Core Competencies, Matching, and the Structure of Foreign Direct Investment*

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Abstract

We develop a matching model of foreign direct investment to study how multinational firms choose between greenfield investment, acquisitions, and joint ownership. Firms must invest in a continuum of tasks to bring a product to market, where each firm possesses a core competency in the task space, though are otherwise identical. For acquisitions and joint ownership, a multinational enterprise (MNE) must match with a local partner, where the local partner may provide complementary expertise within the task space. However, under joint ownership, investment in tasks is shared by multiple owners, and hence is subject to a holdup problem which varies with contract intensity. In equilibrium, ex-ante identical multinationals enter the local matching market, and ex-post, three different types of heterogeneous firms arise. Specifically, the worst matches dissolve and the MNEs invest greenfield, the middle matches operate under joint ownership, and the best matches integrate via full acquisition. We also link the firm-level model to cross-country and industry predictions related to development and contract intensity, respectively, where greater contract intensity or a more developed target market relative to the FDI source yield a higher share of full acquisitions. Using data on partial and full acquisitions across industries and countries, we find robust support for both predictions.

Keywords: foreign direct investment, multinational firms, joint venture, merger and acquisition, greenfield investment, incomplete contracts

JEL Classification: F12, F23

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1 Introduction

The decision of whether or not to engage in foreign direct investment (FDI) is the first of many decisions facing a multinational enterprise (MNE). Once the MNE decides to operate directly in a foreign market, the firm then chooses from a number of different options regarding *how* to operate in the foreign market: greenfield investment, acquisition, or joint ownership. In many cases, this latter component is arguably more important than the initial market entry decision since operational profits of an MNE in an unfamiliar market may depend on the importance of local relationships through different investment types, and in some cases, varying policies that differ by investment type. Further, theses issues may be more pronounced in different industries, and across target markets that vary by their degree of development. Indeed, when evaluating aggregate patterns of investment, different host country and industrial environments appear to be correlated with distinct forms of foreign direct investment. For instance, developing economies tend to attract more greenfield investment than acquisitions, while the opposite pattern holds in developed economies.[1] Moreover, while joint ownership is a typical form of foreign investment into developing countries, it is quite rare in developed countries where wholly owned subsidiaries are the norm.[2]

However, these broad aggregate patterns tend to obfuscate the issues that motivate cross-border ownership at the firm and industry level. How do firms choose between these investment options? A crucial distinction between greenfield investment and the other two options is that both acquisitions and joint ownership involve the MNE matching with a local partner before production takes place. If the matching takes place, the MNE must then choose the type of ownership structure that best utilizes the assets of both firms in the local market. Indeed, the quality of the match itself is likely to have a profound impact on the nature of the relationship that is chosen ex-post. For example, an MNE may choose to bring a match under full ownership to limit any possibility that agency issues might ruin the potential of a good match. Crucially, industries which are intensive in tasks that require contracts may be more susceptible to these agency issues. The level of development in the host country relative to the source of FDI may also matter substantially, where firms with a lower outside option in the former may be easier to purchase, and hence, the total fixed costs of the trans-

[1] UNCTAD (2000, 2011) reports that over two-thirds of greenfield investment is directed to developing economies, while only 25 percent of the cross-border merger and acquisitions take place there. Moreover, cross-border merger and acquisitions in manufacturing industries are concentrated in automobiles, pharmaceuticals and chemicals, and food, beverages, and tobacco.

[2] Desai et al. (2004) find that almost 60 percent of U.S. affiliates in developing countries are partially owned, whereas this figure drops to 15.5 percent in the case of the richest countries.

action may be lower. Indeed, this lower cost of FDI may mitigate the relative importance of matches which are ex-post inefficient.

In this paper, we develop a model of FDI in which MNEs choose whether to match with a local partner, and, if they do, whether to bring the match under full ownership. The elements of the investment model are twofold. First, we view production as a set of tasks that must be completed to produce a product in the foreign market, where each firm, local and MNE, possesses a unique core competency within the task space. Entering the market for corporate control is a way to increase efficiency by finding a local parter that can improve upon the MNE's deficiencies. However, as each task requires investment, an ownership structure involving multiple independent parties may bring about agency issues within the investment process, and hence, we also allow the MNE to choose the contractual arrangement that governs the new foreign affiliate. Depending on the quality of the match with the local partner—which we allow to vary along with the importance of contracts—the MNE may be compelled to complete the match through a full acquisition rather than operate under joint ownership with multiple owners sharing revenues of a final product.

In equilibrium, all ex-ante identical firms will enter the foreign matching market to find a local partner. The result is a group of ex-post heterogeneous firms that have sorted into three forms of ownership. In particular, we find that the least efficient of these matches are forgone, the mid-efficiency matches operate under joint ownership, and the most efficient matches involve mergers and acquisitions. The intuition for this sorting is straightforward. The least-efficient matches are forgone since the match does not offer joint profits sufficient to compensate the MNE for forgoing the outside option of greenfield investment for the MNE and provide profits for the local firm. However, for matches that reach a threshold level of efficiency gains, firms operate as a jointly owned firm, or if superior in efficiency, via full acquisitions. Indeed, the incomplete contracts associated with joint ownership cause a holdup problem in coordinating investments in the final product. When match potential is high, the loss of profits due to holdup is quite severe, and the MNE instead chooses to buy out the local firm, pay a fixed integration cost, and bring all investment responsibilities under one owner.

The model yields a number of aggregate predictions regarding industry-level contract intensity and relative development of the host-source that can be taken to the data. Specifically, industries with a greater contract intensity yield a larger share of transactions which are full acquisitions. Intuitively, when industries need very specific inputs requiring contracts, the potential for holdup problems is more pronounced, and MNEs are more likely to avoid these issues by purchasing firms 100%. In terms of cross-country predictions, a more developed target market increases the outside option of the target-country firm, making both types of acquisition less profitable for the source-country firm. However, since joint ownership involves the least profitable matches, selection operates through this margin, and thus, a more developed target relative to the source country yields a greater share of 100% acquisitions. Both predictions are supported using a large database of acquisitions by host-source-industry groups. Indeed, using contract intensity data from Nunn (2007), we find that industries with a greater share of inputs requiring contracts involve a greater share of full acquisitions. Further, we find that within target industries, a more developed target relative to the source in terms of GDP per capita also yields a higher share of full acquisitions. Finally, we also evaluate different legal structures, where we find evidence linking more full ownership in industry-host pairs in which contract intensity is larger and legal systems involve less-complete contracts.

This paper merges three strands of literature relating to firm heterogeneity and FDI, the property rights theory of the firm, and firm-to-firm matching. On a very basic level, our paper is similar to the canonical literature on firm heterogeneity in Melitz (2003) and Helpman, Melitz, and Yeaple (2004) where firms select into different options by balancing fixed costs against heterogeneous operating profits. However, our paper differs in that heterogeneity in operating profits is endogenous, and a function of both the quality of a match with a local partner and the organizational form that governs the match.

In terms of modeling, we integrate a circle-type matching framework similar to Rauch and Trindade (2003) and Grossman and Helpman (2005) within an investment model in the mold of Antràs and Helpman (2008). Specifically, the investment framework in Antràs and Helpman (2008), within which firms invest in a continuum of tasks and earn revenues of CES-type, provides the foundation on which to define tasks around a circle and add-in a simple matching framework. Overall, the result is a hybrid model in which the closed form solution for match efficiency is very simple, and is likely applicable to any CES-type model that requires a matching component.

Our framework also provides other contributions to the literature on firm-to-firm matching. Relative to Rauch and Trindade (2003), which focuses on the role of information in the matching process, we allow for a varying degree of common ownership within the match. As discussed above, we are able to distinguish between joint ownership and full ownership as different forms of foreign investment, and use this distinction to motivation an empirical test of the model. Relative to Grossman and Helpman (2005), our contributions are complementary, in that we focus on the choice of foreign investment type rather than on the outsourcing vs. integration decision in developing a product. In contrast with both Rauch and Trindade (2003) and Grossman and Helpman (2005), we offer greenfield investment as an option when matches fail, and vary the degree of contracting intensity to better match the empirics.

The results are also related to the literature that examines the optimal mode of foreign investment. Nocke and Yeaple (2007) examine the choice between greenfield FDI and mergers and acquisitions as a function of whether capabilities are transferrable across borders. Their work shows that the optimal sorting of firms is critically dependent on the degree to which capabilities are internationally mobile. Raff, Ryan, and Stähler (2009) examine the three-way decision between joint ventures, acquisitions, and greenfield investment in an oligopoly setting, where they find that the profits from greenfield investment are a crucial threat-point in the choice between mergers and acquisitions and joint ventures. Finally, in recent work, Bircan (2011) examines the stability of partial ownership using a learning model of FDI and unique plant-level data from Turkey.[3] Our focus on contracts is similar to his, though our approach to evaluating cross-industry and cross-country patterns of investment is novel.

In terms of the empirics, our paper is related to a burgeoning empirical literature that evaluates the incentives for acquisitions, and in some cases, the distinctions between different investment types—see, for example, Arnold and Javorcik (2005), Breinlich (2008), Spearot (2012), and Blonigen, Fontagné, Sly, and Toubal (2012). Given data constraints, where target and acquiring firm observables are rarely jointly reported, we use our firm-level model to to motivate a country pair-industry analysis of the composition of acquisition types as a function of relative development of targets, and industry specific contract intensity. In terms of broader policy questions, our model and aggregate empirics may provide a framework to help guide future work that evaluates the efficacy of investment policies, which in some cases, are industry-specific.

