their model as a basis for our estimation. However, unlike their paper where frictional costs are assumed to be homogeneous across sectors, we extend their model to have sectoral heterogeneity and provide empirical evidence for heterogeneous sector-specific frictional costs.

The rest of the chapter proceeds as follows. Section 2 describes the theoretical model. Section 3 derives an empirical specification from the model, conducts an empirical analysis, and provides evidence. The last section presents conclusions.

## 2. THE MODEL

We use Head and Ries' (2008) model as a base theoretical framework for our analysis, and modify the original model to accommodate heterogeneous sector-specific frictional costs. Head and Ries (2008) model cross-border M&A as an international market for corporate control context, where the headquarters' monitoring cost of the subsidiary plays a key role in the cross-border M&A decision. Frictional costs associated with cross-border M&A comes from this monitoring cost because they assume that monitoring costs increase as the geographical or cultural distance between the home and the host countries increases. Thus, the value of the merged firm decreases as the monitoring cost increases, which is possibly correlated with cultural or geographical distance.

The model starts with a simple inspection game, which is played between the headquarters (HQ) and its subsidiary (Sub). We assume that without monitoring by the HQ, the manager of the Sub lacks incentives to exert effort to maximize the value of the Sub. We also assume that monitoring requires costs that are increasing in distance (both cultural and geographical) between the HQ and its Sub. Sub chooses whether to work or shirk. Gross profit depends on the contributions of HQ and Sub, which we denote by $a$ and $b$ respectively. HQ always adds $a$, whereas Sub adds $b$ only when it chooses to exert effort. HQ simultaneously chooses whether to trust Sub or verify whether it has worked or not. The following table shows the payoffs of Sub and HQ.

| | | HQ chooses | |
|---|---|---|---|
| | | Trust $(1-y)$ | Verify $(y)$ |
| Sub manager chooses | Shirk $(x)$ | $w, a-w$ | $0, a-c$ |
| | Work $(1-x)$ | $w-e, a+b-w$ | $w-e, a+b-w-c$ |

HQ pays $w$ to Sub unless HQ verifies and finds out shirking, in which case Sub gets zero. Working generates gross output of $a+b$, but Sub incurs cost of effort, $e$. Verification costs HQ $c$ (i.e. the monitoring costs). Following Head and Ries (2008), we assume $b>w>e>c>0$. Under these assumptions, there is no Nash equilibrium in pure strategies. In a mixed strategy Nash equilibrium, Sub shirks with probability $x$ and HQ verifies with probability $y$. Expected revenues are given by $a+b(1-x)$. HQ compensates Sub unless

HQ verifies that shirking occurred (probability $xy$). Taking these observations into account, HQ's expected payoff is

$$v = a + b(1 - x) - cy - w(1 - xy) \quad (1)$$

Sub's expect utility is $w(1 - xy) - e(1 - x)$. The agents choose their respective probabilities taking the others' as given. The first order condition for HQ is therefore $v_y = -c + wx = 0$ and that for Sub is $v_x = -wy + e = 0$. The equilibrium mixing probabilities are therefore $x=c/w$ and $y=e/w$. Plugging these results back into HQ's payoff gives us,

$$v = a + b(1 - c/w) - w \quad (2)$$

Maximizing (2) with respect to $w$ implies the contract of paying w = $\sqrt{bc}$ except when HQ verifies that shirking has occurred. Substituting $\sqrt{bc}$ back into (2) results in:

$$v = a + b - 2\sqrt{bc} \quad (3)$$

Equation (3) shows us that higher verification costs lower the value of the Sub to HQs. Thus, if two HQs of equal $a$ were bidding, the one with lower inspection costs would bid higher. Head and Ries (2008) make $c$ an increasing function of $D_{ij}$, which is a vector of geographic and cultural distance measures between the host country $i$ and the home country $j$. Therefore, $D_{ij}$ acts as frictional costs and reduces the value of the merged firm as the distance between the home and the host countries increases. In this chapter, to accommodate our sector-specific heterogeneous frictional costs assumption, we modify the model and assume that $D_{ijk}$ is sector-specific as well, where subscript $k$ denotes the sector. The $D_{ijk}$ is a vector that includes country-pair variables (geographical and cultural distances), as well as sector-specific variables such as tradeability and regulation.

Specifically, we assume that $c_{ijk} = [\frac{\delta_k D_{ijk}}{2}]^2$. The monitoring cost, $c_{ijk}$ is now heterogeneous across different sectors. Here $k$ denotes the industry in which the cross-border M&A takes place and therefore, $D_{ijk}$ has differing impact on $c_{ijk}$ depending on the value of $\delta_k$. Thus, we modify equation (3) as follows:

$$v_{ijk} = a + b - \sqrt{b}\,\frac{\delta_k D_{ijk}}{2} \qquad (4)$$

Equation (4) illustrates that $D_{ijk}$ acts as frictional costs and reduces the value of the merged firm differently across sectors depending on the value of $\delta_k$ as the distance between the home and the host countries or as other sector-specific frictions increase. Similar to Head and Ries (2008), equation (4) illustrates an ability versus proximity trade-off; i.e. high-ability HQs may have a lower willingness to pay for a target than a less able, but more proximate HQs. However, unlike Head and Ries (2008), this trade-off varies across sectors in our model.

