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ABSTRACT

While there has been significant research to explore the determinants (and frictions) of foreign direct investment (FDI), past literature primarily focuses on country-wide FDI patterns with little examination of sectoral heterogeneity in FDI. Anecdotally, there is substantial sectoral heterogeneity in FDI patterns. For example, a substantial share of FDI (around 40-50%) is in the manufacturing sector, yet manufacturing accounts for a relatively small share of production activity in the developed economies responsible for most cross-border M&A. In this paper, we extend the Head and Ries (2008) model of cross-border M&A to account for sectoral heterogeneity and estimate the varying effects of FDI frictions across sectors using cross-border M&A data spanning 1985 through 2013. We find that non-manufacturing sectors generally have greater sensitivity to cross-border M&A frictions than is true for manufacturing, including such frictions as physical distance, cultural distance, and common language. Tradeability is positively associated with greater cross-border M&A, and is an additional friction for the many non-manufacturing sectors because they consist of mainly non-tradeable goods.

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1. INTRODUCTION

The growth of world foreign direct investment (FDI) over the past few decades has been rapid. In accordance with this, there has been a 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 a substantial share 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 45% of value added by foreign affiliates operating in the US was in manufacturing in 2012 (Calculated from Table 2.1 in Anderson, 2014). However, total value added by manufacturing sector in the US accounted for only about 12% of real GDP in 2012 (Elrod et al., 2013, Table E). Likewise, almost 40% of value added in 2011 by US affiliates operating in foreign countries was in manufacturing (Calculated from Table 2.1 in Barefoot, 2013).

These patterns suggest a number of important questions. First, what are the important differences that make FDI in non-manufacturing (e.g., retail, financial, and service sectors) less frequent 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 these other sectors than manufacturing sectors. Examples of such "culturally- and language-sensitive" non-manufacturing sectors include media, film, retail, 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 non-manufacturing 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, communication sectors, and even health services.

In this paper, we contribute to the growing FDI and cross-border M&A literature by providing empirical evidence for heterogeneous sector-specific frictional costs. We extend the Head and Reis (2008) model of cross-border M&A activity to have sectoral heterogeneity and then examine the empirical evidence for heterogeneous sector-specific frictional costs. The data we use for this analysis are the cross-border M&A data from Thomson SDC Platinum database ranging from 1985-2013. There are two main reasons that we use cross-border M&A to study frictional costs in FDI. First, cross-border M&A is typically double that of greenfield FDI, the other major form of FDI. (For example, see Table I.10 on p. 11 of UNCTAD, 2015). Thus, by conducting empirical analysis with the cross-border M&A data, we are capturing a substantial component of the FDI pattern. Second, the cross-border M&A data from SDC Platinum provide disaggregated information across all countries at the four-digit SIC level, a level of detail that other FDI data cannot provide, even for the countries with the most comprehensive FDI data.

Our empirical analysis finds that physical distance, cultural distance, common language, and tradeability all play an important role in determining the heterogeneous

incidence of cross-border M&A activity across sectors. In general, non-manufacturing sectors, including "Construction", "Transportation, Communications, and Utilities", "Wholesale Trade," "Retail Trade," "Finance, Insurance, and Real Estate," and "Services" are more sensitive to a number of cross-border frictions. Physical distance, cultural distance, and commonality of language affect cross-border M&A in these non-manufacturing sectors anywhere from 5% to 50% more than the manufacturing sector. Tradeability is also an important determinant of cross border M&A activity and is positively associated with it. Many non-manufacturing sectors do not have tradeable goods (e.g., Construction), which then significantly lowers the incidence of cross-border M&A activity. The only friction to which the manufacturing sector as more senstive than the non-manufacturing sectors in our estimates is FDI regulation, though the effect of FDI regulation is relatively minor generally.

There is a growing literature that investigates the determinants of cross-border M&A, including Rossi and Volpin (2004), Di Giovanni (2005) Head and Ries (2008), Hijzen et al. (2008), and Erel et al. (2012)). They generally find that gravity-type forces are important for cross-border M&A and especially examine the role of various types of cross-border frictions, as well as financial and institutional frictions in the home and host country. However, there are few papers of which we are aware that investigate heterogeneity in frictions and their impact on cross-border M&A activity *across* sectors. The closest to our study is Ramasamy and Yeung (2010) who examine FDI in OECD countries across different sectors. Unlike our study, they rely on annual time series data aggregated at the one-digit sector level, which is estimated by a reduced-form equation. Their focus is on host-country characteristics unlike our focus on frictions. They find that the same types of host-market characteristics generally

affect FDI across all sectors, and that service FDI appears to follow manufacturing FDI over time.

The rest of the paper proceeds as follows. Section 2 provides empirical facts about cross-border M&A activity. Sections 3 and 4 derive an empirical specification from the Head and Reis (2008) model, conduct an empirical analysis, and provide evidence on the effects of cross-border frictions on cross-border M&A activity, with a focus on sectoral heterogeneity. The last section concludes.

2. CROSS-BORDER M&A ACTIVITY

Like many other prior papers on M&A activity, we rely on the Thomsen Reuters SDC Platinum M&A database to examine patterns in cross-border M&A activity. The database begins in 1985 and records all M&A transactions across the world that are valued at $5 million or higher. If the percentage of shares acquired by the acquiring firm is 10% or more, we consider this an acquisition. A limitation of the data is that it does not have information on the value of transactions for about half of the observations, as private firms do not have to report this information. As a result, we rely on counts of M&A transactions. The empirical model we present and estimate below naturally explains counts of transactions.