2 Basic Setup

The focus of the model is an MNE that is deciding how to enter a foreign market and, where applicable, how to organize with a local partner. Specifically, the MNE has three

[3]Other papers focusing on the stability of joint ownership include Killing (1982), Gomes-Casseres (1987), Kogut (1989), Inkpen and Beamish (1997), Miller et al. (1997), Sinha (2001), Inkpen and Ross (2001), Roy Chowdhury and Roy Chowdhury (2001).

possible ways to enter the market: greenfield investment, acquiring a local firm, and forming a joint venture with a local firm (operating under joint ownership). The key to the model is how an MNE may divide the tasks required for production with the local firm and how the choice of organizational form incentivizes investment in each task. Shortly, we detail further particulars about each entry type, although the crucial distinction for the model will be that joint ownership projects operate under a less "complete" contract than are the other forms of direct investment. While there may be fixed cost savings from not fully integrating the local partner, there may also be inefficiencies due to the standard holdup problem.

2.1 Production

Production in the model is defined over a continuum of tasks in which firms must invest to execute production of a final product, similar to the approach taken by Antràs and Helpman (2008). Specifically, we assume that all firms produce subject to the following revenue function:

$$R = A\theta^{1-\beta}Y^{\beta}, \qquad \beta \in (0,1). \tag{1}$$

In (1), θ is a measure of the quality of an idea, and Y is a measure of the execution of the idea (marketing, quality control, R&D, etc.). The intuition for this framework is that a high-quality idea is worth nothing if poorly executed, and executing a bad idea well is also worthless.

As mentioned above, Y will be a function of how the firm invests in a continuum of tasks. Specifically, we assume that Y is characterized by the following constant returns function over a continuum of tasks, T:

$$Y = \exp\left(\int_{t\in T} \log(y_t)dt \right). \tag{2}$$

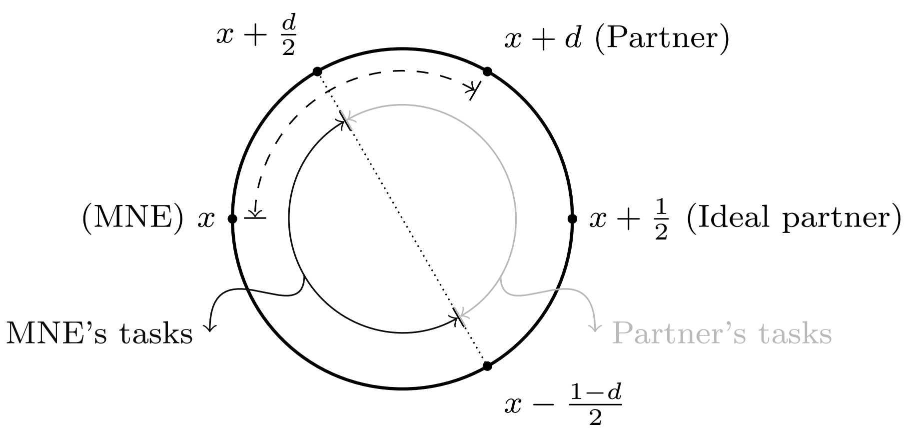
Here, y_t is investment in task t. We assume that tasks are uniformly distributed around a unit circle, where every firm, whether local or multinational, has a unique position around the circle. This is the location of a firm's *core competency*, where tasks farther away from the firm around the circle are more costly. A standalone firm cannot change its position around the circle to improve the efficiency of production. However, a firm may match with a partner in order to divide tasks in a way that minimizes costs, and, if it chooses to do so, may operate the combined firm under joint or full ownership.

Figure 1 provides a graphical representation of the division of tasks around the circle.

The MNE is positioned at point x, making x its core competency. Ideally, the MNE would like to form a match with a partner located exactly halfway around the circle, at point $x+\frac{1}{2}$. Generally, the partner will be located at a distance $d \in [0, \frac{1}{2}]$ from x, with the MNE taking care of the tasks closest to x, and the partner those closest to $x+d$ (as we explain below).

We now consider production under all three cases of entry into the host country.

Figure 1: Allocation of Tasks Around the Circle



Standalone Firms (Greenfield Investment)

In the model, there are two types of standalone firms: MNEs that invest greenfield, and local firms that operate independently. We introduce the profits for each in order.

Denote the cost of investing in each task t as c_t. The optimization problem of a standalone MNE that has invested greenfield is the following:

$$\pi_G = \max_{y_t \forall t \in T} \left\{ A\left(\theta\right)^{1-\beta} \left(\exp\left(\int_{t\in T} \log(y_t) dt \right) \right)^{\beta} - \int_{t\in T} c_t y_t dt \right\}. \tag{3}$$

Differentiating with respect to y_t yields the following for all t:

$$y_t = \frac{\beta A \theta^{1-\beta} Y^{\beta}}{c_t}. \tag{4}$$

Naturally, higher-cost tasks receive less investment. Since tasks are defined around a unit circle, it makes sense to normalize their distance relative to a given firm's core competency.

Specifically, we assume that task t, which is at a distance s_t (around the circumference of the circle) from the firm's core competency x, costs $c_t = e^{|s_t - x|}$ per unit to complete. Hence, a unit of investment in the task precisely at x requires one unit of labor to complete, and the unit labor requirement rises with distance around the circle from the firm's core competency. With this parameterization, optimal investment in task t is written as:

$$y_t = \frac{\beta A \theta^{1-\beta} Y^{\beta}}{e^{|s_t - x|}}. \tag{5}$$

Taking into account the uniform location of tasks around the unit circle, the equation for Y can be written as

$$Y = \exp\left(\int_{x}^{x+1/2} \log\left(\frac{\beta A \theta^{1-\beta} Y^{\beta}}{e^{s_t - x}} \right) ds + \int_{x-1/2}^{x} \log\left(\frac{\beta A \theta^{1-\beta} Y^{\beta}}{e^{x - s_t}} \right) ds \right), \tag{6}$$

which is simplified as:

$$Y = \beta^{\frac{1}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{1}{1-\beta} \left(\frac{1}{4} \right) \right). \tag{7}$$

Finally, using (2), we can rewrite operating profits in the following way:

$$\begin{aligned} \pi_G &= (1-\beta)\beta^{\frac{\beta}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{\beta}{4(1-\beta)} \right) \\ &\equiv \pi_0. \end{aligned} \tag{8}$$

The operating profits of greenfield investment for the MNE are labeled π_0. The operating profits of all other options will be measured against this "numeraire."

With respect to total profits, the MNE must also pay a fixed cost F_G under greenfield investment. This is meant to embody the costs of new facilities and management associated with new investment in a foreign market. Hence, total profits under greenfield investment are labeled as:

$$\Pi_G = \pi_0 - F_G. \tag{9}$$

Moving on to the local firms in the host country, we assume that these firms differ from MNEs in two dimensions. First, local firms may differ from MNEs in the quality of the product that they are able to produce absent a match with an MNE. Second, local firms may differ from MNEs in the fixed costs (or lack thereof) that must be incurred to produce. We assume that when an MNE can produce a product at quality θ, the local firm can produce the product at quality $\delta\theta$, where $\delta \in [0, 1]$. Hence, the local firm can produce the product, but only a lower-quality variety that earns lower profits. Therefore, the operating profits for the local firm are written as follows:

$$\begin{aligned} \pi_L &= (1-\beta)\beta^{\frac{\beta}{1-\beta}} A^{\frac{1}{1-\beta}} \delta\theta \exp\left(-\frac{\beta}{4(1-\beta)}\right) \\ &= \delta\pi_0. \end{aligned} \tag{10}$$

The second dimension on which the local firm differs from the MNE is that, as an established firm in the local market, the local firm incurs no fixed costs. Hence, total profits of the local firm are written as:

$$\Pi_L = \delta\pi_0. \tag{11}$$

Acquisition

The difference between a greenfield investment and an acquisition is that in the latter case the MNE is matched with a local partner and purchases the capabilities of the local partner. Hence, the MNE decides which capabilities, MNE or local, are best suited to invest in each of the tasks required for production. The MNE then chooses the investment level in each task, using whichever capabilities are closest in the task space (the MNE's or the acquired firm's).

Since only one firm controls the investment levels in tasks, the optimal investment in task t as a function of c_t is the same as for the standalone firm. However, the marginal costs may differ because some of the tasks are being performed by capabilities acquired from the local partner. Within the circle context discussed above, assume (without loss of generality) that the core competency of the matched local firm is at a distance $d \leq \frac{1}{2}$ away from the MNE. Hence, via cost minimization, the MNE, which is located at x, performs tasks between $\left(x - \frac{1-d}{2}, x + \frac{d}{2}\right)$. The assets acquired from the local partner perform all other tasks. This is also depicted in Figure 1. With this parameterization, the equation for Y can be written as:

$$Y = \exp\left(2\int_x^{x+d/2} \log\left(\frac{\beta A\theta^{1-\beta}Y^\beta}{e^{s-x}}\right) ds + 2\int_{x-\frac{1-d}{2}}^{x} \log\left(\frac{\beta A\theta^{1-\beta}Y^\beta}{e^{x-s}}\right) ds\right). \tag{12}$$

Simplifying yields the optimal level of production for the merged firm, Y:

$$Y = \beta^{\frac{1}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{1}{1-\beta}\left(\frac{d^2 - d + 1/2}{2}\right)\right). \tag{13}$$

Using the equation for Y and simplifying yields the following equation for operational profits of the merged firm:

$$\begin{aligned}\pi_A(d) &= (1-\beta)\beta^{\frac{\beta}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{\beta}{1-\beta}\left(\frac{d^2-d+1/2}{2}\right)\right) \\ &= \phi(d)\,\pi_0,\end{aligned} \tag{14}$$

where $\phi(d) \equiv \exp\left(\frac{\beta}{1-\beta}\frac{d(1-d)}{2}\right) \geq 1,\ \forall d \in \left[0, \frac{1}{2}\right]$.