## 3. EMPIRICS

### 3.1. Specification

We assume that the HQ that anticipates the highest expected payoff (i.e. $v$) makes the highest bid and wins the auction for control of a subsidiary. Let $\pi_{ijk}$ denote the probability that a HQ from country $j$ takes control of a randomly drawn target in country $i$ in industry $k$. Also, let $K_{ik}$ denote the asset value of the entire stock of targets in the host country $i$ in industry $k$. Then we can represent the expected bilateral FDI stocks as follows,

$$E[F_{ijk}] = \pi_{ijk} K_{ik} \tag{5}$$

We follow Head and Ries (2008) in specifying $\pi_{ijk}$. We assume that country $j$ has $m_j$ headquarters, each of which have different valuations for a given target in country $i$. Heterogeneity in the valuations is introduced through the HQ value-added term $a$. We assume that the cumulative density of $a$ takes the Gumbel (type-I extreme value): $\exp(-\exp(-(x-\mu)/\sigma))$, where $\mu$ is the location parameter and $\sigma$ is the shape parameter. Using the results of Anderson, de Palma, and Thisse (1992, p. 39), one can then show that $\pi_{ijk}$ is given by the multinomial logit formula:

$$\pi_{ijk} = \frac{\exp[\frac{\mu_j}{\sigma} + \ln(m_j) - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ijk}]}{\sum_l \exp[\frac{\mu_l}{\sigma} + \ln(m_l) - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ilk}]} \tag{6}$$

Substituting (6) into (5), we can express expected bilateral FDI stocks as

$$E[F_{ijk}] = \frac{m_j \exp[\frac{\mu_j}{\sigma} - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ijk}]}{\sum_l m_l \exp[\frac{\mu_l}{\sigma} - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ilk}]} K_{ik} \tag{7}$$

In order to obtain an estimating equation, we first define $\theta_k \equiv (\frac{\sqrt{b}}{\sigma})\delta_k$, which determines the FDI-impeding effect. Also, $E[F_{ijk}]$ depends only on the shares of HQs in each country, so we introduce $s_j^m \equiv \frac{m_j}{\sum_l m_l}$ to represent a country's share of the world's bidders. And finally, we define $B_{ik} \equiv \sum_l s_l^m \exp[\frac{\mu_l}{\sigma} - \theta_k D_{ilk}]$ as the "bid competition" for targets in country $i$ in industry $k$. Re-expression of (7) in terms of these variables yields:

$$E[F_{ijk}] = \exp[\tfrac{\mu_j}{\sigma} - \theta_k D_{ijk}] s_j^m K_{ik} B_{ik}^{-1} \qquad (8)$$

Equation (8) now resembles the gravity equation where expected bilateral stocks are increasing in the product of origin and destination size variables ($s_j^m$ and $K_{ik}$) and decreasing in measures of bilateral distance. Higher bid competition in $i$ in industry $k$ (i.e., $B_{ik}$) implies that a higher fraction of assets in $i$ in industry $k$ will be taken by rivals from other countries, thereby reducing the expected bilateral stocks of HQs from country $j$.

Further re-arrangement of equation (8) gives us some insight into how the parameters of the model can be estimated:

$$E[F_{ijk}] = \exp[\tfrac{\mu_j}{\sigma} + \ln s_j^m + \ln K_{ik} - \ln B_{ik} - \theta_k D_{ijk}] \qquad (9)$$

Equation (9) shows that bilateral FDI can be separated into a origin $j$-specific term relating to its share of the world's HQs ($\ln s_j^m$) and their mean ability ($\frac{\mu_j}{\sigma}$), a destination $i$ and industry $k$ specific term relating to the share of target assets ($\ln K_{ik}$) and the competing set of bidders ($\ln B_{ik}$). We will denote $O_j \equiv \frac{\mu_j}{\sigma} + \ln s_j^m$ as outward direct investment effect for origin $j$, and $I_{ik} \equiv \ln K_{ik} - \ln B_{ik}$ as inward direct investment effect for destination $i$ in industry $k$. Compressing the outward and inward effects into one term each, we obtain the following expression for expected bilateral FDI stocks:

$$E[F_{ijk}] = \exp[O_j + I_{ik} - \theta_k D_{ijk}] \qquad (10)$$

In order to move from the expected values determined in the theory to the actual values of FDI recorded in the data set, we define $\eta_{ijk} \equiv \dfrac{F_{ijk}}{E[F_{ijk}]}$ as the ratio of actual to expected bilateral FDI stocks. Using equation (10),

$$F_{ijk} = E[F_{ijk}]\eta_{ijk} = \exp[O_j + I_{ik} - \theta_k D_{ijk}]\eta_{ijk} \tag{11}$$

The $D_{ijk}$ is a vector consisting of geographical distance, cultural distance, tradeability, regulation, and unobserved linkages:

$$D_{ijk} = \{distance_{ij}, CD_{ij}, tradeability_k, regulation_{ik}, u_{ijk}\} \tag{12}$$

The variable $distance_{ij}$ is the physical distance between countries *i* and *j* and $CD_{ij}$ is a cultural distance variable between countries *i* and *j*. The variable $tradeability_k$ measures the degree of tradeability in industry *k* (greater tradeability corresponds to high values of $tradeability_k$). The variable $regulation_{ik}$ measures the degree of regulation in country *i*'s industry *k* (stricter regulation corresponds to high values of $regulation_{ik}$). And finally, $u_{ijk}$ capture all the unobserved linkages between two countries that affect the monitoring cost. Equation (11) can now be written as,

$$F_{ijk} = \exp[O_j + I_{ik} + \theta_1 distance_{ij} + \theta_{2k} CD_{ij}$$
$$+\theta_3 tradeability_k + \theta_4 regulation_{ik} + (\theta_5 u_{ijk} + \ln \eta_{ijk})] \tag{13}$$

Note that $\theta_{2k}$ varies with *k* because $CD_{ij}$ has differing effects on different industries. Define $\varepsilon_{ijk} \equiv \theta_5 u_{ijk} + \ln \eta_{ijk}$ as the error term and re-write equation (13) as,

$$F_{ijk} = \exp[O_j + I_{ik} + \theta_1 distance_{ij} + \theta_{2k} CD_{ij}$$
$$+\theta_3 tradeability_k + \theta_4 regulation_{ik} + \varepsilon_{ijk}] \tag{14}$$

Equation (14) now can be estimated to test our hypotheses that heterogeneous frictional costs arise due to: I) Sensitivity to cultural distance in services-producing industries compared to other industries, II) Low tradeability in services-producing industries, or III) High regulation in services-producing industries. First, to check hypothesis I, we interact $CD_{ij}$ with services-producing industries dummy variable and see if the interaction term has negative effect on the dependent variable. We test hypothesis II by checking whether the tradeability variable has a positive effect on the dependent variable. Low tradeability of an industry can increase the informational frictional cost because exporting may be an important source of information on foreign markets for firms, which can significantly reduce the fixed costs (and uncertainty) of the decision to engage in FDI. Lastly, we test hypothesis III by estimating whether the regulation variable has a negative effect on the dependent variable.