The entire database from 1985 through 2013 has over 600,000 acquisitions where 10% or more of the target company is acquired. About one-quarter (155,997) of these observations are M&A transactions that are cross-border; i.e, the acquiring firm's headquarters are located in a different country than the target firm's headquarters. Due to data availability issues, we examine cross-border acquisitions between countries that are

the top 50 target countries for M&A activity. M&A activity in these top 50 countries accounts for almost 90% of all M&A activity in the database, and cross-border activity between them accounts for about 63% of all cross-border acquisitions in the database. We also look at cross-border activity between OECD countries, which represents 58% of all cross-border acquisitions.[1] Importantly, the data have information on the primary 4-digit SIC classification of the acquiring and target firm, allowing us to focus on sectoral patterns of cross-border acquisitions, including non-manufacturing ones. For our purposes, we classify the M&A transaction according to the SIC of the target firm. We are interested in explaining the cross-sectional variation in cross-border M&A, not time-series variation. For this reason and because of the many observations of zero transactions across all our country pairs and 4-digit SIC classifications in a given year, we sum up all the transactions over the 1985-2013 period and seek to explain these cross-sectional totals in our empirical analysis.[2]

To get a sense of the variation in cross-border M&A activity across industries, Table 1 looks at such activity across one-digit sectors for our full sample and the OECD sample.[3] As mentioned in the introduction, the manufacturing sector accounts for nearly 40% of all cross-border M&A activity and this is nearly identical across both the top 50 and OECD samples. Of the non-manufacturing sectors, services is largest in accounting for about one-quarter of all cross-border M&A activity. The next largest sectors are "Finance, Insurance, and Real Estate" (10-12%), "Transportation, Communications, and

[1] We rank M&A activity in terms of the number of firms targeted in that country for a M&A and define OECD membership as of January 1, 2000 – roughly the midpoint of our sample. Appendix A lists the OECD countries, as well as the adidtional countries that comprise the top 50 target countries comprising our full sample of countries.
[2] Head and Ries (2008) use this database on cross-border M&A as a primary dataset in their analysis and similarly sum up over years to focus on the cross-sectional variation.
[3] In the empirical analysis below, we examine data at a much more disaggregated 4-digit SIC level.

Utilities" (7-8%), and "Wholesale Trade" (6%). The distribution of cross-border M&A across one-digit sectors is strikingly similar across the two samples.

A concern for our analysis is that a high share of manufacturing in cross-border M&A may be due to other factors that are not connected with lower cross-border frictions. One reason is that manufacturing may simply have many more potential firms that can be acquired even if manufacturing's share of value added in the economy is much lower than 40% (as pointed out in the introduction). It's not simple to measure the number of available firms for acquistion (i.e., targets) in a given sector in general. However, we have such data for the U.S. on a five-year basis through the U.S. censuses of various industrial sectors. Column 1 of Table 2 shows the number of U.S. firms acquired (by both domestic and cross-border acquisitions) over our sample (1985-2013) and compares that with the number of firms (or "companies") in the U.S. one-digit sectors as of 1992 -- a proxy for the relative number of firms available in the sector as potential targets – in column 2. We think the number of firms in 1992 is a reasonable proxy for available targets over the entire sample because the number of firms in a sector (especially relative to other sectors) does not change substantially over time.[4] Column 3 shows the ratio of acquisitions to the number of potential targets for each one-digit sector. The ratio in manufacturing is 0.17 and higher than all the other non-manufacturing sectors with the exception of mining, which has a ratio of 0.42. The "Finance, Insurance, and Real Estate" sector is next highest with a ratio of 0.11. These numbers indicate that M&A activity in manufacturing is simply more frequent in general than for all acquisitions in a market (not just cross-border). By itself, this fact could be explaining the differences we see in cross-border

[4] We cannot create a measure over time for this proxy as U.S. censuses later in the sample change industrial classification from SIC to NAICS.

M&A activity across sectors, not differences in cross-border frictions, and so we will need to control for this in the empirical work below.

However, we can see evidence in the raw data that cross-border frictions may lead to different frequencies of manufacturing vs. non-manufacturing cross-border M&A. Table 3 shows the number of acquisitions in manufacturing and non-manufacturing for both domestic and cross-border M&A activity across all our sample years and for various sample countries. A universal pattern across all our differing sample of countries is that manufacturing accounts for a significantly larger share of cross-border M&A activity (column 6) than domestic M&A activity (column 3). For example in our two samples of countries (top 50 and OECD), manufacturing accounts for only about 27-28% of targets acquired by domestic acquirers, but 39% of targets acquired by foreign firms (i.e, cross-border M&A). Across all top 10 target countries, the share of manufacturing targets is also always larger in the cross-border activity than in the domestic activity. These numbers suggest that cross-border M&A is relatively easier for manufacturing industries than non-manufacturing ones, and we next build an empirical model to explore how various cross-border frictions play a role in this.

3. MODEL

To generate a theoretically-founded empirical specification to test our hypotheses, we begin with the Head and Ries (2008) model of cross-border M&A and modify it to accommodate heterogeneous sector-specific frictional costs. The Head and Ries (2008) model views cross-border M&A as an international market for corporate control of productive assets, where the headquarters' monitoring cost of a (potential) subsidiary plays a

key role in the cross-border M&A decision. Frictional costs associated with cross-border M&A stem from this monitoring cost because its assumed that monitoring costs increase as the geographic or cultural distance between the home and host countries increases.

