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Contracting Institutions and Firm Boundaries

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CONTRACTING INSTITUTIONS AND FIRM BOUNDARIES*

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Abstract

Contractual frictions are widely known to shape firm boundaries. But do better contracting institutions, which reduce these frictions, induce firms to be more or less deeply integrated? This paper provides a large-scale investigation of this question using a unique micro dataset of ownership shares across half a million firm pairs worldwide. We uncover strong evidence that better contracting institutions in subsidiaries' countries favor deeper integration, particularly in relationship-specific industries. We formally show that these findings can be explained by a generalized Property-Rights Theory of the firm featuring partial ownership, while they are at odds with the canonical Transaction-Cost Theory.

JEL classifications: F21, F23, D02, D23, L14, L23.
Keywords: firm boundaries, contracting institutions, multinational firms, property-rights theory, firm-level analysis.

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1 Introduction

In his seminal contribution, Coase (1937) raised one of the most fundamental questions in economics: What determines firm boundaries? Virtually every firm has to decide whether to cooperate with its business partners at arm's-length or integrate them to some degree into its boundaries. A profound understanding of this integration decision is required more than ever in the age of globalization, characterized by the emergence of multinational corporations that span their boundaries across several countries.[1] All theoretical explanations of firm boundaries provided to date recognize the fundamental importance of contractual imperfections (cf. Gibbons, 2005), which arguably depend on the quality of contracting institutions. Thus, the large international differences in judicial quality prevailing across the globe should play a key role in shaping firm boundaries. Yet, the direction of this effect is a priori not clear. Do better contracting institutions induce firms to be more or less deeply integrated? To answer this question, this paper develops a parsimonious theoretical model of the relationship between contracting institutions and firm boundaries and tests its predictions using a unique micro dataset of ownership shares across half a million firm pairs worldwide.

While existing theories of the firm agree on the importance of contractual imperfections for shaping firm boundaries, they make *opposite* predictions regarding the effect of contracting institutions on the optimal degree of integration. To illustrate this point, consider the two classical theories of the firm: the Transaction-Cost Theory (TCT) by Williamson (1971, 1975, 1985) and the Property-Rights Theory (PRT) by Grossman and Hart (1986) and Hart and Moore (1990).[2] Under both theories, we examine a production relationship between two parties, a firm's headquarters (HQ) and a manufacturing producer. If courts cannot fully enforce contracts between the parties, and if the producer needs to invest into relationship-specific inputs, then these investments are plagued by a hold-up problem. According to the TCT, the HQ can eliminate the resulting inefficiencies by integrating the producer into firm boundaries at the expense of an exogenous governance cost. In this theory, better contracting institutions in the producer's country mitigate the hold-up problem in arm's-length transactions, and therefore make integration less attractive. By contrast, the PRT argues that contractual imperfections cause hold-up inefficiencies even *within* firm boundaries. By integrating the producer, the HQ obtains residual control rights over non-contractible inputs, but undermines the producer's incentives to invest into these inputs. According to the PRT, better contracting institutions in the producer's country reduce the need to incentivize the producer, and therefore make integration more attractive.[3] Hence, the predictions of the two theories regarding the effect of contracting institutions on firm boundaries are diametrically opposed.

Which of the two competing hypotheses finds empirical support? As a first glance at the relationship between the degree of integration and contracting institutions, Figure 1(a) plots the ownership shares of more

[1] UNCTAD (2011, 2013) estimates that multinationals accounted for one quarter of world GDP and participated in 80% of world trade in 2010, with more than one third of world exports traded within multinational firms' boundaries. See Barba Navaretti and Venables (2004) for stylized facts on the growing significance of multinationals over time.