We use cross-border M&A data to construct the dependent variable. The following is our estimating equation:

$$MA_{ijkt} = \exp[O_j + I_{ik} + \delta_1 distance_{ij} + \delta_2 CD_{ij} + \delta_3 service + \delta_4 service \times CD_{ij} + \delta_5 tradeability_k + \delta_6 regulation_{ikt} + e_{ijkt}] \quad (15)$$

The dependent variable, $MA_{ijkt}$ is the number of firms acquired in country $i$ in industry $k$ by firms in country $j$ at time $t$.[29] The variable $distance_{ij}$ measures the physical distance between the home and the host country. We expect the coefficient on this variable to be negative. The variable $CD_{ij}$ measures the cultural distance between the home and the host country. We expect the coefficient on this variable to be negative. We expect coefficients on geographical and cultural distance variables to be negative because past studies in the gravity equation literature have shown this to be true (e.g. Head and Ries (2008)). The variable *service* is an indicator variable that takes a value of one if the industry is a services-producing sector. This variable is included to

[29] The value of M&A deals cannot be used since they are not consistently available in the data.

capture its independent effect. The variable $service \times CD_{ij}$ is an interaction term of the two variables, $CD_{ij}$ and $service$. We expect the coefficient on this variable to be negative because it identifies the effect of cultural distance on cross-border M&As into services-producing sectors. The variable $tradeability_k$ measures the tradeability of industry $k$. An increase in this variable implies that the industry's tradeability is high. We expect the coefficient on this variable to be positive because engaging in trade in foreign country can serve as an important information channel on the foreign market that can lead to increase in FDI activity. The variable $regulation_{ikt}$ measures the level of regulation imposed by the host country at the industry level. We expect the coefficient on this variable to be negative because high regulations inhibit FDI activity. The $e_{ijkt}$ denotes the error term. Since the dependent variable is count data, negative binomial estimation is used to estimate equation (15).

### 3.2. Data

We use the M&A data from the Thomson SDC Platinum database, which has data on acquired firms by foreign and domestic firms in various countries, to construct our dependent variable. If the percentage of shares acquired by a foreign firm is 10% or more, we consider this as an acquisition. SDC Platinum also has SIC codes at the four-digit level for each acquired firm and provides the country of origin of the firms that are engaged in acquisition.

Using the data set, we create a M&A count dependent variable at the four-digit SIC industry level and form a data set that ranges from 1985 to 2007, for the OECD countries (except Slovakia).[30] We use OECD countries because more than 70% of FDI activities are among the developed countries. All countries in the sample are both host and home countries.

A services-producing sector indicator variable is constructed by giving it a value of one if the industry is a private services-producing industry.[31] These are the industries that have SIC codes greater than 4000 and less than 9000 at four-digit level. All other sectors take on a value of zero. According to BEA (Gilmore et al.), in 2009, value added by private services-producing industries accounted for 68.7% of the US GDP. Value added by private goods-producing industries[32] accounted for 17.7% of the U.S. GDP. Our dataset show that 51.5% of the total cross-border M&A occurred in private services-producing industries and 48.4% of the total cross-border M&A occurred in private goods-producing industries. As we can see from these descriptive statistics, cross-border M&A seems to be much more frequent in goods-producing industries than in services-producing industries relative to their total size in the economy.

We use Kogut and Singh's cultural index to measure the cultural distance between the home and the host country. The cultural dimensions needed to construct this index are taken from the Geert Hofstede's website. The tradeability measure is the sum of exports and imports divided by shipments of the domestic firms in the industry.

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[30] M&A data for Slovakia is not included in SDC Platinum.

[31] This is the definition used by BEA and include the following industries: utilities; wholesale trade; retail trade; transportation and warehousing; information; finance, insurance, real estate, rental, and leasing; professional and business services; educational services, health care, and social assistance; arts, entertainment, recreation, accommodation, and food services; and other services, except government.

[32] This is the definition used by BEA and includes following industries: agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing

We use U.S. data for the year 2000 to construct this measure for our four-digit SIC industries (see Blonigen (2011) for more details).

We use the regulation indicator index from the OECD.stat website for our regulation variable. This regulation indicator index measures the level of regulation for non-manufacturing industries (mostly industries in service sectors) in each OECD countries. The regulation indicator index is a weighted average score (the score is on a scale of 0-6, 6 being the highest regulation). Manufacturing and other sectors, which don't have a regulation indicator index, take on a value of zero in our regulation variable. The distance variable is constructed using the great circle distance. It measures the physical distance between the home and the host countries' capital cities in miles. Table 7 shows the descriptive statistics of the variables. The mean of tradeability in services-producing sectors is 0.054, which is substantially less than the full sample average (0.357) and much less than the goods-producing sector average (0.619).

Table 7. Descriptive statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| # of acquisition by foreign firms | 18769380 | 0.003 | 0.082 | 0 | 45 |
| Distance | 18769380 | 3330.293 | 3344.478 | 107.504 | 12327.05 |
| Cultural Distance | 17474940 | 2.003 | 1.507 | 0.026 | 7.472 |
| Tradeability | 17032512 | 0.357 | 1.235 | 0 | 21.402 |
| Regulation | 18745244 | 0.246 | 0.879 | 0 | 6 |

### 3.3. Results

Column 1 of table 8 shows the results from estimating equation (15). The coefficient on the interaction term of cultural distance and service sector indicator variable is negative and significant. This implies that cultural differences between the home and the host countries have a greater negative impact on cross-border M&As in services-producing sectors than in goods-producing sectors. This supports our first hypothesis that the service sectors are more sensitive to cultural differences and thus firms in the service sector are less likely to engage in cross-border M&A than firms in the manufacturing sectors.