The model starts with a simple inspection game, which is played between the headquarters (HQ) and its subsidiary. Without monitoring by the HQ, the manager of the subsidiary lacks incentives to exert effort to maximize the value of the subsidiary. Monitoring requires costs that are increasing in distance (both cultural and geographic) between the HQ and its subsidiary. The subsidiary (manager) chooses whether to work or shirk. Gross profit depends on the contributions of the HQ and the subsidiary, which are denoted by *a* and *b*, respectively. The HQ always adds *a*, whereas the subsidiary adds *b* if it chooses to exert effort. The HQ simultaneously chooses whether to trust subsidiary or monitor and verify for a cost of *c* that the subsidiary has worked. HQ pays *w* to the subsidiary, unless monitoring reveals that the subsidiary is shirking, in which case the subsidiary gets zero. Working generates gross output of $a+b$, but the subsidary incurs effort costs of *e*. Head and Ries (2008) make parameter assumptions that $b>w>e>c>0$, and then solve for a mixed strategy Nash equilibrium of the inspection game, which yields the following expression for the value of the subsidiary:

$$v = a + b - 2\sqrt{bc} \qquad (1)$$

As can be seen from equation (1), higher verification costs (*c*) lower the value of the subsidiary to HQs. Head and Ries (2008) postulate *c* as 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. This naturally

explains the strong inverse correlations between these frictions and cross-border M&A found in the data.

Our focus is on potential heterogenity in frictions across sectors, and so we modify frictions in the Head and Ries model to be sector-specific. We denote these as D_{ijk}, where subscript *k* denotes the sector. Following Head and Ries (2008), we make a functional form assumption that $c_{ijk} = [\frac{\delta_k D_{ijk}}{2}]^2$, which then modifies equation (1) as follows:

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

Equation (2) illustrates that D_{ijk} acts as frictional costs and reduces the value of the merged firm differently across sectors depending on the value of δ_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 (2) 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.

4. EMPIRICS

4.1. Specification

We assume that the HQ with the highest expected payoff (i.e., *v*) makes the highest bid and wins the auction for control of a subsidiary. Let π_{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,

$$E[F_{ijk}] = \pi_{ijk} K_{ik} \tag{3}$$

We follow Head and Ries (2008) in specifying π_{ijk}, 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 μ is the location parameter and σ is the shape parameter. Using the results of Anderson, de Palma, and Thisse (1992, p. 39), it can then be shown that π_{ijk} is given by the multinomial logit formula:

$$\pi_{ijk} = \frac{\exp[\frac{\mu_j}{\sigma} + \ln(m_j) - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ijk}]}{\sum_l \exp[\frac{\mu_l}{\sigma} + \ln(m_l) - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ilk}]} \tag{4}$$

Substituting (4) into (3), we can express expected bilateral FDI stocks as

$$E[F_{ijk}] = \frac{m_j \exp[\frac{\mu_j}{\sigma} - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ijk}]}{\sum_l m_l \exp[\frac{\mu_l}{\sigma} - (\frac{\sqrt{b}}{\sigma})\delta_k D_{ilk}]} K_{ik} \tag{5}$$

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 (5) in terms of these variables yields:

$$E[F_{ijk}] = \exp[\frac{\mu_j}{\sigma} - \theta_k D_{ijk}] s_j^m K_{ik} B_{ik}^{-1} \quad (6)$$

Equation (6) 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*.

Standard industrial classifications used to define *k* in our data vary for both market structure reasons and artificial classification reasons. For example, manufacturing has many narrowly-defined industry classifications each composed of a relatively small number of establishments, whereas services tends to have more broadly-defined industry classifications with many firms. This matters because it directly affects the number of potential targets (K) and potential bidders (B) across sectors in a systematic way. To account for this we introduce a *k*-specific scaling factor that we assume allows us to rewrite $K_{ik} B_{ik}^{-1}$ as $\lambda_k K_i B_i^{-1}$. While this assumes a common industrial structure across our economies with respect to the relative number of firms in each sector, it allows us to extend Head and Ries (2008) in a tractable way to the sectoral level given available data.

Further re-arrangement of equation (6) gives us some insight into how the parameters of the model can be estimated:

$$E[F_{ijk}] = \exp[\frac{\mu_j}{\sigma} + \ln s_j^m + \ln K_i - \ln B_i + \ln \lambda_k - \theta_k D_{ijk}] \quad (7)$$

Equation (7) 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*-specific term relating to the share of target assets ($\ln K_i$) and the competing set of bidders ($\ln B_i$). We

will denote $O_j \equiv \frac{\mu_j}{\sigma} + \ln s_j^m$ as the outward direct investment effect for origin *j*, and $I_i \equiv \ln K_i - \ln B_i$ as the inward direct investment effect for destination *i*. Compressing the outward and inward effects into one term each, we obtain the following expression for expected bilateral FDI stocks:

$$E[F_{ijk}] = \exp[O_j + I_i + \ln \lambda_k - \theta_k D_{ijk}] \tag{8}$$

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 $\eta_{ijk} \equiv \frac{F_{ijk}}{E[F_{ijk}]}$ as the ratio of actual to expected bilateral FDI stocks. Using equation (8),

$$F_{ijk} = E[F_{ijk}]\eta_{ijk} = \exp[O_j + I_i + \ln \lambda_k - \theta_k D_{ijk}]\eta_{ijk} \tag{9}$$

As Head and Ries (2008) shows, with the right assumption on the error term, we can use maximum likelihood estimation of a count data model (such as a (quasi-)Poisson) to estimate the parameters of the model, θ_k.

The focus of our analysis is the effect of the observed variables that comprise the vector of cross-border frictions, D_{ijk}, and how their effects may vary across sectors of the economy. The first ones we specify are the same as Head and Ries (2008), which relate to factors that should increase or decrease the costs to the HQ of monitoring an acquired affiliate. 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 as it increases costs of monitoring the affiliate. The variable $CulturalDist_{ij}$ measures the cultural distance between the home and the host country, and for the same reason, we expect the coefficient on this variable to be negative. Similarly, for $CommonLang_{ij}$, a measure of the commonality of

language between the two countries, which should lower monitoring costs and increase cross-border M&A. We also include variables that indicate a colonial relationship between the two countries, $AcquirorFromColony_{ij}$ and $TargetInColony_{ij}$, which should lower monitoring costs and increase FDI corresponding to a positive coefficient.