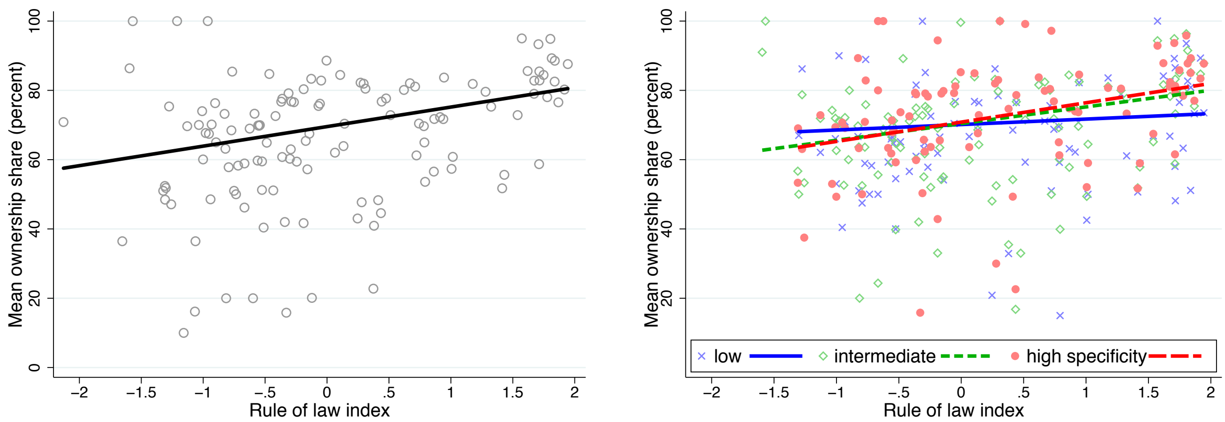
[2] These two theories are among the most acclaimed in organizational economics (see e.g. Whinston, 2003). They have also been instrumental in understanding the boundaries of multinational firms; see Grossman and Helpman (2002, 2003, 2005) for a TCT view, and Antràs (2003) as well as Antràs and Helpman (2004, 2008) for a PRT perspective.

[3] The original work by Grossman and Hart (1986) and Hart and Moore (1990) does not provide a testable prediction regarding the effect of contracting institutions on firm boundaries. Hence, we formally derive this PRT prediction in our paper.

than half a million firm pairs from more than one hundred countries in 2014, recorded in the Orbis database by Bureau van Dijk (BvD), against the rule of law index of the subsidiary's country – a standard measure of the quality of contracting institutions.[4] We observe a positive and significant correlation between ownership shares and judicial quality, suggesting that subsidiaries tend to be more deeply integrated in countries with better contracting institutions. This observation runs counter to the TCT logic, but it is in line with the PRT.

FIGURE 1: *Ownership shares and contracting institutions*

(a) *By subsidiary's country* (b) *By country and relationship-specificity*



Note: The graphs plot mean values of ownership shares (exceeding 10%) of firm pairs against the rule of law index of the subsidiary's country in the cross-section of 2014. In Figure 1(a), the ownership shares are arithmetic means by the subsidiary's country. In Figure 1(b), the ownership shares are arithmetic means by the subsidiary's country and the relationship-specificity category of the subsidiary's industry, whereby 'low' relationship-specificity means that the industry contains zero differentiated or reference-priced products according to the liberal Rauch (1999) classification, for 'intermediate' specificity the share of these products lies between zero and one, and 'high' reflects a share equal to one. The lines are obtained from univariate regressions of the mean ownership shares on the rule of law index, whereby each observation is weighted by the underlying number of firm pairs. In Figure 1(a), the estimated slope parameter is 5.639 with a t-value of 2.65 (based on robust standard errors), the R^2 is 0.026, and the sample is based on N=605,547 firm pairs. In Figure 1(b), for low relationship-specificity the slope is 1.577 (t=0.90, R^2=0.002, N=25,751), for intermediate specificity it is 4.818 (t=2.15, R^2=0.023, N=104,014), and for high specificity it is 5.583 (t=3.10, R^2=0.027, N=101,172).