We think of $\phi(d)$ as a measure of the quality of the match between the MNE and the domestic firm: $\phi(d)$ measures the improvement from splitting tasks with a partner (as opposed of being in charge of all tasks). Since $\phi(d) \geq 1$, an acquisition (weakly) increases the efficiency of production relative to a standalone firm. Additionally, since ϕ is increasing in d for $d \in [0, \frac{1}{2})$, this implies that better matches (that is, matches where the partners are farther away and are better complements) enjoy higher profits.

In terms of total profits, the MNE must pay two fixed costs associated with an acquisition. The first, F_A, is a simple integration cost that is required to "solve" the holdup problem. The second, T_A, is a transfer from the MNE to the local firm as payment for the local firm's assets. Overall, total profits of the acquisition are written as:

$$\Pi_A(d) = \phi(d)\pi_0 - F_A - T_A. \tag{15}$$

Joint Ownership

Having detailed the (polar) options of establishing a wholly owned subsidiary in the local market via greenfield investment and via acquisitions, we now turn to the option of a joint ownership, for example, a joint venture.[4] Under this mode of FDI, the MNE forms a match with a local partner, but without buying out the local firm's capabilities. This option may provide advantages in terms of the costs of market entry—no new facilities are built, and there is no cost of buying out the local firm. However, because there are two owners jointly investing in the combined product, agency issues may arise when contracts are incomplete. Indeed, we adopt the assumption that contracts are incomplete under the joint venture and focus on these issues in this section.

We assume a flexible framework of partial contractibility, where specifically, we allow the degree of contractual incompleteness to vary across industries. Indeed, the contractual severity for industries that must deal with highly sophisticated, customized tasks (hard to

[4] We will use both terms, joint ownership and joint venture, interchangeably.

verify for a third party) is different than industries contracting over something homogeneous (like how much light-sweet crude to buy). So, having a varying degree of contractual intensity will be helpful for guiding the empirics.

To add-in contractual incompleteness, suppose that task y_t is made of a contractable component and a component subject to incomplete contracts. Specifically, assume that the composite task is split into the two types of tasks as follows:

$$y_t = \left(\frac{y_t^I}{\gamma}\right)^{\gamma} \left(\frac{y_t^c}{1-\gamma}\right)^{1-\gamma} \tag{16}$$

Here, y_t^I represents investment in tasks subject to incomplete contracts, and y_t^c is investment in tasks subject to complete contracts. The term γ represents the relative weight on tasks subject to incomplete contracts.

Substituting (16) into the expression for Y, we have the following:

$$\begin{aligned} Y &= \exp\left(\int_{t \in T} \log(y_t) dt\right) \\ &= \exp\left(\gamma \int_{t \in T} \log\left(\frac{y_t^I}{\gamma}\right) dt\right) \exp\left((1-\gamma) \int_{t \in T} \log\left(\frac{y_t^c}{1-\gamma}\right) dt\right) \end{aligned} \tag{17}$$

Next, we need to specify how the investment levels for contractible and non-contractible tasks are determined. First, note that for tasks subject to complete contracts, we assume that the investment levels will be as if both parties agreed to maximize the joint production of the relationship. In this case, investment is:

$$y_t^c = \frac{(1-\gamma)\,\beta A \theta^{1-\beta} Y^{\beta}}{c_t}. \tag{18}$$

For tasks subject to incomplete contracts, assume that the parties each receive one half of the total revenue earned from the joint investment. Under this assumption, investments in non-contractible tasks (y_t^I) by the MNE are defined by the following maximization problem:

$$\begin{aligned} \widetilde{\pi}_J = \max_{y_t^I \forall t \in T_{MNE}} &\left\{ \frac{A}{2}\theta^{1-\beta} \left(\exp\left(\int_{t \in T_{MNE}} \log\left[\left(\frac{y_t^I}{\gamma}\right)^{\gamma} \left(\frac{y_t^c}{1-\gamma}\right)^{1-\gamma} \right] dt + \int_{t \in T_P} \log(y_t) dt \right) \right)^{\beta} \right\} \\ &- \int_{t \in T_{MNE}} c_t \left(y_t^I + y_t^c\right) dt \end{aligned}$$

where T_{MNE} is the set of (composite) tasks that are performed by the MNE within the total set of tasks T. The maximization problem of the local partner is identical to that of the MNE, shown above, with the exception that T_P, the set of tasks undertaken by the local firm, and T_{MNE} are switched. Note that while the parties agree to share the revenue generated by the joint venture, the revenue itself depends on the investments undertaken by both parties. Given the environment of incomplete contracts, the parties cannot commit to an investment level (the maximization takes the contractible tasks y_t^c and the other party's tasks as given) despite the fact that each party must incur the full costs of the tasks for which it has responsibility.

Differentiating with respect to y_t^I yields the following for all t:

$$y_t^I = \frac{\gamma\beta\frac{A}{2}\theta^{1-\beta}Y^{\beta}}{c_t}. \tag{19}$$

Hence, investment levels in each non-contractible task are exactly one half of what they would be under complete contracts. Plugging the investment levels, contractible and non-contractible, into the equation for Y, we get:

$$Y = \left(\frac{1}{2}\right)^{\frac{\gamma}{1-\beta}} \beta^{\frac{1}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{1}{1-\beta}\frac{d^2-d+1/2}{2}\right) \tag{20}$$

Using the equation for Y and simplifying yields the following equation for the MNE's profits under joint ownership:

$$\widetilde{\pi}_J(d) = \left[1-\beta\left(1-\gamma+\frac{\gamma}{2}\right)\right]\left(\frac{1}{2}\right)^{\frac{1-\beta+\beta\gamma}{1-\beta}} \beta^{\frac{\beta}{1-\beta}} A^{\frac{1}{1-\beta}} \theta \exp\left(-\frac{\beta}{1-\beta}\frac{d^2-d+1/2}{2}\right). \tag{21}$$

We assume that the MNE and the local firm, if they choose a joint venture, can engage in side payments so that the primary measure relevant for each is the total profits earned under the venture, which is compared with the total profits earned from other the organizational options (the motivation for this will become clear below). Since there are no fixed costs under the joint venture, the total profits accruing to both parties under joint ownership can be written as follows:

$$\Pi_J(\gamma, d) = \lambda(\gamma)\phi(d)\pi_0, \tag{22}$$

where $\lambda(\gamma) \equiv \frac{1-\beta\left(\frac{2-\gamma}{2}\right)}{1-\beta}\left(\frac{1}{2}\right)^{\frac{\beta}{1-\beta}\gamma} \in [0,1]$. As with acquisitions, the MNE benefits from matching with a partner that is more efficient at some tasks—there is an efficiency gain through $\phi(d)$. However, there is also a potential efficiency loss due to a loose contractual relationship, which is measured by the term $\lambda(\gamma)$. Lemma 1 details precisely the properties of λ, and in particular, how λ changes with γ.

Lemma 1 *For $\beta \in [0,1]$, $\lambda(0) = 1$, and $\frac{\partial \lambda}{\partial \gamma} < 0$.*

Proof. See Appendix ■

In Lemma 1, the inefficiency related to hold-up is nil when there are no tasks subject to incomplete contracts ($\gamma = 0$), and more pronounced when γ is higher ($\frac{\partial \lambda}{\partial \gamma} < 0$). Intuitively, the greater share of each task that involves unverifiable contracts, the larger is the degree to which hold-up reduce operating profits under joint ownership.

Crucially, as detailed in equation (22), the degree to which inefficiency related to holdup reduces operational profits is, in absolute terms, a function of the quality of the match, $\phi(d)$. More specifically, the profit loss from holdup $(1 - \lambda(\gamma))$ is larger in absolute terms when match quality $\phi(d)$ is higher. Lemma 2 provides two useful benchmarks:

Lemma 2 *For $d \in [0, 1/2]$ and $\beta \in [0,1]$:*

1. $\lambda(1)\phi(d) < 1$,

2. $\lambda(0)\phi(d) = \phi(d)$.

Proof. See Appendix ■

Via Lemma 2, whenever $\gamma = 1$, it is always the case that $\lambda\phi(d) < 1$, which implies that the inefficiency associated with hold-up *always* degrades the match to the point of being less profitable (on an operational basis) than a standalone firm. In contrast, whenever $\gamma = 0$ and all tasks are contractible, there is no efficiency loss due to holdup, and hence, operational profits under joint ownership are identical to acquisitions.

3 Organizational Choice

In this section we characterize optimal organizational choice as a function of the quality of the matches that occur and prove that a parameter space exists such that all three types of FDI occur after ex-ante identical firms enter the matching market for corporate control.

To begin, and to build intuition regarding the equilibrium of the model, it is straightforward to show that:

$$\begin{aligned}\frac{\partial \Pi_G}{\partial \phi(d)} &= 0 \\ \frac{\partial \Pi_J}{\partial \phi(d)} &= \lambda(\gamma)\pi_0 \\ \frac{\partial \Pi_A}{\partial \phi(d)} &= \pi_0\end{aligned}$$

Obviously, greenfield investment is not affected by the quality of a match simply due to no matching having occurred. However, for joint ventures and acquisitions, the effect of match quality is an increasing and monotone function of $\phi(d)$, where via Lemma 2, we have that $\frac{\partial \Pi_J}{\partial \phi(d)} < \frac{\partial \Pi_A}{\partial \phi(d)}$ for $\gamma > 0$. Assuming that $\gamma > 0$ for the remainder of the paper, it is clear that the critical issue in pinning down the sorting of entry choices as a function of match quality will be the relative ranking of fixed costs. We now turn to addressing precisely this issue subject to the effects of match quality derived above.