We also introduce a number of additional variables to the vector of FDI frictions, which have cross-industry variation. The variables, $Tradeable_k$ and $Tradeability_k$, indicate whether industry *k* is tradeable or not and, if so, how tradeable its products are, respectively. We split tradeability up in this non-linear way, as we hypothesize that tradeability can have two opposing effects. On one hand, exporting products to another country can provide information about that country that could be helpful for FDI, especially cross-border M&A. It allows the firm to know more about the business conditions and regulations of a country, as well as possible targets in that country for acquisition. In other words, incurring the fixed costs of exporting to a market, should lower the fixed costs of cross-border M&A into the country. For this reason, we expect the coefficient on $Tradeable_k$ to be positive. At the same time, we hypothesize that the *degree* of tradeability, represented by $Tradeability_k$, will be inversely related to FDI and have a negative coefficient. This is from the well-known tradeoff that firms face in deciding whether to serve foreign markets with exporting or FDI. Lower costs of exporting, reflected in high degrees of tradeability, will mean there is less incentive to engage in FDI.

Finally, we include the variable $FDIRegulation_{ik}$, which measures the level of regulation and other restrictions imposed on foreign investment by the host country *i* in

industry *k*. We expect the coefficient on this variable to be negative because high regulations inhibit FDI activity.

Following the specification in equation (9), we control for the number of potential bidders and targets for each observation. We include both acquirer-country-fixed effects and target-country-fixed effects, which controls not only for the size of countries in various dimensions that would affect potential bidders and targets, but also unobservable time-invariant, country-wide institutions and business culture that impact all M&A activity. However, there are also industry-specific factors that could further affect the number of targets or acquirors, as well as the mechanical issue that the SICs do not break up economic activity into relatively equal parts, as noted above.[5] Therefore, we also include an across-sector scaling factor, $\ln \lambda_k$, that measures the the cross-sectional variation in potential bidders and targets by industry. Lower numbers of potential bidders and targets will naturally limit the number of acquisitions that may occur, ceteris paribus.

4.2. Data

As discussed in section 2, we use cross-border M&A data from the Thomsen Reuters SDC Platinum M&A database to construct our dependent variable over the period from 1985 to 2013. Using the data set, we create a dependent variable of the number of cross-border acquistions at the four-digit SIC industry level for all directional country pairs from the set of the top 50 target countries in the database, cumulated over the period from 1985 through 2013.[6] We also explore samples with only the OECD countries, which have

[5] In particular, manufacturing is broken into many more (and, thus, smaller) units of activity in terms of firms, employees, and output in each SIC than sectors such as services.
[6] We limit to the top 50 because M&A activity begins to get sparse beyond this set and then includes countries where we cannot easily obtain data for some of our regressors.

more intense M&A activity amongst them and account for a substantial share of overall cross-border M&A activity.

Data for a number of our covariates come from publicly available data at the CEPii website (www.cepii.fr) and have been used by many others for statistical studies of international economic activity. These are $CommonLang_{ij}$,which indicates whether the two countries share an official language, and the indicators of colonial status. Our distance variable measures the physical distance (in thousands of kilometers) between the home and the host countries' capital cities.[7]

We use Kogut and Singh's (1988) cultural index to create a $CulturalDist_{ij}$ variable that measures the cultural distance between the home and host countries. This is a composite index formed based on the weighted difference between the four cultural dimensions (i.e. power distance, uncertainty avoidance, masculinity/femininity, and individualism) of each country. Algebraically, we build the following index:

$$CD_{ij} = \sum_{c=1}^{4} \{(I_{ci} - I_{cj})^2 / V_c\} / 4 ,$$

where I_{ci} stands for the host country *i*'s *c*th cultural dimension, I_{cj} is the home country *j*'s *c*th cultural dimension, V_c is the variance of the *c*th dimension, CD_{ij} is the cultural distance index between the host country *i* and home country *j*. The cultural dimensions needed to construct this index are taken from the Geert Hofstede's website at http://www.geerthofstede.nl/dimension-data-matrix.

The $Tradeability_k$ measure is the sum of exports and imports divided by shipments of the domestic firms in the industry. We use U.S. data for the year 2000 to construct this

[7] Also from www.cepii.fr.

measure for our 4-digit SIC industries (see Blonigen (2011) for more details). The variable, $Tradeable_k$, simply indicates whether this index is non-zero.

To construct the variable measuring the degree of FDI regulation we use the OECD's FDI restrictiveness index from Blanka et al. (2010). The index ranges from 0 to 1 and is a composite of information on 1) foreign equity restrictions, 2) screening and prior approval requirements, 3) rules for key personnel, and 4) other restrictions on the operation of foreign enterprises.[8] The source of information for constructing the index for OECD countries is the list of countries' reservations under the OECD Code of Liberalisation of Capital Movements and their lists of exceptions and of other measures reported for transparency under the National Treatment Instrument (NTI). For the non-member countries additional sources of information have been used to identify restrictions. Such additional sources include official national publications, information gathered by the Secretariat in the preparation of OECD Investment Policy Reviews, and other international organizations such as the WTO and IMF.

We use the detailed U.S. data on firms by 4-digit SIC to construct a measure of $\ln \lambda_k$, the cross-sector scaling factor. We use data from various 1992 U.S. censuses of economic activity in the main sectors, which can be found at https://www.census.gov/prod/www/economic_census.html. We use the 1992 censuses because it was the earliest where we could get data by SIC for all our sectors before the U.S. switched over to the North American Industrial Classification System (NAICS). We collected firm (or company) data because acquisitions are typically of an entire firm, not

[8] Table I-1 of Blanka et al. (2010) provides a list of practices that are included and the weights used to aggregate the information into an index. 1 of Golub (2003) provides a list of practices that are included and the weights used to aggregate the information on them into an index. If the sector requires complete national ownership, the index takes the value of 1.

individual establishments.[9] We do not examine M&A activity in the "Agriculture, Forestry, and Fisheries" sector (SIC 0), as there is no analogous census completed for these industries.