It is well-known that contractual imperfections *per se* do not necessarily lead to hold-up inefficiencies. It is the combination of contractual incompleteness and relationship-specificity – defined as the extent to which investments have a higher value within a given relationship than outside of it – that causes 'lock-in' and hold-up (see e.g. Joskow, 2005). Hence, one would expect a differential impact of contracting institutions depending on the degree of relationship-specificity of a subsidiary's investments. More precisely, a high degree of relationship-specificity magnifies the respective effect of contracting institutions predicted by either theory of the firm. According to the TCT, the negative impact of contracting institutions on the attractiveness of integration is particularly pronounced in industries with high degrees of relationship-specificity, since the hold-up problem in those industries is relatively more severe (see Antràs, 2015). Conversely, as we formally show in this paper, the PRT predicts a positive interaction effect between the quality of contracting institutions and the degree of relationship-specificity of producers' goods on the optimal ownership share. Figure 1(b) provides a first assessment of this interaction effect. It distinguishes subsidiaries' industries

[4]For the purpose of illustration, we plot mean ownership shares aggregated by country (Figure 1(a)) or by country and relationship-specificity of the subsidiary (Figure 1(b)), instead of the myriad of individual observations at the level of firm pairs. However, the regression lines are weighted by the underlying numbers of firm pairs, so they represent correlations in the raw data. The data are described in detail in Section 3.2.

by their degree of relationship-specificity, measured by the share of differentiated goods according to the Rauch (1999) classification. The figure reveals that the positive correlation between ownership shares and the rule of law index is strongest for subsidiaries operating in industries with a high degree of relationship-specificity; the correlation is slightly weaker for intermediate degrees of relationship-specificity, and it is small and insignificant in non-specific industries. Hence, the patterns observed in the raw data do not match the TCT view but square well with the PRT predictions.

To formalize the above arguments, we set up a theoretical model in the spirit of the PRT. Motivated by our empirical setup, this framework generalizes the conventional PRT of the multinational firm (as in Antràs, 2003) in three respects. First, the key novel feature of our model is that the HQ faces a continuous integration decision and chooses the equilibrium ownership *share* in the producer, rather than deciding only between the two extreme cases of full integration and arm's-length transactions. Second, we allow for partial contractibility, in the sense that courts can verify and enforce a fraction of the producer's investments into inputs, and this fraction may vary across countries with different quality of contracting institutions (as in Acemoglu et al., 2007; Antràs and Helpman, 2008). Third, rather than assuming that the producer's inputs are fully customized to a given relationship, we consider partial relationship-specificity and allow the degree of customization to vary across industries.[5] Given that the producer's investments are not fully contractible, the parties bargain over the distribution of the surplus from the relationship ex-post (i.e., after all inputs have been produced). This setup is characterized by a hold-up problem and ex-ante underinvestment by the producer. As a result, the HQ's ownership decision involves a simple trade-off between her *share* of the surplus generated by the relationship and the *size* of this surplus.[6] Intuitively, an increase in the ownership share shifts residual control rights between the two parties: It increases the HQ's outside option but reduces that of the producer. This improves the HQ's bargaining position and allows her to reap a larger share of the surplus in ex-post negotiations. Yet, the producer anticipates the stronger hold-up associated with a higher ownership share of the HQ, so his underinvestment becomes more severe, and the surplus size decreases.

Our generalized PRT model delivers the following two key predictions, which rationalize the patterns observed in Figure 1. First, it predicts a positive relationship between the optimal ownership share and the quality of contracting institutions in the producer's country. Intuitively, if courts can verify and enforce contracts on a larger share of inputs, the need for incentivizing the producer's investments decreases. Consequently, the HQ integrates the producer more deeply in order to obtain a larger fraction of the surplus. Second, the positive effect of contracting institutions on the optimal ownership share is predicted to be more pronounced in industries with a higher relationship-specificity. To develop the intuition behind this result, it is important to understand first that a high relationship-specificity mitigates the negative effect of a higher ownership share on the producer's investment incentives. In industries with a high degree of relationship-specificity, where inputs have little value on the outside market, the producer's potential outside option is small and of little importance for his ex-post payoff and ex-ante underinvestment. Hence, an increase in the

[5]Note that a PRT with partial contractibility and relationship-specificity has been considered before by Antràs (2015); our novel framework combines these features with the explicit modeling of non-zero outside options for both parties and continuous ownership shares, which are required to explain the above-mentioned empirical patterns.