3.1 Equilibrium

First, consider the choice between joint ownership and declining the match. The MNE can compensate the local firm for its outside option and also make additional profit for itself, if the following holds:

$$\begin{aligned}\Pi_J(d) &\geq \Pi_G + \Pi_L \qquad (23)\\ \lambda\phi(d)\pi_0 &\geq \pi_0 - F_G + \delta\pi_0.\end{aligned}$$

Simplifying, this condition can be written as:

$$\phi(d) \geq \frac{1}{\lambda}\frac{(1+\delta)\,\pi_0 - F_G}{\pi_0} \equiv \phi_J. \qquad (24)$$

In (24), only matches of relatively high quality form joint ventures rather than declining the match and operating as standalone entities. Note that a higher δ increases the value of the cutoff ϕ_J: a higher outside option for the domestic firm (or, more precisely, a smaller difference in the outside options of both firms) makes joint ownership less desirable for the

MNE *vis-à-vis* greenfield investment. In contrast, a higher value of λ decreases the cutoff ϕ_J: more complete contract environments increase the relative profitability of joint ventures.

Consider next the choice between an acquisition of a local firm by the MNE and a joint venture, where an acquisition is preferred if the profits earned under acquisition are larger than the combined profits of the MNE and the local firm under joint ownership (note that this guarantees that there exists a value of T_A such that total profits are positive for both the MNE and the local firm). This is characterized in the following condition:

$$\phi(d)\pi_0 - F_A \geq \lambda\phi(d)\pi_0.$$

Simplifying, this condition is written as:

$$\phi(d) \geq \frac{F_A}{(1-\lambda)\,\pi_0} \equiv \phi_A. \tag{25}$$

In (25), a matched party prefers an acquisition to a joint venture when the match is of relatively high quality. In this case, the additional rents earned from the match are sufficient to overcome the fixed costs of integrating the local firm into the MNE. Note that the cutoff ϕ_A increases with λ, as better contracting settings increase the range of quality matches for which operating under joint ownership is preferred to a full acquisition. Moreover, note that ϕ_A does not depend of δ as both acquisitions and joint ventures involve dealing with a domestic firm that has the same outside option in either case. Consider also a polar case in which the fixed costs of integration are equal to zero. In this case, all matches that provide a non-zero benefit of specialization take the form of acquisitions rather than joint ventures. In this case, there are no additional fixed costs, and an acquisition provides the benefits of a match without the agency issues of two parties splitting revenues but making independent investments.

Finally, consider the choice between acquisition and greenfield investment. The former organizational form will be preferred over the latter if and only if:

$$\begin{aligned} \phi\pi_0 - F_A &> (1+\delta)\,\pi_0 - F_G \\ \phi &> \frac{(1+\delta)\,\pi_0 - F_G + F_A}{\pi_0} \equiv \phi_A'. \end{aligned} \tag{26}$$

Note that a high δ, low F_G, or high F_A requires a better match to make acquisition preferred over greenfield investment. However, as we show below, this choice is redundant in our baseline equilibrium.

3.2 Equilibrium Sorting of Matches

In this subsection, we prove that there exists a range of exogenous parameters such that the least efficient matches are declined, mid-efficiency matches become joint ventures, and the most efficient matches result in acquisitions. Given the preference conditions above, this occurs if the following condition holds:

$$1 < \phi_J < \phi_A < \widehat{\phi}, \tag{27}$$

where $\widehat{\phi} \equiv \phi|_{d=1/2}$ is the maximum possible benefit from a match.

To begin, consider the condition $1 < \phi_J < \widehat{\phi}$. As a function of the model's parameters, this condition can be simplified as:

$$\begin{aligned} \lambda\pi_0 &< (1+\delta)\,\pi_0 - F_G < \lambda\pi_0\widehat{\phi} && (28)\\ &\Leftrightarrow \\ \left(1+\delta-\lambda\widehat{\phi}\right)\pi_0 &< F_G < (1+\delta-\lambda)\,\pi_0. && (29)\end{aligned}$$

Next, consider $\phi_J < \phi_A < \widehat{\phi}$, which implies the following condition:

$$\frac{1-\lambda}{\lambda}\left((1+\delta)\,\pi_0 - F_G\right) < F_A < \frac{1-\lambda}{\lambda}\lambda\widehat{\phi}\pi_0. \tag{30}$$

Note that $((1+\delta)\,\pi_0 - F_G) < \lambda\widehat{\phi}\pi_0$ is equivalent to the right-hand side of (28) being satisfied. Hence, if joint ventures are chosen at all over greenfield investment, then there exists a range of F_A such that acquisitions also occur, but only for matches of the highest quality. This is intuitive, as F_A simply shifts up and down Π_A, where the slope of Π_A is fixed given match quality and is steeper than Π_{JV}. Hence, there exists a value of F_A such that $\phi_J < \phi_A < \widehat{\phi}$.

Finally, the above expressions imply that $\phi_J < \phi'_A$ and that $\phi'_A < \phi_A$. Indeed, substituting in the expressions for the cutoffs, we find that

$$\frac{1-\lambda}{\lambda}\left[(1+\delta)\,\pi_0 - F_G\right] < F_A, \tag{31}$$

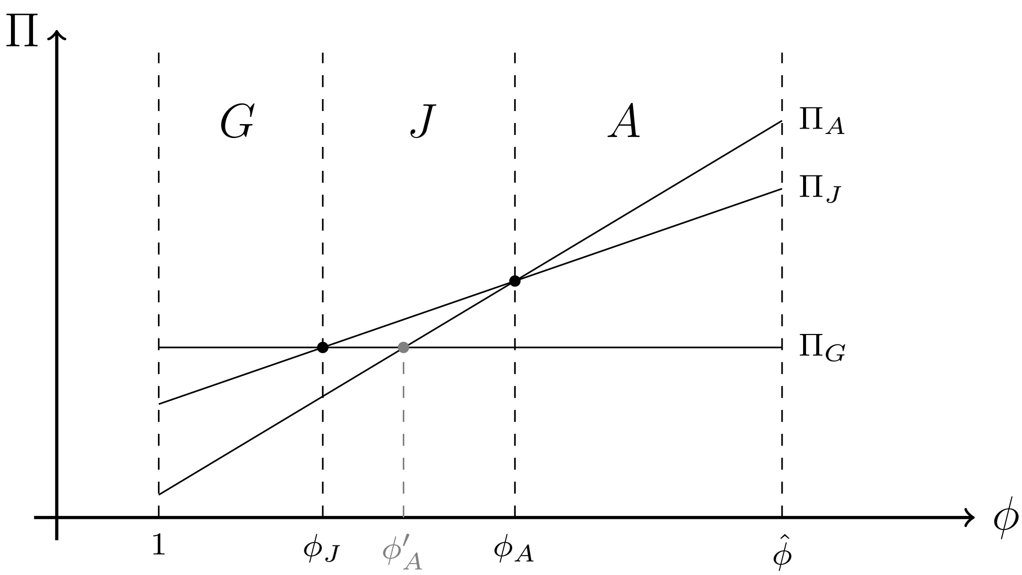
which is precisely the left-hand side of expression (30).

Overall, we have the following proposition:

Proposition 1 *Suppose that F_G and F_A satisfy (29) and (30). Then, for $\phi \in (1, \phi_J)$ matches are immediately declined (and firms operate independently); for $\phi \in (\phi_J, \phi_A)$, matches form joint ventures; and for $\phi \in (\phi_A, \widehat{\phi})$, matches form acquisitions.*

Figure 2 provides a graphical representation of the equilibrium, and the shaded area in Figure 3 represents all the possible combinations of fixed costs F_G and F_A such that the equilibrium is the one described in Figure 2. We see that the marginal value of a high-quality match is higher for acquisitions than for joint ventures. This is due to the holdup problem that is present with joint ventures, and is key to understanding the equilibrium sorting of matches into entry modes. Specifically, the forgone profits due to the holdup problem are largest when the potential profits of the match are large. Hence, the MNE is willing to pay a fixed cost to solve the holdup problem and integrate the local firm into one entity that controls investment in all tasks.

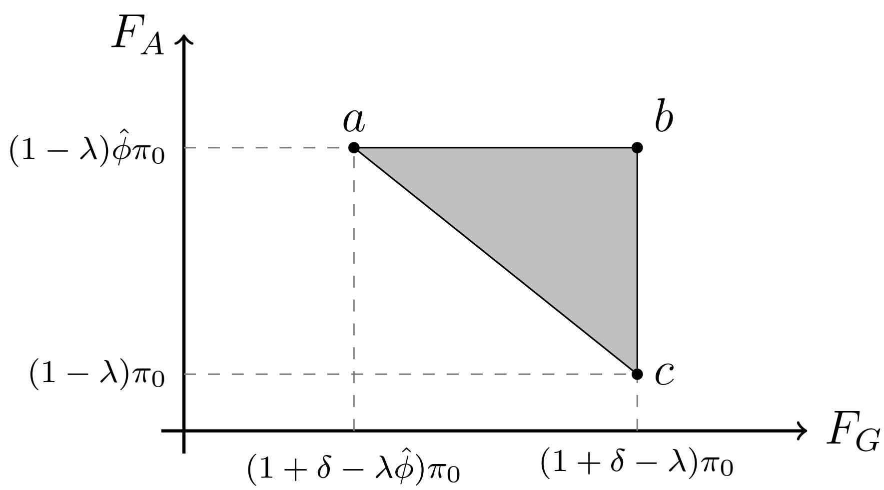
Figure 2: Profits as a Function of Match Quality, ϕ



3.3 Comparative Statics

The equilibrium above details the average investment behavior of a given group of multinationals entering a foreign market deciding whether to proceed with a match and if so whether that match is loose or deep. However, the relative attractiveness of each option may change

Figure 3: Conditions for F_G and F_A



given the contracting environment, and relative development of the host and source nations. In this section we evaluate how different industries and source - host pairs change the relative propensity of different ownership types.