Table 4 and 5 provide descriptive statistics of our variables for the full sample and the OECD country sample. The average number of cross-border acquisitions per country-industry observation is fairly small considering that we are cumulating all cross-border M&A activity over the 1985-2013 period, averaging 0.07 cross-border M&A transactions per country-industry pair over this entire period for the full sample and 0.15 for the OECD sample. This is due to lots of "0" observations in the data and a large variance, as the maximum value is 531 cross-border transactions over the period for one particular observation. Given this feature of the data, we explore below the robustness of our results using a zero-inflated negative binomial estimator.

There are a number of things to note about the characteristics of our regressors. A number of them are familiar because of their heavy use in explaining international trade patterns. The tradeability and FDI regulation measures are less well-known. Across all our sectors, about 65% are tradeable and the average ratio of exports and imports to shipments is about 40%. This is highly skewed by a few industries that have very high traded goods ratios. Our measure of FDI regulation suggests that substantial FDI regulations are not highly prevalent, but there is significant variation across sectors.

[9] An exception is the "Construction" sector where only the number of establishments are reported perhaps because firms are more often single-establishment in this sector than others.

4.3. Initial Results

We begin the empirical results by estimating equation (9) with a Poisson maximum likelihood estimator to estimate the impacts of cross-border frictions on M&A activity. (We get qualitatively identical estimates when we use OLS) We then explore robustness with alternative estimators – Negative Binomial and a zero-inflated Negative Binomial – and a sample of only OECD countries. Throughout we provide marginal effects of our coefficients to aid in interpretation. Finally, we explore the robustness of our conclusions when we allow our estimated marginal effects to vary across one-digit sectors and then use these estimated marginal effects to examine how cross-border frictions have differential impacts on cross-border M&A across various sectors.

Column 1 of Table 6 shows the base regression results from estimating equation (9) with a Poisson regression, which is consistent with the structural model developed in section 3. Most of the estimated marginal effects are of expected sign and statistically significant. Distance and cultural distance both significantly lower cross-border M&A activity. Physical distance has a larger effect, with a standard deviation increase in distance associated with a 9% lower rate of cross-border M&A activity, while a standard deviation increase in cultural distance is associated with about a 3.5% lower rate.
A standard deviation increase in the extent to which countries share a common language increases cross-border M&A activity with a similar magnitude to that of cultural distance – about a 3.5% effect. The colony variables are of mixed sign and generally small in magnitude. FDI regulation has the expected negative sign, but a standard deviation increase of the index (0.1 on a 1.0 scale) is only associated with a 1% decrease in cross-border M&A activity. Tradeability is estimated to have a significant positive effect on

cross-border M&A activity, consistent with the hypothesis that international trade activity can be a mechanism for information on available targets in other countries. The estimated marginal effect indicates that tradeable sectors increase cross-border M&A activity by about 9%. Tradeability has the expected negative sign, consistent with the hypothesis that there will be less FDI when trading is easier, but the effect is not statistically significant.

There is clearly substantial skewness in the dependent variable such that the variance of the distribution is much greater than the mean. The Poisson distribution, however, imposes the condition that the mean and variance are equal, which can bias parameter estimates. In column 2 of Table 6, we provide estimated effects when we use a negative binomial specification, which allows the variance and mean to differ. The marginal effects are quite robust to this alternative specification (even in magnitude) though the marginal effect on both colony variables are now the expected positive sign and statistically significant. The additional parameter allowing the mean and variance of the distribution to vary is highly statistically signficant, so we use the negative binomial specification in our remaining reported results.

The vast majority of M&A activity in the world is amongst the developed countries and the dependent variable has the value of "0" in 97% of the observations in our full sample of the top 50 countries. Even the more flexible negative binomial distribution may not be able to fit the data well because of this. To address this concern, we first limit the sample to only cross-border M&A activity between the OECD countries. This also allows us to see if the impact of various frictions on M&A activity between developed countries is different than for a sample that has both advanced and less-developed countries.

Column 1 of Table 7 provides marginal effects using a negative binomial specification for our OECD sample. While the signs are identical to our full sample results, the magnitudes are much larger, suggesting substantial impacts of cross-border frictions on OECD cross-border M&A activity. A standard deviation increase in physical and cultural distance are associated with a 17% and 14% reduction in cross-border M&A activity, respectively, while a standard deviation increase in commonality of language increases it by 34%. Colonial relationships matter much more in the OECD sample as well with former colonists investing in former colonies 61% more, ceteris paribus, while former colonies are 19% more likely to invest in former colonists. Tradeability matters much more as well. Tradeable sectors are 20% more likely to enage in cross-border M&A activity, while a standard deviation increase in tradeability of the sector is associated with about a 6% lower level of cross-border M&A activity. The FDI regulation index continues to be associated with a negative impact on cross-border M&A, but at a fairly modest level (only a 3% reduction for a standard deviation increase).

The dependent variable takes on the value of "0" in 94% of the observations even in the OECD sample. As as a result, we next explore a zero-inflated negative binomial specification. To do so, we need a variable that explains whether there is any cross-border M&A activity in country-industry observation in the first place. We use a variable indicating whether there is any *domestic* M&A activity for the country-industry observation to proxy for unobserved factors that make any kind of M&A activity in that country and industry prohibitive. Column 2 of Table 7 provides marginal effects using this zero-inflated negative binomial specification. The indicator for no domestic M&A activity is highly statistically significant. Signs and significance of the main regressors are

qualitatively identical to those estimated by a negative binomial specification, though magnitudes of the marginal effects have changed with a couple of the regressors. Notable changes are the marginal effect of common language falling in half, but still suggesting about a 17% increase in cross-border M&A for a standard deviation change, and a similar fall in the effect of FDI regulation.