[6]For clarity, we refer to the HQ as 'she' and the producer as 'he' throughout the paper.

ownership share, reducing the producer's outside option, has only a weak negative effect on his investment incentives. Conversely, in industries with a low degree of relationship-specificity, the producer's potential outside option is large, and any increase in the ownership share strongly aggravates the underinvestment problem. Hence, an improvement in contracting institutions allows the HQ to disproportionately increase the optimal ownership share in industries with a high degree of relationship-specificity, where increased ownership disincentivizes the producer's investments less. To summarize, our PRT model predicts a positive direct effect of the quality of contracting institutions and a positive interaction effect of contracting institutions and relationship-specificity on the optimal ownership share.

We test the model's predictions using unique data on global ownership links from Orbis. This database provides an extensive account of multinational firms' ownership structures at an exceptional level of detail. It reports the ownership shares of roughly 300,000 headquarters in more than half a million subsidiaries worldwide. The dataset is uniquely suited for the purpose of our study because it combines three key advantages: First, it includes *firm-pair* specific ownership data along with information on the countries, industry affiliations, and other characteristics of *both* firms. Second, it covers headquarters and subsidiaries in more than one hundred countries around the globe. And third, it includes both domestic and international ownership links as well as multiple ownership links for some firms. These features allow us to provide a large-scale investigation of the relationship between firm boundaries and contracting institutions, while thoroughly controlling for heterogeneity across countries, industries, and firms on both sides of the ownership link.[7] We enrich the database with various country-level proxies for contracting institutions and industry-level measures of relationship-specificity to test the theoretical predictions.

Our empirical analysis proceeds in two steps. In the first step, we scrutinize the correlation between the quality of contracting institutions and firm boundaries illustrated in Figure 1(a). To this end, we regress firm-pair specific ownership shares on the rule of law index, while controlling for a large set of observable characteristics (of the subsidiary's country, the ownership structure, and bilateral investment costs) and a battery of fixed effects (for the subsidiary's industry as well as the HQ's country-industry). Conditional on all of these covariates, we find that firms own significantly higher shares of their subsidiaries in countries with better judicial quality. This finding supports our first theoretical prediction.

In the second step, we move towards a more stringent test of the theory by regressing ownership shares on an interaction term between the quality of contracting institutions in the subsidiary's country and the relationship-specificity of its industry (scrutinizing the pattern from Figure 1(b)). This approach allows us to effectively account for all observable or unobservable characteristics of the subsidiary's country using fixed effects, thereby addressing first-order concerns related to omitted variables (such as cultural traits or other institutions). In our preferred specification, we further control for bilateral investment costs by country-pair fixed effects. The estimates yield a positive interaction effect of country-level judicial quality and industry-level relationship-specificity on the depth of integration, which is both statistically and economically significant. This finding supports the second key prediction of our model: The positive effect of contracting

[7] The only alternative dataset covering multinational firms in many countries is by Dun & Bradstreet. To the best of our knowledge, this database documents neither ownership intensities nor multiple ownership links per firm.

institutions on the ownership share is more pronounced in industries with a higher relationship-specificity.

Our main findings are robust to addressing several challenges to identification. We find very similar results using various alternative proxies for contracting institutions and approximating relationship-specificity by a firm-pair specific measure based on the duration of a relationship. In an important set of robustness checks, we accommodate remaining concerns regarding omitted variables. To this end, we allow for the effects of economic development and other institutions on firm boundaries to differ arbitrarily across industries by including interaction terms of these country characteristics with subsidiary industry dummies (following Levchenko, 2007). We further ensure that our results are not driven by firm heterogeneity among subsidiaries or headquarters. Moreover, the effect of contracting institutions can even be identified from within-firm variation across different ownership links of the same HQ. To address the possibility that selection into production countries may be driven by factors correlated with contracting institutions, we estimate a two-stage model and correct for this type of selection following Heckman (1979). Allowing for non-linearities in ownership decisions in an ordered logistic regression framework provides additional support for our theoretical predictions. Finally, we exploit the historic origins of countries' legal systems as an exogenous source of variation in contracting institutions using instrumental variables and propensity score matching techniques (as in Nunn, 2007). The robustness of our findings to all of these checks lends strong support to the PRT.