To begin, we first evaluate simple comparative statics of match quality cutoffs ϕ_J and ϕ_A. Lemma 3 details the effects of λ and δ on these cutoffs.

Lemma 3 *The effects of λ and δ on ϕ_J and ϕ_A are as follows:*

$$\textbf{i.} \quad \frac{\partial \phi_J}{\partial \delta} > 0, \qquad \frac{\partial \phi_A}{\partial \delta} = 0.$$

$$\textbf{ii.} \quad \frac{\partial \phi_J}{\partial \lambda} < 0, \qquad \frac{\partial \phi_A}{\partial \lambda} > 0.$$

$$\textbf{iii.} \quad \frac{\partial^2 \phi_J}{\partial \delta \partial \lambda} < 0, \qquad \frac{\partial^2 \phi_A}{\partial \delta \partial \lambda} = 0.$$

Proof. See Appendix. ■

The first set of results in Lemma 3 summarizes the effect of δ. Here, we find that higher values of δ reduce the cutoff ϕ_J and have no effect on the cutoff ϕ_A. The intuition is that higher δ makes it more difficult to buyout the local target, which affects both the profits from acquisitions and joint ventures equally. Hence the match quality at which MNEs are indifferent between the two options does not change. However, as the worst matches are joint ventures, joint ventures become less profitable relative to greenfield investment, and in equilibrium, raises the match quality at which firms are indifferent between these options.

The second set of results in Lemma 3 summarizes the effect of the level of contractual completeness, λ. Intuitively, higher λ increases the level of contractual completeness, and hence, decreases the loss in profits due to loose ownership, in this case through joint ownership. Hence, relative to both greenfield investment and acquisitions, the region of joint ownership expands.

The last set of results, the cross-derivatives, relates to how λ interacts with overall profitability through match quality. As detailed above, an increase in δ increases the outside option of the target, and hence, ϕ_J must rise to compensate for this better outside option. However, higher λ can also increase the relatively profitability of joint ventures, and mitigates the original upward shift in ϕ_J required to adjust for a different value of δ.

Finally, to motivate the forthcoming empirical exercise, we use the results in Lemma 3 to evaluate the effects of λ and δ on the share of corporate reallocation that is a full acquisition. Specifically, we are interested in the following measure of acquisition depth

$$S = \frac{1 - G(\phi_A)}{1 - G(\phi_J)}$$

where $G(\phi)$ is the CDF of observed match quality (pdf $g(\phi)$). The following proposition summarizes the effects of λ and δ and the share of 100% acquisitions.

Proposition 2 *The effects of λ and δ on S are as follows:*

$$\textbf{i.} \quad \frac{\partial S}{\partial \delta} > 0,$$

$$\textbf{ii.} \quad \frac{\partial S}{\partial \lambda} < 0,$$

$$\textbf{iii.} \quad \frac{\partial^2 S}{\partial \delta \partial \lambda} < 0.$$

Proof. See Appendix. ■

The intuition in Proposition 2 is the same as the cutoffs in Lemma 3, though its importance is worthy of a proposition on two levels. First, in the next section, we will propose a measure of the share of acquisitions that are 100% using a common merger database that can be linked back to measures of relative development and contractual completeness. Hence, Proposition 2 details precisely the predictions that will be taken to the data. Specifically, that relative development of the target has a positive effect on the likelihood of a full acquisition within all firm-to-firm transactions, while increased contractual completeness reduces this share. The interaction of the two effects is also negative, which highlights how δ and λ interact, in equilibrium. Second, despite clear intuition, the calculation of the cross-derivative of λ and δ on the full acquisition share is non-trivial, and requires a derivation of the precise shape of $g(\phi)$. As the technique may be of interest to other matching frameworks, we have detailed this derivation in the Appendix.

4 Empirical Analysis

The model in sections two and three delivers rich predictions regarding acquisition depth across industries and countries. Specifically, in Proposition 2, we prove that a greater degree of contractual completeness reduces the share of 100% acquisitions within all corporate reallocation, and that a less-developed target market relative to the FDI source also reduces this share. We now utilize a large database of acquisitions to test these predictions.

4.1 Data and Sample

A main challenge in testing these predictions is that joint ventures are quite hard to classify. On one hand, joint ventures may involve a loose agreement within which two parties work on a project without swapping ownership shares. On the other hand, joint ventures may involve a limited transaction of ownership shares. Given the difficulty in observing the former group of transactions, it is on the latter group that we focus our empirical attention.

Specifically, we classify joint ownership as partial ownership, according to the percentage acquired within a transaction between two firms. The sample of firm transactions is obtained from the *Thomson SDC Platinum* dataset, which uses regulatory filings and public records to build a large database of acquisition behavior across countries and industries.[5] The main sample of acquisitions is constructed by restricting transactions to those that start from 0% ownership. This removes gradual acquisitions from the dataset, focusing the analysis on initial purchases. Further, we restrict attention to those transactions above a 10% purchase. As some countries (namely the US) require additional oversight/disclosure of foreign trans-

[5]The *Thomson* dataset has also been used by Breinlich (2008).

actions above this level, this cutoff is applied to the entire sample for consistency (removing this cutoff adds roughly 10,000 transactions, and has no effect on the results). The sample of transactions consists of 372,542 transactions over the period 1980-2006. We then collapse this dataset into a five-way sample of observations by Acquiring firm SIC2 (ASIC2) - Target firm SIC2 (TSIC2) - Acquiring Nation (ANATION) - Target Nation (TNATION) - Year. Below, i is the acquiring industry SIC2, j is the target industry SIC2, h is host (target) nation, s is the source (acquiring) nation, and t is the year.

Using this sample, the main dependent variable will be the share of transactions within each observation that are 100% acquisitions, $FULL_{i,j,h,s,t}$. The secondary measure will be the average percentage of the target firm that is acquired within each observation, $PERACQ_{i,j,h,s,t}$.[6] We regress these measures of acquisition depth on two primary independent variables—relative development in the target market, and the degree of contractual completeness in the target industry. These variables are meant to respectively measure δ and λ from the theory section. We now discuss the construction of each measure.

In terms of relative development, we acquire GDP per capita data from the *Penn World Tables*, where $AGDPPC_{s,t}$ is acquiring nation GDP per capita in year t, and $TGDPPC_{h,t}$ is target nation GDP per capita in year t. To proxy for δ, we use the log ratio of target to acquiring nation development; $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$. Recall, from the theory section, that δ measures the fraction of the MNE's outside option in terms of operating profits that the local firm can obtain if it operates as a standalone firm. Thus, the ratio of GDP per capita is trying to capture precisely this "fraction."

In terms of contract completeness λ, we utilize measures of contract intensity from Nunn (2007). Nunn (2007), an industry's contract intensity is measured by the share of inputs that are procured from differentiated industries. To construct our measure, for each target SIC2 industry, we average contract intensity weighted by total value (from Nunn) from the SIC 4-digit level. Then, we subtract this average from 1 to measure contract completeness for target industry j, CC_j. Thus, those industries that need a larger share of differentiated inputs (hard to contract) are more prone to suffer from contractual problems. In contrast, those industries dealing with homogeneous, easy-to-contract, inputs will generally enjoy a more complete-contract environment.

Finally, to identify cross-border relationships, we define the dummy variable $D_{cross} = 1$

[6] These measures are not weighted by the value of the transaction since values are not consistently reported in *Thomson*. We have also used measures of full acquisitions over a three year window from initial purchase and the results are unchanged.

Table 1: Descriptive Statistics

Variable	Mean	St. Dev.	Min	Max
$FULL_{i,j,h,s,t}$	0.693	0.440	0	1
$PERACQ_{i,j,h,s,t}$	0.869	0.242	.101	1
D_{cross}	0.441	0.497	0	1
CC_j	0.228	0.203	0.004	0.903
$\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$	-0.131	1.59	-12.6	12.7

Notes: Descriptive statistics calculated by across acquiring SIC2 industry i, target SIC2 industry j, source country s, host country h and year t groups. See text for variable definitions.

when the host and source nations are different. Summary statistics for all variables are presented in Table 1. Consistent with earlier studies of mergers, most a majority of mergers are 100% transactions, and many partial mergers involve a high share of ownership. Further, domestic mergers comprise the majority of all observed mergers, though this is masked somewhat when aggregating as we do in our dataset.[7]

4.2 Relative Development and Acquisition Depth

To begin, we focus on the analysis of δ in the paper, estimating the following specification linking acquisition depth to development of the target nation relative to the acquiring nation:

$$FULL_{i,j,h,s,t} = \alpha_1 \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) \cdot D_{cross} + \alpha_2 \cdot D_{cross} + \alpha_{i,j,t} + \epsilon_{i,j,h,s,t} \qquad (32)$$

In equation 32, $\alpha_{i,j,t}$ is a fixed effect defined by ASIC2, TSIC2, and year groups. Given this choice of fixed effect, identification is obtained by exploiting variation across host-source country pairs within an ASIC2-TSIC2-Year group. Of note, any average differences in industry characteristics (say, contract intensity) are absorbed by the fixed effects. Given the predictions from the theory, we hypothesize that $\alpha_1 > 0$, where a relatively developed target

[7]Across the transaction level data, 78.3% of acquisitions are domestic.

nation will experience a greater share of 100% acquisitions. The results from this regression are presented in column one of Table 2. While cross border mergers tend to involve more joint ventures - a feature which is likely due to risk aversion and country-specific policies related to foreign ownership (see below) - a more developed target nation relative to the acquiring nation promotes more full acquisitions. This matches with higher δ from the model.