Table 8. Frictional costs in cross-border M&A activity: OECD countries

| Variables | Negative binomial Full sample | Negative binomial Full sample | Negative binomial Marginal effects |
|---|---|---|---|
| Distance | -0.000289*** | -0.000311*** | -0.0000002 |
| | (2.68e-06) | (3.02e-06) | - |
| Cultural Distance | -0.351*** | -0.337*** | -0.0002 |
| | (0.00750) | (0.00760) | - |
| Service | - | 0.536*** | 0.0003 |
| | - | (0.0159) | - |
| Service x Cultural Distance | -0.0874*** | -0.0895*** | -0.00005 |
| | (0.00996) | (0.00918) | - |
| Tradeability | - | -0.0572*** | -0.000031 |
| | - | (0.00607) | - |
| Regulation | -0.336*** | -0.107*** | -0.00006 |
| | (0.0119) | (0.00648) | - |
| Constant | 1.947*** | 0.216*** | - |
| | (0.0275) | (0.0274) | - |
| Home country dummy | Yes | Yes | Yes |
| Host country dummy | No | Yes | Yes |
| Host country and industry FE | Yes | No | No |
| Observations | 6,752,295 | 15,841,737 | 15,841,738 |

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Coefficient on the regulation variable is negative and significant. This suggests that strong regulation hinders cross-border M&A. This is consistent with our expectation and provides evidence for our third hypothesis that strong regulations inhibit cross-border M&A. The coefficient on the distance variable is also negative and significant. This is consistent with our expectation and shows that increase in physical distance between the home and the host countries decrease cross-border M&A activities.

Coefficient on the tradeability variable is not reported because its effect is subsumed by the host country and industry fixed effects. Therefore, we cannot test our second hypothesis by estimating equation (15). We modify equation (15) by excluding the host country and industry fixed effects and instead include host county dummy variables and re-estimate the modified equation. The results are presented in column 2. The coefficients don't seem to change much when host country dummy variable is included instead of host country and industry fixed effects. This suggests that our results are not very sensitive to inclusion or exclusion of the host country and industry fixed effects.

Coefficient on the tradeability variable is negative and significant. This is counter to our expectation. It seems to suggest that industries that have a lot of exports and imports engage in less cross-border M&A. This also makes sense in a way. If there's a lot of exports and imports in an industry it implies that firms in that industry use exporting as the main foreign market entry method rather than cross-border M&A. This can be the case if the most desirable or easiest way to access this particular industry by foreign firms is exporting. Thus it is conceivable that our tradeability coefficient is negative.

Column 3 presents the marginal effects of the variables from column 2. The marginal effect of cultural distance is –0.0002 and the marginal effect of the interaction term is –0.00005. Therefore, a one standard deviation increase in the Kogut and Singh's cultural index (1.507) decreases the number of cross-border M&As by approximately 0.0005 units into services-producing sectors. Since the predicted dependent variable is equal to 0.0005, this implies that one standard deviation increase in the cultural index leads to 100% decrease in the dependent variable from its predicted value for services-producing sectors, which is quite significant. The marginal effect of regulation suggests that a one standard deviation increase in regulation indicator index (0.879) decreases the number of cross-border M&As by approximately 0.00005 units. Thus, a one standard deviation increase in the regulation indicator index leads to a 10% decrease in the dependent variable from its predicted value. The marginal effect of tradeability suggests that a one standard deviation increase in tradeability (1.235) decreases the number of cross-border M&As by approximately 0.00004 units. Thus, a one standard deviation increase in the tradeability variable leads to a 8% decrease in the dependent variable from its predicted value.

The tradeability variable overall has a negative impact on cross-border M&A activity. However, if we just consider services-producing sectors, the coefficient on the tradeability variable becomes positive and significant. First column in table 9 shows the coefficient and the second column shows the marginal effect of tradeability when only services-producing sectors are considered. This shows that in service sectors, where exporting activity rarely occurs, exporting activity by firms does lead to an increase in cross-border M&A. This provides some support for our second hypothesis. The marginal effect suggests that a one standard deviation increase in the tradeability variable (0.228) increases the number of cross-border M&A into services-producing sectors by 0.00005 units.[33] Since the predicted value of the dependent variable in services-producing sectors is 0.0006, this implies that a one standard deviation increase in the tradeability variable leads to a 8.3% increase in the dependent variable from its predicted value.

Table 9. Frictional costs in cross-border M&A activity: OECD countries (services-producing sectors only)

| Variables | Negative binomial Coefficients | Negative binomial Marginal effects |
|---|---|---|
| Distance | -0.000332*** | -0.0000002 |
| | (4.37e-06) | - |
| Cultural Distance | -0.447*** | -0.0003 |
| | (0.00864) | - |
| Service | - | - |
| | - | - |
| Service x Cultural Distance | - | - |
| | - | - |
| Tradeability | 0.288*** | 0.0002 |
| | (0.0283) | - |
| Regulation | -0.0966*** | -0.00006 |
| | (0.00661) | - |
| Constant | 0.770*** | - |
| | (0.0388) | - |
| Home country dummy | Yes | Yes |
| Host country dummy | Yes | Yes |
| Host country and industry FE | No | No |
| Observations | 6,921,693 | 6,921,694 |

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

[33] Standard deviation of tradeability in services-producing sectors is 0.228.

## 4. CONCLUSIONS

The growth of world FDI over the past few decades has been rapid and has received significant attention. In accordance with this, there has been significant research effort to explore the frictions that determine worldwide FDI patterns. But past literature primarily focused on country-wide FDI flows and very little has been done to examine sectoral heterogeneity in FDI patterns.

In this chapter, we empirically examine the relevance of heterogeneous sector-specific frictional costs using detailed data on worldwide mergers and acquisitions (M&A) activity. We contribute to the growing FDI and cross-border M&A literature by providing empirical evidence for heterogeneous sector-specific frictional costs. Our results show that cultural distance, tradeability, and regulation play an important role in determining heterogeneous frictional costs across different sectors.