Our paper is closely related to the work by Antràs (2015), who investigates the role of contracting institutions for firms' integration decisions both theoretically and empirically. Similar to our analysis, he contrasts the effects of contracting institutions governing the producer's investments on the relative attractiveness of vertical integration in the TCT and the PRT. Yet, our theoretical contributions differ in two respects. First, we model the integration decision as a continuous (rather than a binary) variable.[8] Second, and most importantly, we derive a clear testable prediction of the PRT regarding the *interaction* effect of contracting institutions and relationship-specificity on firm boundaries. Our empirical approach is also substantially different. While Antràs (2015) approximates the relative attractiveness of foreign integration vs. outsourcing using industry-level data on U.S. intra-firm imports, we test our predictions using a global dataset of ownership shares at the level of firm pairs.[9] Although the author considers the interaction between a country's contracting institutions and an industry's relationship-specificity in their impact on U.S. intra-firm trade, the evidence remains inconclusive. By contrast, our micro data yield strong evidence for the positive interaction

[8] In so doing, we relate to Antràs and Helpman (2008), who show that the HQ's optimal share of ex-post surplus increases in the contractibility of a supplier's inputs according to the PRT. However, the authors treat this share as a hypothetical construct, which cannot be freely chosen by the HQ. We complement their findings by allowing the HQ to choose from a continuum of ownership shares and show how the integration decision depends on contracting institutions and relationship-specificity. Previous theoretical contributions have studied partially integrated production processes across *multiple* producers, either organized sequentially along the value chain (Antràs and Chor, 2013; Alfaro et al., 2015) or simultaneously contributing to a single production stage (Schwarz and Suedekum, 2014). However, none of these papers considers partial integration of a *single* firm.

[9] The U.S. intra-firm trade data has become a workhorse tool in empirical studies of international integration decisions (see Yeaple, 2006; Nunn and Trefler, 2008, 2013; Antràs and Chor, 2013). Corcos et al. (2013) have taken this approach to the firm level using French customs data. In line with the PRT, they find a positive correlation between contract enforcement in the foreign country and the share of intra-firm imports. Other studies on intra-firm trade using firm-level data from a single country include Carluccio and Fally (2012), Defever and Toubal (2013), Kohler and Smolka (2014, 2015), and Tomiura (2007), all of which find patterns consistent with the PRT.

effect of contracting institutions and relationship-specificity on the depth of integration.

To the best of our knowledge, Acemoglu et al. (2009) is the only existing firm-level study of the link between contracting institutions and vertical integration in a large cross-section of countries. The authors combine data on primary and secondary activities within a given firm with U.S. industry-level input-output (I-O) tables to construct a vertical integration index, designed to approximate the firm's propensity to own a vertically integrated supplier.[10] The authors do not find a significant relationship between this index and a country's contracting costs, but they document a higher degree of vertical integration in countries that have both higher contracting costs and greater financial development. A key advantage of our data is that we observe ownership intensities across firm *pairs*, which allows us to identify the effect of subsidiary country institutions while controlling for the potentially confounding role of HQ country institutions using fixed effects. In contrast to Acemoglu et al. (2009), our approach uncovers a robust positive link between the quality of contracting institutions in a subsidiary's country and the integration intensity.