4.4. Exploring Cross-sector Heterogeneity

The focus of the paper is on sectoral differences in cross-border M&A frictions. We can use the marginal effects in column 2 of Table 7 to infer some of these differences with respect to the variables that vary by industry - $Tradeable_k$, $Tradeability_k$, and $FDIRegulation_{ik}$. In particular, we examine the differences in manufacturing versus other one-digit sectors by multiplying the difference in the average values of these regressors (relative to manufacturing) by the marginal effects in column 2 of Table 7. We report these in Table 8, while the average value of our regressors by one-digit sector are reported in Appendix B. Our reported calculations in Table 8 show that the degree to which a sector has tradeable goods is estimated to have a large impact on cross-border M&A activity. For example, sectors with no tradeable goods (Construction, Wholesale Trade, and Retail Trade) have 35% lower cross-border M&A activity. Transportation, Communication, and Utilities, and the Service sectors also have significantly lower cross-border M&A activity for this reason as well. In contrast, differences in the degree of tradeability or FDI regulation have only marginal impacts on differences in cross-border M&A activity across sectors.

This exercise using marginal effects when pooling all sectors together can only take us so far in understanding sectoral differences in cross-border M&A frictions, since the impact of the frictions may vary across sectors. For example, the importance of commonality in language may be more or less important for the retail sector than the manufacturing sector. To explore this, we interact our regressors with one-digit sector indicator variables to be able to estimate separate marginal effects on all our regressors at one-sector level.

These results are displayed in Table 9, where marginal effects that are statistically different from the marginal effect estimated for the same variable in the manufacturing sector are bolded and italicized. As one can see, the majority of the marginal effects in the non-manufacturing sectors (42 out of 63) is bolded and italicized, indicating substantial differences in the effect of cross-border M&A frictions across sectors relative to manufacturing. Excluding the mining sector, most of the marginal effects in the non-manufacturing sectors suggest greater sensitivity to cross-border M&A frictions than is true for manufacturing. For example, the impact of physical distance impedes cross-border M&A activity in the other sectors from 5% (Finance, Insurance and Real Estate) to 38% (Construction) more than in manufacturing. Likewise, cultural distance impedes cross-border M&A activity in the other sectors from 5% (Transportation, Communication, and Utilities) to 46% (Finance, Insurance and Real Estate) more than in manufacturing. Former colonial relationships are relatively unimportant in manufacturing compared to Wholesale Trade, Services, and Finance, Insurance, and Real Estate, while the impact of common language on cross-border M&A is 20-30% greater than manufacturing in a number of the other sectors. Marginal effects for *Tradeable* and *Degree of Tradeability*

were not estimated for the three one-digit sectors that do not have any tradeable sectors (denoted as "na"), and there are generally no statistical differences in the marginal effect of whether a sector has tradeable goods or not. Interestingly, the effect of FDI regulation in impeding cross-border M&A is largest in manufacturing, though it still significantly impedes activity in Mining, Transportation, Communications, and Utilities, Wholesale Trade and Retail Trade.

5. CONCLUSION

The empirical international trade literature often focuses on manufactured goods because those are the main traded goods in the world economy – at least the ones for which we can easily track. But FDI, including cross-border M&A, can occur in any sector of the economy. Yet, manufacturing is where a disproportionately large amount of FDI occurs as well. To this point, there has little to no analysis for why this is true.

In this paper we empirically examine the relevance of heterogeneous sector-specific frictional costs using detailed data on worldwide mergers and acquisitions (M&A) activity and find evidence for substantial differences. Non-manufacturing sectors generally show much greater sensitivity to cross-border frictions and, thus, lower incidence of cross-border M&A activity. Tradeability is also strongly associated with cross-border M&A activity, which is a further impediment in many non-manufacturing sectors that are mainly comprised of non-tradeable products.

Such differences are important to understand for a wide variety of reasons. First, industry development and globalization is inherently linked to the ability of firms to engage in cross-border M&A activity. Second, policymakers are often keen in

encouraging FDI activity because they perceive it to help employment and productivity in their economies. Our results provides some of the first evidence that not all sectors are equal in the impediments that policymakers would face to encourage cross-border M&A activity.

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Table 1: Sectoral Composition of Cross-border M&A Across Different Samples

	Top 50	OECD
Manufacturing	39%	39%
Non-Manufacturing	61%	61%
Mining	5%	5%
Construction	2%	1%
Transportation, communications, and utilities	8%	8%
Wholesale trade	6%	6%
Retail trade	3%	3%
Finance, insurance and real estate	12%	11%
Services	25%	26%

Notes: Data from Thomsen Reuters SDC Platinum M&A Database, 1985-2013. Samples as defined in Appendix A.

Table 2. Acquisitions in the U.S. by Sector over the 1985-2013 Period Per U.S. Companies as of 1992

Sector	U.S. Acquisitions 1985-2013	Total number of U.S. companies in 1992	Ratio
Manufacturing	56,968	337,323	0.17
Non-Manufacturing			
Mining	9,964	23,830	0.42
Construction	2,762	572,848	0.00
Transportation, communications, and utilities	17,361	184,067	0.09
Wholesale trade	9,147	393,693	0.02
Retail trade	9,566	1,074,195	0.01
Finance, insurance, and real estate	35,686	338,040	0.11
Services	63,719	1,570,892	0.04

Notes: Data on acquisitions come from Thomsen Reuters SDC Platinum M&A Database, 1985-2013. We use data from various 1992 U.S. censuses of economic activity in the main sectors for dat aon number of U.S. companies, which can be found at https://www.census.gov/prod/www/economic_census.html.