Also, our findings from this chapter provide better understanding of FDI and cross-border M&A patterns, which can offer valuable information for policy makers as well. Past studies have shown that FDI activities can have significant impact on the host country's economy. By better understanding heterogeneous sectoral frictions in FDI patterns the government can implement better policies for different sectors to increase or decrease FDI activity into their country. For example, our study shows that regulation does inhibit FDI. Thus, if the government wants more FDI into service sectors it can loosen the regulation to encourage FDI. On the other hand, if the government is concerned about takeovers of domestic firms by foreign firms to access the technology in manufacturing sectors, imposing tougher regulations can be an effective tool in preventing hostile takeovers by foreign firms.

# CHAPTER V

# CONCLUSION

FDI has played a major role in the increasing economic globalization of the past couple decades. Cross-border M&A is the major source of FDI, particularly for developed countries accounting for as much as two-thirds of FDI. Yet, studies on such cross-border M&A activities are scant in the literature.

This dissertation looks at the relationship between cross-border M&A, technology, and frictional costs using both theoretical and empirical analyses to better understand cross-border M&A activity. In chapter II, I find that depreciation of the host country's currency leads to increase in acquisition FDI that are seeking complementary assets (e.g. technology) for U.S. inbound acquisition FDI from multiple country sources, but not for inbound acquisition FDI for other various developed countries. In chapter III, I develop an equilibrium model of cross-border M&A and show that the model predicts that firms from a larger country are more likely to acquire in a smaller country when M&A activity is driven by a technology-seeking motive, but the opposite is true when it is driven by a market-seeking motive. I also find empirical evidence that cross-border M&A activity exhibits behavior consistent with this prediction. In chapter IV, I empirically examine the relevance of heterogeneous sector-specific frictional costs using detailed data on worldwide M&A activity. Results show that cultural distance, tradeability, and regulation play on important role in determining heterogeneous frictional costs across different sectors.

The theoretical model, I develop in my third chapter is somewhat limited in the sense that it is a static model. In the real world acquisition process, synergy realization and integrating market-specific expertise occur over a period of time. Thus, in the future I plan to develop dynamic models of M&A activity. Also, recent data suggests that FDI activity into agricultural and natural resources industries have been increasing. These activities seem to be motivated by the desire to secure food supply or natural resources. Thus, in the future I plan to develop cross-border M&A model with this resource-seeking motive and analyze empirically as well.

## APPENDIX A

## FIXED EFFECTS NEGATIVE BINOMIAL MODEL

In order to develop a fixed effects Negative binomial model, Hausman et al. (1984) start with a standard Poisson distribution with parameter $\lambda_{it}$ where $\lambda_{it}$ is the conditional mean and variance of the dependent variable. Standard procedure is to make $\lambda_{it}$ to be an exponential function of the explanatory variables:

$E(y_{it} \mid X_{it}) = \text{var}(y_{it} \mid X_{it}) = \lambda_{it} = \exp(X_{it}\beta)$ where $y_{it}$ denotes the dependent variable and $X_{it}$ denotes the explanatory variables.

The Negative binomial model allows for heterogeneity in the mean function by introducing an additional stochastic component to $\lambda_{it}$: $\lambda_{it} = \exp(X_{it}\beta + \varepsilon_{it})$, where $\varepsilon_{it}$ captures unobserved heterogeneity and is uncorrelated with the explanatory variables. Fixed effects negative binomial model is obtained by building the fixed effect into the model as an individual specific $\theta_i$: $E(y_{it} \mid X_{it}) = \theta_i \exp(X_{it}\beta)$.

# APPENDIX B

## DISCUSSION ON SYNERGY EFFECT AND INTEGRATION COST

### 1. DISCUSSION ON THE SYNERGY EFFECT

The synergy is realized because the target firm from another country has a technology that is different from the acquirer. In this case, the target's technological capability does not have to be necessarily more advanced or more efficient than the acquirer, for the synergy to be realized. As long as the target's technological capability gives a different perspective on producing the product unknown to the acquirer, then this could be useful information and thus cross-border M&A will take place to obtain the synergy effect. Evidence of synergy effect from cross-border M&A can be found from the following articles (see, for example Morosini *et al* (1998), Vermeulen & Barkema (2001), and Gertsen *et al* (1998)). Empirical papers from international trade literature also suggest possible synergy realization coming from cross-border M&A (see, for example Branstetter (2000) and Takechi (2006)).

### 2. SYNERGY DEPENDENT ON TARGET'S TECHNOLOGICAL CAPABILITY

In my model I assume that the synergy effect $g$, coming from acquiring target firm's technological capability is constant. It might sound more realistic if $g$ depends on target firm's technological capability. However, I will show that even if $g$ depends on target firm's technological capability it will not change the equilibrium outcome as long as acquirer can't observe target firm's technological capability. Assuming that the acquirer doesn't know the true value of the target's technological capability is not so far fetched compared to the real world because even in the real world, the acquirer cannot know the true value of the target.

I'll assume that $g$ is a function of $m$ where $g(\cdot)$ increase as $m$ increase. I'll also assume that $g(\underline{m})$ is greater than 1 where $\underline{m}$ is the lowest value of $m$ (this is to insure that expected value of $g(m)$ is greater than 1)[34]. Then the actual profit realized for the acquirer from synergy will depend on $g(m)$ but when acquirer makes a cross-border M&A decision, they will base it on the expected profit generated from getting expected synergy, i.e. $E(g(m) \mid m < m_s)$. This expected value is constant and is equal to all potential acquirers so their decision making process will be identical to having a constant synergy $g$. Thus, the equilibrium outcome will look identical too.

## 3. CULTURAL DISTANCE AND INTEGRATION COST

Integration cost of cross-border M&A is the subject of an extensive literature. For example, when firms from different countries merge, a lot of the time they fail the integration process due to conflicts caused by cultural differences (See, for example, Finkelstein (1999), Zhu and Huang (2007), Drogendijk and Slangen (2006)). Thus, I assume that integrating target firm's capabilities into the acquiring firm is costly for cross-border M&A and this integration cost is more costly for market-specific expertise than technological capability. Technological capability is transferred directly upon acquisition and no *IC* needs to be spent to realize the synergy effect.