Our theoretical and empirical results further contribute to the literature that aims to discriminate between the two prominent theories of the firm: TCT vs. PRT. The fact that the predictions of the TCT differ in important ways from those of the PRT is generally known among economists (see Whinston, 2001, 2003; Gibbons, 2005). A substantial body of empirical research has assessed various predictions of the two theories using data from a single firm, industry, or country.[11] Yet, we are unaware of any empirical investigation attempting to contrast these differential predictions using micro data from multiple countries. We suggest a twofold explanation for the scarcity of empirical evidence on this fundamental question. First, theories of the firm have mostly concentrated on the two 'extreme' cases of full integration and arm's-length contracting. Thus, the fact that commercial transactions between independent firms are rarely observed in the data poses a major challenge for testing these theories. We make progress in this discourse by deriving predictions regarding the *intensity* of integration and test them using data on firm ownership *shares*. Second, theoretical predictions are often formulated in terms of abstract concepts (e.g. marginal returns on investments or quasi-rents; see Whinston, 2003), which are extremely difficult to capture empirically. The key explanatory variables in our analysis are contracting institutions and relationship-specificity, for which we can obtain well-established proxies from readily available data.

The remainder of the paper is organized as follows. Section 2 sets up a PRT model of the firm and derives our key predictions regarding optimal ownership shares. Section 3 describes our empirical approach and the data. Section 4 presents our estimation results and a multitude of robustness checks. Section 5 concludes.

[10]This approach has subsequently been used by Alfaro and Charlton (2009) and Alfaro et al. (2015) to characterize the organization of multinational production activities. Recent evidence on US firms with multiple domestic plants (Atalay et al., 2014) or with multinational affiliates (Ramondo et al., 2016) suggests that integrated firm pairs do not necessarily engage in intra-firm trade even if they are vertically linked via I-O tables. Note that we do not rely on I-O tables to identify vertical links in this paper. Also, our theoretical explanation of the integration decision is not restricted to vertical links, nor does it presuppose any intra-firm trade, as producers in the model may sell their output to final consumers.

[11]For instance, Masten (1984) studies procurement decisions of a large aerospace company, Baker and Hubbard (2003, 2004) examine ownership shares in the U.S. truck industry, Feenstra and Hanson (2005) consider the ownership structure of processing trade in China, and Acemoglu et al. (2010) investigate technological determinants of vertical integration in the UK. See also Whinston (2003) and Klein (2015) for reviews of other empirical studies.

2 Theoretical Model

2.1 Set-up

Consider a simple game between a firm's headquarters (H) and a (manufacturing) producer (M). Since the latter may eventually be owned to some degree by the former, we frequently refer to M as the subsidiary. The two parties can be located in the same or in different countries. Each firm is run by one owner-manager. The HQ possesses the idea (a blueprint) for the production of a differentiated final good, and the producer has the capacity to implement this idea. Without loss of generality, we normalize both parties' ex-ante outside options to zero.[12] Assuming constant elasticity of substitution (CES) preferences over varieties of a differentiated final good implies the following iso-elastic demand for a single variety:

$$x = Dp^{-1/(1-\alpha)}, \quad 0 < \alpha < 1,$$

whereby x and p denote quantity and price, respectively, $D > 0$ is a demand shifter, and α is a parameter related to the elasticity of substitution between any two varieties, $\sigma = 1/(1-\alpha)$. This demand function yields the following revenue:

$$R = x^{\alpha} D^{1-\alpha}. \tag{1}$$

Final goods are produced by M with a continuum of (*m*anufacturing) inputs $m(i)$, indexed by points on the unit interval, $i \in [0, 1]$. One unit of $m(i)$ is produced with one unit of labor. Without loss of generality, we normalize the unit production costs of $m(i)$ to one. M combines these inputs into final goods according to the Cobb-Douglas production function:

$$x = \exp\left[\int_0^1 \ln m(i) \mathrm{d}i\right]. \tag{2}$$

Throughout the analysis, we assume that M is indispensable for the production of x, in the sense that H cannot manufacture final goods without M.[13]