Table 3: Share of Manufacturing in Domestic and Cross-border M&A for Various Samples and Top 10 Target Countries

	Domestic Acquisitions			Cross-border Acquisitions		
	Manufacturing	Non-Manufacturing	Share of Manufacturing	Manufacturing	Non-Manufacturing	Share of Manufacturing
Top 50 Sample	123464	322756	0.28	38311	60645	0.39
OECD Sample	104416	277273	0.27	35798	55055	0.39
Top 10 Target Countries						
Australia Targets	2728	13638	0.17	1366	4657	0.23
Canada Targets	3434	16512	0.17	2431	5529	0.31
China Targets	4871	6069	0.45	2218	2817	0.44
France Targets	6765	11661	0.37	3588	4153	0.46
Germany Targets	7673	11924	0.39	5049	5417	0.48
Italy Targets	2893	5115	0.36	2083	1901	0.52
Netherlands Targets	1655	4228	0.28	1504	2498	0.38
Spain Targets	2851	6582	0.30	1471	2546	0.37
U.K. Targets	11900	33131	0.26	4921	10149	0.33
U.S. Targets	44497	127153	0.26	9110	14865	0.38

Notes: Data from Thomsen Reuters SDC Platinum M&A Database, 1985-2013. Samples as defined in Appendix A.

Table 4: Descriptive Statistics for Variables in the Full Sample

	Mean	Standard Deviation	Minimum	Maximum
Number of Cross-border Acquisitions	0.073	1.250	0.000	531.000
$Distance_{ij}$	7.311	5.189	0.173	19.772
$CulturalDist_{ij}$	1.992	1.346	0.013	7.821
$TargetInColony_{ij}$	0.014	0.116	0.000	1.000
$AcquirerFromColony_{ij}$	0.019	0.136	0.000	1.000
$CommonLang_{ij}$	0.086	0.281	0.000	1.000
$Tradeable_k$	0.654	0.476	0.000	1.000
$Tradeability_k$	0.396	1.328	0.000	21.402
$FDIRegulation_{ik}$	0.068	0.131	0.000	1.000
Scale Factor (λ_k)	-0.106	2.012	-5.298	5.622

Notes: Author's calculations.

Table 5: Descriptive Statistics for Variables in OECD Sample

	Mean	Standard Deviation	Minimum	Maximum
Number of Cross-border Acquisitions	0.145	1.898	0.000	531.000
$Distance_{ij}$	5.603	5.511	0.173	19.586
$CulturalDist_{ij}$	1.893	1.414	0.013	7.821
$TargetInColony_{ij}$	0.020	0.140	0.000	1.000
$AcquirerFromColony_{ij}$	0.020	0.140	0.000	1.000
$CommonLang_{ij}$	0.085	0.280	0.000	1.000
$Tradeable_k$	0.654	0.476	0.000	1.000
$Tradeability_k$	0.396	1.328	0.000	21.402
$FDIRegulation_{ik}$	0.048	0.101	0.000	1.000
Scale Factor (λ_k)	-0.106	2.012	-5.298	5.622

Notes: Author's calculations.

Table 6: Marginal Effects on Counts of Cross-border M&A Activity
Full Sample

Variables	Poisson	Negative Binomial
$Distance_{ij}$	-0.0013	-0.0013
	(0.00002)	(0.00002)
$CulturalDist_{ij}$	-0.0019	-0.0018
	(0.00004)	(0.0001)
$TargetInColony_{ij}$	-0.0005	0.0015
	(0.0001)	(0.0003)
$AcquirerFromColony_{ij}$	0.0005	0.0021
	(0.0002)	(0.0003)
$CommonLang_{ij}$	0.0092	0.0095
	(0.0002)	(0.0003)
$Tradeable_k$	0.0067	0.0067
	(0.0001)	(0.0002)
$Tradeability_k$	-0.0006	-0.0007
	(0.00004)	(0.0001)
$FDIRegulation_{ik}$	-0.0049	-0.0040
	(0.0003)	(0.0004)
Scale Factor (λ_k)	0.0027	0.0025
	(0.00004)	(0.00004)
Chi-Squared Statistic on Likelihood Ratio Test	402687.88	120254.11
P-value of Chi-squared Statistic	(0.000)	(0.000)
Number of Observations	1,328,480	1,328,480

Notes: See text for variable definitions. Each specification also includes fixed effects for target and acquirer countries. P-values are in parentheses.

Table 7: Marginal Effects on Counts of Cross-border M&A Activity OECD Countries

Variables	Negative Binomial	Zero-inflated Negative Binomial
$Distance_{ij}$	-0.0044	-0.0052
	(0.000)	(0.000)
$CulturalDist_{ij}$	-0.0147	-0.0151
	(0.000)	(0.000)
$TargetInColony_{ij}$	0.0275	0.0376
	(0.000)	(0.000)
$AcquirerFromColony_{ij}$	0.0886	0.0526
	(0.000)	(0.000)
$CommonLang_{ij}$	0.1758	0.0968
	(0.000)	(0.000)
$Tradeable_k$	0.0610	0.0509
	(0.000)	(0.000)
$Tradeability_k$	-0.0064	-0.0041
	(0.000)	(0.000)
$FDIRegulation_{ik}$	-0.0400	-0.0186
	(0.000)	(0.000)
Scale Factor (λ_k)	0.0234	0.0157
	(0.000)	(0.000)
Regressor for First-Stage Logit		
Indicator for No Domestic Acquisitions		-0.1073
		(0.000)
Chi-Squared Statistic on Likelihood Ratio Test	34815.32	16143.13
P-value of Chi-squared Statistic	(0.000)	(0.000)
Number of Observations	533,520	533,520

Notes: See text for variable definitions. Each specification also includes fixed effects for target and acquirer countries. P-values are in parentheses.