The intuition behind this is based on the assumption that technological capability is readily transferable. For example, transferring technological capability can be as

[34] This is sufficient condition to insure that M&A takes place in equilibrium. If expected synergy effect is less than one it is possible that M&A won't take place because it can actually harm your productivity.

simple as just sending the blue prints to a specific technology from the target firm to the acquiring firm. Cultural barrier shouldn't have any affect on this process but for market-specific expertise, since it represents knowledge on local marketing strategy, local market condition, and local tastes, overcoming the cultural barrier and understanding the target firm's local culture is crucial to the acquirer if it wants to fully utilize market-specific expertise. Thus, I assume in my model that acquiring firm must incur *IC* if it wants to fully integrate the target firm's market-specific expertise, but no *IC* is necessary for integrating the technological capability. In the next section, I present a descriptive statistical evidence of my argument.

### 3.1. *Descriptive statistical evidence*

Table 10 shows the number of acquisitions made by foreign firms into United States[35].

Table 10. Number of foreign acquisitions into U.S. in Manufacturing and Non-manufacturing sectors and the ratio

| | Manufacturing | Non-manufacturing | Ratio (Manufacturing/Non-manufacturing) |
|---|---|---|---|
| Australia | 165 | 371 | 0.44 |
| Canada | 1069 | 2309 | 0.46 |
| France | 345 | 337 | 1.02 |
| Germany | 421 | 339 | 1.24 |
| Japan | 556 | 358 | 1.55 |
| United Kingdom | 1421 | 1844 | 0.77 |

As we can see from the table, France, Germany and Japan made more acquisitions in manufacturing sector than in non-manufacturing sector whereas Australia, Canada and United Kingdom made more acquisitions in non-manufacturing sector. If we look at the

[35] Acquisition data are from SDC platinum.

ratios of number of acquisitions in manufacturing to non-manufacturing, it becomes more evident that France, Germany and Japan were more active in manufacturing sector's M&A market and Australia, Canada and United Kingdom were more active in non-manufacturing sector's M&A market.  This suggests that since R&D expenditure is much higher in manufacturing sector than in non-manufacturing sector, French, German and Japanese firms' motives were generally to acquire technological capability whereas the Australian, Canadian, and British firms' motives were generally to acquire market-specific expertise.  Australia, Canada, United Kingdom, and United States speak the same language and are known to share similar culture.  On the other hand, France, Germany, and Japan do not speak the same language as in United States and their cultures are not as similar to United States as the former group.  This stark distinction is quite surprising if we assume integration cost for both capabilities is homogeneous.

If we assume cultural difference between the two merging firms imply high *IC* for market-specific expertise relative to technological capability the result of this table is not so surprising.  For Australia, Canada and United Kingdom, *IC* that the firms have to incur after acquiring market-specific expertise would be relatively low since cultural distance with United States is relatively small, thus it wouldn't be much difficult for them to integrate the market-specific expertise of the target firm.  But for firms from France, Germany, and Japan, this *IC* would be pretty high causing them to prefer technological capability driven acquisition, which does not require high *IC*.  Thus, the summary statistics provide some evidence for heterogeneous integration cost between the two capabilities.

## APPENDIX C

## LEMMA AND PROPOSITION PROOFS

**PROOF OF LEMMA 1.**

This is the proof shown in Nocke and Yeaple (2004). The endogenous variable *u* in country *k* may be written as a function of the country sizes, $f(Y^k, Y^l)$, where the first argument refers to the own country size, and the second argument to the size of the other country. Assuming differentiability of *f* (which can be verified to hold for our problem at hand), the endogenous change in the value of $u^k$ is given by

$du^k = f_1(Y^k, Y^l)dY^k + f_2(Y^k, Y^l)dY^l$, where $f_i$ is the derivative of *f* with respect to its *i*th argument. Similarly, the endogenous change in the value of

$du^l = f_1(Y^l, Y^k)dY^l + f_2(Y^l, Y^k)dY^k$. Since $Y^k = Y^l$, we have $f_i(Y^k, Y^l) = f_i(Y^l, Y^k)$.

Moreover, by assumption, $dY^k = -dY^l$, and so

$du^l = -f_1(Y^k, Y^l)dY^k - f_2(Y^k, Y^l)dY^l = -du^k$.

**PROOF OF PROPOSITION 2.**

I use similar proof method used in Nocke and Yeaple (2004) to prove Proposition 2. From the market clearing condition (13), we know that $H(m_s) = 1 - H(m_g)$. So the merger market clearing condition $E^k(1 - H(m_g^k)) = E^l H(m_s^l)$ (*k* stands for the large country and *l* stands for the small country; $E^k = E^l$ and the thresholds in country *k* and *l* are the same when the two countries are identical) can be written as

$E^k H(m_s^k) = E^l H(m_s^l)$.

Taking the logarithm of the merger market clearing condition and taking the total derivative yields,

$$\frac{dE^k}{E^k}+\frac{h(m_s^k)dm_s^k}{H(m_s^k)}=\frac{dE^l}{E^l}+\frac{h(m_s^l)dm_s^l}{H(m_s^l)}$$

Using Lemma 1 and the fact that countries were identical before the change in *Y*, this equation can be written as

$$\frac{dE^k}{E^k}+\frac{h(m_s^k)dm_s^k}{H(m_s^k)}=-\frac{dE^k}{E^k}-\frac{h(m_s^k)dm_s^k}{H(m_s^k)}$$, which simplifies to

$$\frac{dE^k}{E^k}=-\frac{h(m_s^k)dm_s^k+h(m_s^k)dm_s^k}{2H(m_s^k)} \tag{18}$$

Now I will look at the free entry condition from equation (12) for country *k*, which is $\int_0^\infty V^k(m)dH(m)-F_e=0$.

This can be written as:

$$\int_0^{m_s^k} Q^k dH(m)+\int_{m_s^k}^{m_x^k}(S^k m+S^l T\delta m)dH(m)+\int_{m_x^k}^{m_g^k}(S^k m+S^l\delta m-F_c)dH(m)+$$
$$\int_{m_g^k}^{m_a^k}(S^k mg+S^l\delta mg-Q^l-F_c)dH(m)+\int_{m_a^k}^{\infty}(S^k mg+S^l mg-Q^l-IC)dH(m)=F_e$$

I'm going to define $\Psi(m_i)\equiv\int_{m_i}^{\infty} mdH(m)$.