To evaluate the robustness of this result, we next consider whether firms may simply be using more partial ownership given the high uncertainty and poor institutions in developing countries. Further, in some country-industry pairs, foreign ownership may be restricted for policy reasons (eg. India pre-1992 and China pre-2000). To examine the predictions subject to these issues, we alter the fixed effects to be $\alpha_{h,j,t}$ (column two), and $\alpha_{h,i,j,t}$ (column three). In the former, we are exploiting variation within target-industry markets in each year, and in the latter, across acquiring (source) countries within target-industry pair markets in each year. In both cases, the results are robust. That is, when looking within target nation-industry-year groups, or target nation-industry pair-year groups, it is still the case that cross-border relationships involve more joint ventures, and that a more developed target nation relative to the acquiring nation also promotes more full acquisitions.

To test the robustness of our dependent variable, we run these same regressions when using $PERACQ_{i,j,h,s,t}$ as the dependent variable. The results, which are presented in Table 3, are arguably stronger when using this measure.

4.3 Contract Intensity and Acquisition Depth

The previous regressions focused on variation in acquisition patterns across country pairs within ASIC2-TSIC2-year groups to identify the effects of relative development on the type of corporate reallocation. In this section, we evaluate the depth of acquisitions as a function of industry differences in contract completeness. To do so, we use the following regression:

$$FULL_{i,j,h,s,t} = \alpha_3 \cdot CC_j + \alpha_{h,s,t} + \epsilon_{i,j,h,s,t} \tag{33}$$

For the baseline regressions, the fixed effects are $\alpha_{h,s,t}$, or country pair-year, so we are identifying the effects of contract completeness while absorbing average effects of country differences (that were the focus of the previous table). According to the comparative statics in Section 3, we hypothesize that α_3 is negative, where a greater share of tasks subject to complete contracts increases the relative profitability of the organizational form subject to contracting issues; namely, joint ventures.

Table 2: Relative Development and Full Acquisitions

	(1)	(2)	(3)
$\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) \cdot D_{cross}$	0.014***	0.008***	0.003**
	(0.001)	(0.001)	(0.002)
D_{cross}	-0.067***	-0.026***	-0.060***
	(0.004)	(0.003)	(0.004)
Observations	97,900	97,900	97,900
R^2	0.010	0.002	0.009
Number of fixed	23,687	26,435	75,992
ASIC2-TSIC2-Year Fixed?	Yes	No	No
TNATION-TSIC2-Year Fixed?	No	Yes	No
TNATION-ASIC2-TSIC2-Year Fixed?	No	No	Yes

Notes: The dependent variable used in this table is $FULL_{i,j,h,s,t}$, the share of 100% acquisitions within each observation, and is regressed on a dummy variable identifying cross-border acquisitions, D_{cross}, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$. Note that the level effect of relative development is not included since for domestic acquisitions $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) = 0$. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Relative Development and Percent Acquisitions

	(1)	(2)	(3)
$\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) \cdot D_{cross}$	0.009***	0.005***	0.003***
	(0.001)	(0.001)	(0.001)
D_{cross}	-0.035***	-0.014***	-0.033***
	(0.002)	(0.002)	(0.002)
Observations	92,197	92,197	92,197
R^2	0.010	0.003	0.010
Number of fixed	22,439	25,556	71,962
ASIC2-TSIC2-Year Fixed?	Yes	No	No
TNATION-TSIC2-Year Fixed?	No	Yes	No
TNATION-ASIC2-TSIC2-Year Fixed?	No	No	Yes

Notes: The dependent variable used in this table is $PerAcq_{i,j,h,s,t}$, the average percent acquisition within each observation, and is regressed on a dummy variable identifying cross-border acquisitions, D_{cross}, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$. Note that the level effect of relative development is not included since for domestic acquisitions $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) = 0$. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The baseline results are presented in column one of Table 4. Here, we see that when target industries have more inputs that involve complete contracts, there is a lower share of 100% acquisitions. To use a more demanding set of fixed effects to net-out other characteristics that affect the propensity for full acquisitions, in column three we adjust the fixed effect to look within ASIC2 - Host - Source - Year groups. Here, the estimates are essentially the same. Finally, in columns 1 and 3 of Table 5, we extend the analysis to the continuous measure of acquisition activity, $PERACQ_{i,j,h,s,t}$, where the results are also supportive.

As a final test of the aggregate predictions in the model, we interact the measure of contract completeness CC_j with relative development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$:

$$FULL_{i,j,h,s,t} = \alpha_3 \cdot CC_j + \alpha_4 \cdot CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) + \alpha_{h,s,t} + \epsilon_{i,j,h,s,t} \tag{34}$$

In Proposition 2 in section three, we discussed how the shift away from full acquisitions to joint ventures due to improved contracting is more pronounced when relative development is higher. Hence, we hypothesize that both α_3 and α_4 are negative. The results are presented in column two of Table 4. The results are significant, and supportive of the negative effect of contract completeness, and the negative interaction between contract completeness and relative development of the target market to the acquiring market. In column four, we focus more sharply on variation across target industries by using Acquiring SIC2 - Host - Source - Year fixed effects, and while the sign is still negative as the model predicts, the estimate is no longer significant. However, in columns 2 and 4 of Table 5, the results are highly significant when using $PERACQ_{i,j,h,s,t}$ as the dependent variable.

4.4 Contract Intensity, Legal Origins, and Acquisition Depth

As a final empirical test of the model, we evaluate the robustness of the results to differences in legal structures across host and target countries. Broadly speaking, legal structures can have two effects on the structure of foreign investment. On one hand, familiarity with the legal structures under which the target operates can reduce the fixed integration costs that (in the model) are associated with acquisitions. This would lead to more full acquisitions in better legal environments. On the other hand, the ex-post verification of investment levels may be easier when the acquiring firm has knowledge of the legal system under which the target assets operate, or when the target operates in an environment that is protective of property rights. In this case, better legal environments would lead to more feasible partial

Table 4: Contract Completeness, Relative Development, and Full Acquisitions

	(1)	(2)	(3)	(4)
CC_j	-0.057***	-0.058***	-0.061***	-0.061***
	(0.007)	(0.007)	(0.008)	(0.008)
$CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$		-0.012**		-0.012
		(0.006)		(0.011)
Observations	97,874	97,874	97,874	97,874
R^2	0.001	0.001	0.001	0.001
Number of fixed	14,271	14,271	54,231	54,231
Country pair-Year Fixed?	Yes	Yes	No	Yes
ASIC2-Country pair-Year Fixed?	No	No	Yes	Yes

Notes: The dependent variable used in this table is $FULL_{i,j,h,s,t}$, the share of full acquisitions within each observation, and is regressed on the degree of contract completeness in industry j, CC_j, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$. Note that the level effect of relative development is not included since it is absorbed by the country pair component of the fixed effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Contract Completeness, Relative Development, and Percent Acquisitions

	(1)	(2)	(3)	(4)
CC_j	-0.035***	-0.036***	-0.033***	-0.034***
	(0.004)	(0.004)	(0.005)	(0.005)
$CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$		-0.008**		-0.015**
		(0.004)		(0.007)
Observations	92,178	92,178	92,178	92,178
R^2	0.001	0.001	0.001	0.001
Number of fixed	13,719	13,719	51,627	51,627
Country pair-Year Fixed?	Yes	Yes	No	Yes
ASIC2-Country pair-Year Fixed?	No	No	Yes	Yes

Notes: The dependent variable used in this table is $PerAcq_{i,j,h,s,t}$, the average percent acquisition within each observation, and is regressed on the degree of contract completeness in industry j, CC_j, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$. Note that the level effect of relative development is not included since it is absorbed by the country pair component of the fixed effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

ownership. Below, we use a within country-pair-year estimation strategy to test for issues related to the latter issues, while absorbing the former.

To identify the legal origins of source and target countries, we merge information from Nunn (2007), which breaks down legal regimes as originating from English, French, German, Socialist, or Scandinavian legal traditions. Using this information, we construct two dummy variables. First, we construct an indicator variable D_h^{ComLaw} that takes a value of 1 when the target country has a legal system originating from English common law. As discussed in La Porta, de Silanes, and Shleifer (2008), there are essentially two main legal traditions, common law and civil law, where the former is based in English legal traditions and the latter from Roman law (mostly adapted by the French). The important economic distinction between the two is that common law developed out of desire for property rights protections by land owners, and disputes are settled by judges with independence from other law-making bodies. In contrast, civil law has an ancient history based on decree and codes set by lawmakers rather than impartial dispute settlement and precedent setting. Given these differences, we hypothesize that targets originating from English common law have more "complete" contracts, and as discussed at the beginning of this section, the effects of industry-level contract completeness are amplified when targets are of English-common law origin. Put differently, effective contract completeness (λ from the model) is higher when industries use a greater share of inputs from homogeneous industries, the target is a under a common-law legal system, or both.

Our second legal-structure variable identifies source-target pairs that share the same legal origin. Precisely, we define $D_{h,s}^{Same}$ as an indicator variable taking on a value of 1 when target (host) h and source s share the same legal origin. Similar to D_h^{ComLaw}, we hypothesize that acquiring firms with greater familiarity with legal traditions in a target market ($D_{h,s}^{Same} = 1$) are more able to verify contracts.