Table 8: Estimated Differences in Cross-border M&A Activity from Manufacturing

	$Tradeable_k$	$Tradeability_k$	$FDIRegulation_{ik}$
Mining	-4%	1%	-1%
Construction	-35%	2%	0%
Transportation, communications, and utilities	-23%	1%	-2%
Wholesale trade	-35%	2%	0%
Retail trade	-35%	2%	0%
Finance, insurance, and real estate	-9%	2%	-1%
Services	-17%	2%	-1%

Notes: Calculated based on marginal effects reported in Table 7 and differences in average value of regressors across one-digit sectors in the OECD sample reported in Appendix B.

Table 9: Zero-inflated Negative Binomial Marginal Effects on Counts of Cross-border M&A Activity - Results by One-digit Sectors for OECD Countries

Variables	Mining	Construction	Manufacturing	Transport, Commun., and Utilities	Wholesale	Retail	Financial and Real Estate	Services
$Distance_{ij}$	***-0.0017***	***-0.0056***	-0.0040	***-0.0044***	***-0.0049***	***-0.0051***	-0.0042	***-0.0045***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$CulturalDist_{ij}$	***-0.0020***	-0.0083	-0.0061	-0.0064	-0.0054	***-0.0088***	***-0.0089***	-0.0073
	(0.015)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$TargetInColony_{ij}$	***-0.0068***	***0.0134***	0.0016	***0.0079***	***0.0086***	0.0026	***0.0139***	***0.0094***
	(0.079)	(0.001)	(0.186)	(0.001)	(0.000)	(0.388)	(0.000)	(0.000)
$AcquirerFromColony_{ij}$	***-0.0128***	0.0029	0.0045	0.0008	***0.0148***	0.0069	***0.0223***	***0.0140***
	(0.004)	(0.523)	(0.003)	(0.775)	(0.000)	(0.025)	(0.000)	(0.000)
$CommonLang_{ij}$	***0.0429***	0.0209	0.0179	***0.0231***	***0.0211***	***0.0225***	0.0158	***0.0228***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tradeable_k$	***-0.0110***	na	0.0278	0.0211	na	na	0.0280	0.0286
	(0.000)		(0.000)	(0.000)			(0.000)	(0.000)
$Tradeability_k$	***0.0855***	na	-0.0023	***-0.0162***	na	na	***-3.0205***	***0.0048***
	(0.000)		(0.000)	(0.000)			(0.000)	(0.023)
$FDIRegulation_{ik}$	***-0.0183***	***-0.0176***	-0.0943	***-0.0440***	***-0.0291***	***-0.0546***	***0.0003***	***0.0113***
	(0.002)	(0.616)	(0.000)	(0.000)	(0.077)	(0.000)	(0.928)	(0.050)
Scale Factor (λ_k)	**0.0159**	**0.0030**	0.0062	***0.0081***	***0.0145***	***0.0092***	***0.0023***	0.0062
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

NOTES: Marginal effects come from a pooled zero-inflated negative binomial regresssion where one-digit sectoral dummies were included and interacted with the regressors. These regressions also included individual dummy variables for each acquiring country and each target country, excluding the United States. Marginal effects for *Tradeable* and *Degree of Tradeability* were not estimated for the three one-digit sectors that do not have any tradeable sectors (denoted as "na"). P-values in parentheses denote whether at coefficient is statistically significant from zero. Coefficients bolded and italicized indicate coefficients that are significantly different from the marginal effect estimated for the same variable in the manufacturing sector.

Appendix A:
OECD Countries and Additional Countries Comprising the Top 50 Target Countries for Cross-border M&A

OECD Countries		Additional Top 50 Target Countries	
Australia	Luxembourg	Argentina	Malaysia
Austria	Mexico	Brazil	Peru
Belgium	Netherlands	Bulgaria	Philippines
Canada	New Zealand	Chile	Romania
Czech Republic	Norway	China	Russia
Denmark	Poland	Colombia	Singapore
Finland	Portugal	Hong Kong	South Africa
France	South Korea	Iceland	Taiwan
Germany	Spain	India	Thailand
Greece	Sweden	Indonesia	Ukraine
Hungary	Switzerland	Israel	Vietnam
Ireland	Turkey		
Italy	United Kingdom		
Japan	United States		

Appendix B: Average of Dependent Variable and Main Regressors by One-Digit Sector for the OECD Sample

	Mining	Construc-tion	Manufac-turing	Transport, Commun., and Utilities	Wholesale	Retail	Financial and Real Estate	Services
Number of Cross-border M&As	0.197	0.076	0.120	0.162	0.115	0.063	0.381	0.243
$Distance_{ij}$	5.603	5.603	5.603	5.603	5.603	5.603	5.603	5.603
$CulturalDist_{ij}$	1.893	1.893	1.893	1.893	1.893	1.893	1.893	1.893
$TargetInColony_{ij}$	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
$AcquirerFromColony_{ij}$	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
$CommonLang_{ij}$	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
$Tradeable_{k}$	0.897	0.000	0.997	0.349	0.000	0.000	0.737	0.522
$Tradeability_{k}$	0.311	0.000	0.731	0.201	0.000	0.000	0.010	0.034
$FDIRegulation_{ik}$	0.102	0.021	0.023	0.182	0.023	0.023	0.101	0.065
Scale Factor	-1.724	2.516	-1.333	-0.531	1.467	1.984	1.247	1.647
Number of observations	20358	17550	263952	44226	48438	44928	13338	80730