And simplify the free entry condition as,

$$Q^k H(m_s^k)+S^k\Psi(m_s^k)-S^k\Psi(m_g^k)+S^k g\Psi(m_g^k)+S^l T\delta\Psi(m_s^k)-S^l T\delta\Psi(m_x^k)+S^l\delta\Psi(m_x^k)-S^l\delta\Psi(m_g^k)+$$
$$S^l\delta g\Psi(m_g^k)-S^l\delta g\Psi(m_a^k)+S^l g\Psi(m_a^k)-F_c(H(m_a^k)-H(m_x^k))-Q^l(1-H(m_g^k))-IC(1-H(m_a^k))=F_e$$

Now take total derivative of this expression and applying Lemma 1:

$$dQ^k(H(m_s^k)-H(m_g^k)+1)+$$
$$dS^k[\Psi(m_s^k)+(g-1)\Psi(m_g^k)-T\delta\Psi(m_s^k)-(1-T)\delta\Psi(m_x^k)-(g-1)\delta\Psi(m_g^k)-(1-\delta)g\Psi(m_a^k)]=0$$

Note that $dm_i^k=0$ due to the envelope theorem and the fact that the thresholds are efficient from the firms' point of view in that they maximize (expected) profits.

Also, note that $(H(m_s^k)-H(m_g^k)+1)$ is positive

and

$$[\Psi(m_s^k)+(g-1)\Psi(m_g^k)-T\delta\Psi(m_s^k)-(1-T)\delta\Psi(m_x^k)-(g-1)\delta\Psi(m_g^k)-(1-\delta)g\Psi(m_a^k)]\equiv\Gamma>0$$

because $\Psi(m_s^k)>\Psi(m_x^k)>\Psi(m_g^k)>\Psi(m_a^k)$.

Therefore, I can conclude that $dQ^k$ and $dS^k$ has opposite signs, i.e. they move in the opposite direction.

Now I will take logs and then take total derivatives of the threshold equations:

$$m_s^k=\frac{Q^k}{S^k+S^lT\delta},\ m_x^k=\frac{F_c}{S^l\delta(1-T)},\ m_g^k=\frac{Q^l}{(S^k+S^l\delta)(g-1)},\ m_a^k=\frac{IC-F_c}{S^l(1-\delta)g}.$$

Taking total derivatives and appealing to Lemma 1, I get the following conditions:

$$\frac{dm_s^k}{m_s^k}=\frac{dQ^k}{Q^k}-\frac{(1-T\delta)dS^k}{(1+T\delta)S^k}\ ,\ \frac{dm_x^k}{m_x^k}=\frac{dS^k}{S^k},\ \frac{dm_g^k}{m_g^k}=-(\frac{dQ^k}{Q^k}+\frac{dS^k(1-\delta)}{S^k(1+\delta)}),\ \frac{dm_a^k}{m_a^k}=\frac{dS^k}{S^k}.$$

We can see from this that $dm_s^k$ moves in the opposite direction as $dS^k$ and $dm_x^k$ and $dm_a^k$ move in the same direction as $dS^k$. Therefore, we can also conclude from equation (18) that $dE^k$ and $dS^k$ move in the same direction. However, $dm_g^k$ can be ambiguous because if $dS^k$ increase $dQ^k$ will decrease so it is not clear how $dm_g^k$ will move as $dS^k$ increase. Thus it will depend on the magnitude of $dS^k$ and $dQ^k$.

Let's first assume that price $Q$ does not adjust at all with a change in $Y$. Then $dQ^k$ will equal zero and $dm_g^k$ and $dS^k$ will move in the opposite direction. Thus, as long as $dQ^k$ change by a small ε amount, $dm_g^k$ and $dS^k$ will still move in the opposite direction and Proposition 2 will hold. Therefore, price $Q$ needs to be inelastic and does not change much with a change in $Y$.

Lastly, I will look at $S^k = \dfrac{\alpha Y^k}{\sigma(\rho P^k)^{1-\sigma}}$ which is also equal to

$$S^k = \frac{\alpha Y^k}{\sigma\rho^{2(1-\sigma)}}\{E^k[\Psi(m_s^k)+(g-1)\Psi(m_g^k)]$$
$$+E^l[T\delta\Psi(m_s^l)+(1-T)\delta\Psi(m_x^l)+(g-1)\delta\Psi(m_g^l)+(1-\delta)g\Psi(m_a^l)]\}$$

By taking logarithm and taking total derivative I get the following equation:

$$\frac{dS^k}{S^k}+\frac{\frac{dE^k}{E^k}\Gamma+\{(1-T\delta)\Psi'(m_s^k)dm_s^k+(g-1)(1-\delta)\Psi'(m_g^k)dm_g^k-(1-T)\delta\Psi'(m_x^k)dm_x^k-(1-\delta)g\Psi'(m_a^k)dm_a^k\}}{(1+T\delta)\Psi(m_s^k)+(1-T)\delta\Psi(m_x^k)+(g-1)(1+\delta)\Psi(m_g^k)+(1-\delta)g\Psi(m_a^k)}$$
$$=\frac{dY^k}{Y^k}$$

Since $\Psi'(m_i)<0$, the term in curly brackets has the same sign as $dS^k$ and $dE^k$. Hence it must be the case that when $dY^k$ is positive $dS^k$ is also positive implying that they move in the same direction. Therefore, if there is a small increase in the size of country $k$ and a small decrease in the size of country $l \neq k$ such that $dY^k = -dY^l > 0$, then $dS^k = -dS^l > 0$, and $dm_s^k = -dm_s^l < 0$, $dm_x^k = -dm_x^l > 0$, $dm_g^k = -dm_g^l < 0$, and $dm_a^k = -dm_a^l > 0$.

## REFERENCES CITED


Balassa, Bela. 1986. "Japan's trade policies" Weltwirtschaftliches Archiv, 122(4), 745-90.