To test the relationship between legal origins and acquisition behavior, we estimate the following equation:

$$\begin{aligned} FULL_{i,j,h,s,t} \quad = \quad & \alpha_3 \cdot CC_j + \alpha_4 \cdot CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right) + \alpha_5 \cdot CC_j \cdot D_h^{ComLaw} \\ & + \alpha_6 \cdot CC_j \cdot D_{h,s}^{Same} + \alpha_{h,s,t} + \epsilon_{i,j,h,s,t} \end{aligned} \tag{35}$$

As discussed above, we hypothesize that $\alpha_5 < 0$ and $\alpha_6 < 0$, signifying that contracts are more complete when operating in target markets with a legal system subject to English common law, or the source-target pair share the same legal system. Again, $\alpha_{h,s,t}$ is a host-source-time fixed effect, so we identify the model using variation within country pairs. This choice of fixed effect is crucial to provide a precise interpretation of the legal origin variables. Indeed, if fixed costs of integration are lower when targets operate under common-law and/or the source and target pair share the same legal system, these effects should be absorbed by the fixed effect. Hence, relative to the discussion at the beginning of this section, the remaining variation is focused on the interaction between industry-level contract completeness and legal origin variables, and hence, related to the ability to verify contracts.

The results from this regression are presented in columns one through three in Table 6. We find support for the hypotheses that contracts are more complete in industries with a greater share of homogenous inputs and targets with common law legal origin or the same legal origin as the source country. Further, note that the interaction between relative GDP per capita and contract completeness also remains negative and significant, suggesting that basic issues of legal origin are not trivially correlated with relative development. In columns four through six, we restrict the sample to include only cross-border acquisitions, where we find that the results are consistent within this group. Finally, in Table 7, we replace $FULL_{i,j,h,s,t}$ with $PerAcq_{i,j,h,s,t}$ as the dependent variable, where the results still remain.

5 Conclusion

We have presented a model of foreign investment in which MNEs match with firms in a local market. When the MNEs match, they choose between incomplete contractual relationships with no fixed costs (joint ventures) or common ownership with integration costs (acquisitions). When they fail to find a sufficiently good match, they instead undertake greenfield investment. In equilibrium, ex-ante identical multinationals enter the local matching market, and, ex post, three different types of ownership within a heterogeneous group of firms arise. In particular, the worst matches dissolve and the MNEs invest greenfield, the middle matches form joint ventures, and the best matches integrate via mergers and acquisitions.

We have also shown that joint ventures are more common when the host country produces products that are of inferior quality to those produced in the source country. Further, we have shown that joint ownership is more common when contract intensity is lower. We find robust empirical support for these predictions using a large database of country and industry acquisitions patterns, where less developed host markets relative to the source lead to more joint ownership, and a less-intensive contract environment and better legal systems also lead to more joint ownerhip.

Table 6: Contract Completeness, Legal Origins, Relative Development, and Full Acquisitions

	(1)	(2)	(3)	(4)	(5)	(6)
CC_j	-0.057***	-0.035***	0.011	-0.035***	-0.007	0.012
	(0.007)	(0.011)	(0.020)	(0.013)	(0.020)	(0.022)
$CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$		-0.013**	-0.011*		-0.012*	-0.011*
		(0.006)	(0.006)		(0.006)	(0.006)
$CC_j \cdot D_h^{ComLaw}$		-0.037**	-0.026*		-0.058**	-0.028
		(0.015)	(0.015)		(0.027)	(0.031)
$CC_j \cdot D_{h,s}^{Same}$			-0.062***			-0.066**
			(0.022)			(0.031)
Observations	97,874	95,980	95,980	43,158	41,870	41,870
R^2	0.001	0.001	0.001	0.000	0.001	0.001
Number of fixed	14,271	13,151	13,151	12,714	11,773	11,773
Country pair-Year Fixed?	Yes	Yes	Yes	Yes	Yes	Yes
Cross Border Only?	No	No	No	Yes	Yes	Yes

Notes: The dependent variable used in this table is $FULL_{i,j,h,s,t}$, the share of full acquisitions within each observation, and is regressed on the degree of contract completeness in industry j, CC_j, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$, an indicator identifying common-law legal origin, D_h^{ComLaw}, and an indicator identifying country pairs that share the same legal origin, $D_{h,s}^{Same}$. Note that the level effect of relative development is not included since it is absorbed by the country pair component of the fixed effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Contract Completeness, Legal Origins, Relative Development, and Percent Acquisitions

	(1)	(2)	(3)	(4)	(5)	(6)
CC_j	-0.035***	-0.026***	-0.009	-0.034***	-0.021*	-0.010
	(0.004)	(0.007)	(0.012)	(0.008)	(0.012)	(0.013)
$CC_j \cdot \ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$		-0.008**	-0.007*		-0.008**	-0.008**
		(0.004)	(0.004)		(0.004)	(0.004)
$CC_j \cdot D_h^{ComLaw}$		-0.016*	-0.012		-0.029*	-0.011
		(0.009)	(0.009)		(0.016)	(0.018)
$CC_j \cdot D_{h,s}^{Same}$			-0.022*			-0.040**
			(0.013)			(0.018)
Observations	92,178	90,452	90,452	40,338	39,161	39,161
R^2	0.001	0.001	0.001	0.001	0.001	0.001
Number of fixed	13,719	12,673	12,673	12,191	11,319	11,319
Country pair-Year Fixed?	Yes	Yes	Yes	Yes	Yes	Yes
Cross Border Only?	No	No	No	Yes	Yes	Yes

Notes: The dependent variable used in this table is $PerAcq_{i,j,h,s,t}$, the average percent acquisition within each observation, and is regressed on the degree of contract completeness in industry j, CC_j, and an interaction with relative target development, $\ln\left(\frac{TGDPPC_{s,t}}{AGDPPC_{h,t}}\right)$, an indicator identifying common-law legal origin, D_h^{ComLaw}, and an indicator identifying country pairs that share the same legal origin, $D_{h,s}^{Same}$. Note that the level effect of relative development is not included since it is absorbed by the country pair component of the fixed effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In future work, we intend to focus on the endogenous choice of the type of products that a firm brings to a local market as a function of the investment mode. Indeed, since many policies restrict the types of foreign investments that are permissible, this focus may elucidate the ramifications of such policies when technology transfer depends on the type of products that a firm brings into a local market.

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Appendix

A Section 2

A.1 Lemma 1

Recall from section 2 that

$$\lambda(\gamma) \equiv \frac{1-\beta\left(\frac{2-\gamma}{2}\right)}{1-\beta}\left(\frac{1}{2}\right)^{\frac{\beta}{1-\beta}\gamma}$$

Substituting $\gamma = 0$, it is clear from above $\lambda(0) = 1$. To sign the derivative with respect to γ, we first take natural logs (written log) to get:

$$\log(\lambda(\gamma)) = \log\left(1-\beta+\gamma\frac{\beta}{2}\right) - \log(1-\beta) + \frac{\beta}{1-\beta}\gamma\log(1/2)$$

Differentiating with respect to γ:

$$\frac{1}{\lambda}\frac{\partial\lambda}{\partial\gamma} = \frac{\beta/2}{1-\beta+\gamma\frac{\beta}{2}} + \frac{\beta}{1-\beta}\log(1/2)$$

Factoring out $\frac{\beta}{1-\beta}$, we get:

$$\frac{1}{\lambda}\frac{\partial\lambda}{\partial\gamma} = \frac{\beta}{1-\beta}\left(\frac{\frac{1-\beta}{2}}{1-\beta+\beta\gamma/2} + \log(1/2)\right)$$

Dividing the first fraction within the parenthesis by $\frac{1-\beta}{2}$, we have:

$$\frac{1}{\lambda}\frac{\partial\lambda}{\partial\gamma} = \frac{\beta}{1-\beta}\left(\frac{1}{2+\frac{\beta}{1-\beta}\gamma} + \log(1/2)\right)$$

Noting that $\log(1/2) < -\frac{1}{2}$, and that $\frac{1}{2+\frac{\beta}{1-\beta}\gamma}$ is bounded between zero and 1/2, it follows that $\frac{\partial\lambda}{\partial\gamma} < 0$

A.2 Lemma 2

In this appendix, we show that $\lambda(0)\phi(d) = \phi(d)$ and $\lambda(1)\phi(d) < 1$ for all d and β. To begin, since $\lambda(0) = 1$ from above, the first results is immediate. In terms of the section, note that $\lambda(1)\phi(d) < 1$ can be written as follows:

$$\lambda(1)\phi(d) = \frac{1-\frac{\beta}{2}}{1-\beta}\left(\frac{1}{2}\right)^{\frac{\beta}{1-\beta}}\exp\left(\frac{\beta}{1-\beta}\frac{d(1-d)}{2}\right) \tag{A-1}$$

Clearly, as a function of d, $\lambda(1)\phi(d)$ is maximized when $d = \frac{1}{2}$. Plugging in $d = \frac{1}{2}$, we have:

$$\lambda(1)\phi(1/2) = \frac{1-\frac{\beta}{2}}{1-\beta}\left(\frac{1}{2}\right)^{\frac{\beta}{1-\beta}} \exp\left(\frac{\beta}{1-\beta}\frac{1}{8}\right)$$

Next, to show that $\lambda(1)\phi(1/2) < 1$ for all β, take logs to get:

$$\log\left(\lambda(1)\phi(1/2)\right) = \log\left(1-\frac{\beta}{2}\right) - \log\left(1-\beta\right) + \frac{\beta}{1-\beta}\log\left(\frac{1}{2}\right) + \frac{\beta}{1-\beta}\frac{1}{8}$$

Substituting $\beta = 0$ we get:

$$\log\left(\lambda(1)\phi(1/2)\right) = \log\left(1\right) - \log\left(1\right) + \frac{0}{1}\log\left(\frac{1}{2}\right) + \frac{0}{1}\frac{1}{8} = 0$$

Clearly, $\log\left(\lambda(1)\phi(1/2)\right)|_{\beta=0} = 0$, or put differently, $\lambda(1)\phi(1/2)|_{\beta=0} = 1$. Next differentiating $\log\left(\lambda(1)\phi(1/2)\right)$ with respect to β, we get:

$$\frac{\partial \log\left(\lambda(1)\phi(1/2)\right)}{\partial\beta} = -\frac{1}{2-\beta} + \frac{1}{1-\beta} + \frac{1}{(1-\beta)^2}\left(\log\left(\frac{1}{2}\right) + \frac{1}{8}\right)$$

Factoring out $\frac{1}{(2-\beta)(1-\beta)}$, we get:

$$\frac{\partial \log\left(\lambda(1)\phi(1/2)\right)}{\partial\beta} = \frac{1}{\left(2-\beta\right)\left(1-\beta\right)}\left(1 + \underbrace{\left(\log\left(\frac{1}{2}\right) + \frac{1}{8}\right)}_{<-\frac{1}{2}} \cdot \underbrace{\frac{(2-\beta)}{(1-\beta)}}_{\in(2,\infty)}\right) < 0$$

Hence, given that $\left(\lambda(1)\phi(1/2)\right)|_{\beta=0} = 1$, and $\frac{\partial \log(\lambda(1)\phi(1/2))}{\partial\beta} < 0$, it must be the case that $\lambda\phi(d) < 1$ for all $d \in [0, 1/2]$ and $\beta \in (0, 1)$.