Blonigen, Bruce. 1997 "Firm specific assets and the link between exchange rates and foreign direct investment," American Economic Review 87, 447-65.

Blonigen, Bruce. 2011 "Revisiting the Evidence on Trade Policy Preferences," Journal of International Economics, Vol. 85, pp. 129-135.

Blonigen, Bruce. Taylor, Christopher. 2000 "R&D Intensity and Acquisitions in High-Technology Industries: Evidence from the US Electronic and Electrical Equipment Industries," The Journal of Industrial Economics, Vol. 48, No. 1, 47-70.

Branstetter, Lee. 2000 "Is foreign direct investment a channel of knowledge spillovers? Evidence from Japan's FDI in the United States," NBER working papers 8015, National Bureau of Economic Research, Inc.

Caves, Richard E. (1989). Exchange-rate movements and foreign direct investment in the United States. In David B. Audretsch and Michael P. Claudon, eds., The internationalization of U.S. markets (199-228). New York: New York University Press.

Danzon, Patricia M., Epstein, Andrew. Nicholson, Sean. 2004 "Mergers and Acquisitions in the pharmaceutical and Biotech Industries," The Wharton School, University of Pennsylvania.

De Vita, Glauco. and Abbott, Andrew. (2007). Do exchange rates have any impact upon UK inward foreign direct investment? Applied Economics, 39, 2553-2564.

Di Giovanni, Julian. 2005 "What drives capital flows? The case of cross-border M&A activity and financial deepening," Journal of International Economics 65, 127-149.

Drogendijk, Rian., Slangen, Arjen. 2006 "Hofstede, Schwartz, or managerial perceptions? The effects of different cultural distance measures on establishment mode choices by multinational enterprises," International Business Review 15, 361-380.

Encarnation, Dennis J. (1992). Rivals beyond trade: America versus Japan in global competition. Ithaca, NY: Cornell University Press.

Feenstra, Robert C., Hanson, Gordon H. 1999 "The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979-1990," Quarterly Journal of Economics, Vol. 114, No. 3, 907-940.

Finkelstein, Sydney. 1999 “Safe ways to cross the merger minefield,” Financial times mastering global business: The complete MBA companion in global business, London: Financial times pitman publishing, 119-123.

Froot, Kenneth A. and Stein, Jeremy C. (1991). Exchange rates and foreign direct investment: An imperfect capital markets approach. Quarterly Journal of Economics, 106(4), 1191-1217.

Gans, Joshua S. Hsu, David H. Stern, Scott. 2002 “When does start-up innovation spur the gale of creative destruction?” RAND Journal of Economics, Vol. 33, No. 4, 571-586.

Georgopoulos, George J. (2008). Cross-border mergers and acquisitions: Does the exchange rate matter? Some evidence for Canada. Canadian Journal of Economics, 41(2), 450-474.

Gertsen, Martine C., Søderberg, Anne-Marie ., Torp, Jens Erik. 1998 “Cultural Dimensions of International Mergers and Acquisitions,” Publisher: Walter de Gruyter.

Guadalupe, Maria, Kuzmina, Olga, Thomas, Catherine, 2010 “Innovation and Foreign ownership,” NBER working papers 16573, National Bureau of Economic Research, Inc.

Guo, Jie Q. and Trivedi, Pravin K. (2002). Firm-specific assets and the link between exchange rates and Japanese foreign direct investment in the United States: A re-examination. The Japanese Economic Review, 53(3).

Hausman, Jerry; Hall, Bronwyn H. and Griliches, Zvi. (1984). Econometric models for count data with an application to the patents-R & D relationship. Econometrica, 52(4), 909-38.

Head, Keith. and Ries, John. 2008 “FDI as an outcome of the market for corporate control: Theory and evidence,” Journal of International Economics 74 2-20.

Helpman, Elhanan. Melitz, Marc J., Yeaple, Stephen R. 2004 “Export versus FDI with Heterogeneous Firms,” The American Economic Review, Vol. 94, No. 1, 300-316.

Kogut, Bruce. Chang, Sea Jin. 1991 “Technological capabilities and Japanese foreign direct investment in the United States,” The Review of Economics and Statistics, Vol. 73, No. 3, 401-413.

Lawrence, Robert Z. (1991). Efficient or exclusionist? The import behavior of Japanese corporate groups. Brookings Papers on Economic Activity, (1), 311-41.

Maurin, E.D., Thesmar, D., Thoenig, M., 2002 "Globalization and the Demand for Skill: An Export Channel," CEPR Discussion Paper 3406, Center for Economic Policy Research.

Morosini, P., Shane, S., Singh, H. 1998 "National cultural distance and cross-border acquisition performance," Journal of international Business Studies, 29(1), 137-158.

National Science Board. (2010). Science and Engineering Indicators 2010. Arlington, VA: National Science Foundation (NSB 10-01).

Nocke, Volker. Yeaple, Stephen. 2007 "Cross-border mergers and acquisitions vs. greenfield foreign direct investment: The role of firm heterogeneity," Journal of International Economics, 72, 336-365.

Nocke, Volker. Yeaple, Stephen. 2004 "Mergers and the Composition of International Commerce," NBER working papers 10405, National Bureau of Economic Research, Inc.

Noland, Marcus. (1997). Public policies, private preferences, and the Japanese trade pattern. Review of Economics and Statistics, Vol. 79, No. 2, 259-66.

Takechi, Kazutaka. 2006 "Synergy effects of domestic and international M&A," Hosei University.

Vermeulen, F., Barkema, H. G. 2001 "Learning through acquisitions," Academy of Management Journal, 44(3), 457-476.

World Investment Report (2000) "Cross-border Mergers and Acquisitions and Development," United Nations Conference on Trade and Development.

World Investment Report (2007) "Transnational Corporations, Extractive Industries and Development," United Nations Conference on Trade and Development.

Zhu, Zhanwen., Huang, Haifeng. 2007 "The cultural integration in the process of cross-border mergers and acquisitions," International management review, Vol. 3, No. 2.