B Comparative Statics

B.1 Lemma 3 - Productivity Cutoffs

To solve for the changes to productivity cutoffs, recall that :

$$\begin{aligned} \phi_J &= \frac{1}{\lambda}\frac{(1+\delta)\pi_0 - F_G}{\pi_0} \\ \phi_A &= \frac{F_A}{(1-\lambda)\pi_0} \end{aligned}$$

Differentiating with respect to δ, we get:

$$\begin{aligned} \frac{\partial \phi_J}{\partial \delta} &= \frac{1}{\lambda} > 0 \\ \frac{\partial \phi_A}{\partial \delta} &= 0 \end{aligned}$$

For here, we can easily derive the cross-partial derivatives:

$$\begin{aligned} \frac{\partial^2 \phi_J}{\partial \delta \partial \lambda} &= -\frac{1}{\lambda^2} < 0 \\ \frac{\partial^2 \phi_A}{\partial \delta \partial \lambda} &= 0 \end{aligned}$$

Finally, differentiating the cutoffs with respect to λ, we get:

$$\begin{aligned} \frac{\partial \phi_J}{\partial \lambda} &= -\frac{1}{\lambda^2}\frac{(1+\delta)\pi_0 - F_G}{\pi_0} < 0 \\ \frac{\partial \phi_A}{\partial \lambda} &= \frac{F_A}{(1-\lambda)^2\pi_0} > 0 \end{aligned}$$

Note that $\frac{\partial \phi_J}{\partial \lambda} < 0$ only if $\phi_J > 0$.

B.2 Proposition 2 - Acquisition Share

Defining the share of acquisitions as S and the distribution of match qualities by the twice differentiable CDF $G(\phi)$ (pdf $(g(\phi))$) we have:

$$S = \frac{1 - G(\phi_A)}{1 - G(\phi_J)}$$

Differentiating S by λ, we get:

$$\frac{\partial S}{\partial \lambda} = \frac{1}{(1-G(\phi_J))^2}\left(-g(\phi_A)\underset{+}{\frac{\partial \phi_A}{\partial \lambda}}(1-G(\phi_J)) + g(\phi_J)\underset{-}{\frac{\partial \phi_J}{\partial \lambda}}(1-G(\phi_A))\right) < 0$$

Differentiating S by δ, we get:

$$\begin{aligned}\frac{\partial S}{\partial \delta} &= \frac{1}{(1-G(\phi_J))^2}\left(g(\phi_J)\underset{+}{\frac{\partial \phi_J}{\partial \delta}}(1-G(\phi_A))\right) \\ &= S \cdot m(\phi_J) \cdot \frac{\partial \phi_J}{\partial \delta} > 0\end{aligned}$$

where $m(\phi_J) = \frac{g(\phi_J)}{1-G(\phi_J)}$.

Finally, to evaluate the cross-derivative of the full acquisition share, we will start with $\frac{\partial S}{\partial \delta}$, which can be differentiated with respect to λ as follows:

$$\frac{\partial^2 S}{\partial \delta \partial \lambda} = \frac{\partial S}{\partial \lambda} m(\phi_J) \cdot \frac{\partial \phi_J}{\partial \delta} + S\left(\frac{\partial m(\phi_J)}{\partial \phi}\frac{\partial \phi_J}{\partial \lambda}\frac{\partial \phi_J}{\partial \delta} + m(\phi_J)\frac{\partial^2 \phi_J}{\partial \delta \partial \lambda}\right)$$

Noting that $\frac{\partial \phi_J}{\partial \lambda} = -\frac{1}{\lambda^2}\frac{(1+\delta)\pi_0 - F_G}{\pi_0} = \frac{\partial^2 \phi_J}{\partial \delta \partial \lambda}\phi_J \lambda$ and $\frac{\partial \phi_J}{\partial \delta} = \frac{1}{\lambda}$ we have:

$$\frac{\partial^2 S}{\partial \delta \partial \lambda} = \frac{\partial S}{\partial \lambda} m(\phi_J) \cdot \frac{\partial \phi_J}{\partial \delta} + S\frac{\partial^2 \phi_J}{\partial \delta \partial \lambda} m(\phi_J)\left(\frac{\partial m(\phi_J)}{\partial \phi}\frac{\phi_J}{m(\phi_J)} + 1)\right) \tag{A-2}$$

The sign (A-2), we now need to derive the elasticity of the inverse mills ratio of the distribution of match quality. The elasticity of the inverse mills ratio can be written as:

$$\frac{\phi_J}{m(\phi_J)}\frac{\partial m(\phi_J)}{\phi_J} = \frac{\phi_J}{g(\phi_J)}\frac{\partial g(\phi_J)}{\partial \phi_J} + \phi_J \frac{g(\phi_J)}{1-G(\phi_J)} \tag{A-3}$$

The term $\phi_J \frac{g(\phi_J)}{1-G(\phi_J)}$ is positive, though the elasticity of the pdf of match quality is yet to be signed. So solve for this elasticity, we first start by noting that the pdf of match quality is related to the pdf $f(h)$ of distance from the match, h, as follows:

$$g(\phi) = f(h)\frac{\partial h}{\partial \phi}$$

By assumption, $f(h)$ is uniform, and thus, log-differentiating $g(\phi)$, yields the following ($\frac{\partial h}{\partial \phi} > 0$ will be shown below):

$$\frac{\phi}{g(\phi)}\frac{\partial g(\phi)}{\partial \phi} = \frac{\phi}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2}$$

To solve for $\frac{1}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2}$, note that the link between match quality and distance from the match is written as:

$$\phi = \exp\left(\frac{\beta}{1-\beta}\frac{h(1-h)}{2}\right)$$

Differentiating, solving for $\frac{\partial h}{\partial \phi}$, we get:

$$\frac{\partial h}{\partial \phi} = \frac{1}{\phi \frac{\beta}{1-\beta}\frac{(1-2h)}{2}} > 0$$

To solve for $\frac{\phi}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2}$, we log-differentiate once again with respect to ϕ and $h(\phi)$ to obtain:

$$\frac{1}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2} = -\frac{1}{\phi} + \frac{1}{\frac{1-2h}{2}}\frac{\partial h}{\partial \phi}$$

Substituting $\frac{\partial h}{\partial \phi} = \frac{1}{\phi \frac{\beta}{1-\beta}\frac{(1-2h)}{2}}$ on the RHS, we get:

$$\frac{1}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2} = -\frac{1}{\phi} + \frac{1}{\frac{1-2h}{2}}\frac{1}{\phi \frac{\beta}{1-\beta}\frac{1-2h}{2}}$$

Multiplying both sides by ϕ, and simplifying the second term on the RHS, we get

$$\frac{\phi}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2} = -1 + \frac{1-\beta}{\beta}\frac{4}{(1-2h)^2}$$

Noting that $\frac{\phi}{g(\phi)}\frac{\partial g(\phi)}{\partial \phi} = \frac{\phi}{\frac{\partial h}{\partial \phi}}\frac{\partial^2 h}{\partial \phi^2}$, the elasticity of the pdf of match quality is written as:

$$\frac{\phi}{g(\phi)}\frac{\partial g(\phi)}{\partial \phi} = -1 + \frac{1-\beta}{\beta}\frac{4}{(1-2h)^2}$$

Plugging the elasticity of $g(\phi)$ into the elasticity of the inverse mills ratio in (A-3), we get:

$$\frac{\phi_J}{m(\phi_J)}\frac{\partial m(\phi_J)}{\phi_J} = -1 + \frac{1-\beta}{\beta}\frac{4}{(1-2h(\phi_J))^2} + \phi_J \frac{g(\phi_J)}{1-G(\phi_J)}$$

Plugging into the cross partial of the full acquisition share in (A-2)

$$\frac{\partial^2 S}{\partial \delta \partial \lambda} = \underset{-}{\frac{\partial S}{\partial \lambda}}\underset{+}{m(\phi_J)} \cdot \underset{+}{\frac{\partial \phi_J}{\partial \delta}} + \underset{+}{S}\underset{-}{\frac{\partial^2 \phi_J}{\partial \delta \partial \lambda}}\underset{+}{m(\phi_J)}\left(\frac{1-\beta}{\beta}\underset{+}{\frac{4}{(1-2h(\phi_J))^2}} + \phi_J \underset{+}{\frac{g(\phi_J)}{1-G(r)}}\right) < 0$$