Firms operate in an environment of contractual incompleteness, i.e., courts cannot fully verify and enforce all of the subsidiary's investments into intermediate inputs. To formalize this idea, we adopt the notion of partial contractibility from Acemoglu et al. (2007) and Antràs and Helpman (2008). More specifically, we assume that investments into inputs in the range $[0, \mu]$, with $0 \leq \mu \leq 1$, can be stipulated in an enforceable ex-ante contract, while investments into the remaining inputs cannot be verified by the courts and are therefore non-contractible. Following these authors, we interpret μ as the quality of contracting institutions in M's country. The idea behind this notion of contracting institutions is that a more efficient judicial system can enforce contracts over a wider range of product characteristics (see also Chapter 4 in Antràs, 2015). Clearly, there might also be technological factors that affect the degree of contractibility μ. Our model-

[12] Throughout the paper, we use 'ex-ante' to describe the point in time before the relationship-specific investments are sunk and 'ex-post' to describe the period thereafter. As will become clear below, both parties may have non-zero outside options ex-post.

[13] This assumption can be justified by the fact that H lacks either the production capacity or the expertise required to assemble the final goods (or both). This is the reason why the two parties need to form a relationship in the first place.

ing of μ as a country-specific variable reflects the notion that, for any given production technology, better contracting institutions are ceteris paribus more efficient at enforcing contracts. To consider an illustrative example, only well-functioning courts are able to verify whether high-tech inputs, such as computer chips, are produced according to the required standard. Hence, production of computer chips is contractible in countries with high judicial quality, but non-contractible in countries with bad contracting institutions.

We assume that M's inputs are customized to H's blueprint, and hence are (partially) relationship-specific. More precisely, by selling an input on the outside market, one can recoup only a fraction $(1-\rho)$ of the production costs, whereby $\rho \in [0,1]$ measures the degree of relationship-specificity. For $\rho = 0$, M's inputs have the same value for an outside party as within the current relationship, whereas $\rho = 1$ represents the case of fully relationship-specific inputs.[14] In what follows, we treat ρ as an industry-specific variable, i.e., subsidiaries in industries with a high ρ produce highly relationship-specific inputs (see also Antràs, 2015).

Since some of M's inputs are non-contractible ex-ante, H and M bargain over the surplus ex-post, i.e., after investments have been made. In anticipation of ex-post bargaining, H chooses ex-ante the optimal ownership share $s \in [0,1]$ in M. What are H's costs and benefits of choosing a higher s? The answer to this question crucially depends on the underlying theory of the firm. According to the Transaction-Cost Theory (TCT), a higher ownership share translates into a higher ability of H to 'dictate' to M the amount of non-contractible inputs, but it involves additional governance costs. The Property-Rights Theory (PRT) challenges this view by arguing that, regardless of the ownership share, H cannot enforce non-contractible inputs by fiat, and that the hold-up problem prevails even within firm boundaries. Instead, the PRT sees the role of ownership in shaping H's residual control rights, i.e., the authority to determine the use of M's inputs under circumstances that are not specified in a contract. As discussed in more detail below, the two theories provide diametrically opposed predictions regarding the effect of contracting institutions on the equilibrium ownership structure of the firm. We develop our main theoretical argument based on the PRT and provide a short discussion of the alternative predictions of the TCT in Section 2.4.3.

Following the PRT approach, we assume that ex-post negotiations take the form of generalized Nash bargaining. More precisely, each party obtains his or her outside option (i.e., the payoff in the absence of trade) plus a fraction of the ex-post gains from trade (the so-called quasi-rent), defined as revenue minus both parties' outside options. Let $\beta \in (0,1)$ denote the share of the quasi-rent accruing to H (henceforth, H's bargaining power), while the remaining share $(1-\beta)$ goes to M. If the bargaining breaks down, intermediate inputs can be sold on the outside market. Each party's outside option depends on the fraction of inputs he or she possesses. The HQ has enforceable ownership rights over contractible inputs $m(i)$, $i \in [0,\mu]$. The extent to which each party has residual control rights over non-contractible inputs depends on H's ownership share in M. More specifically, H controls the fraction s of non-contractible inputs, while M controls the remaining share $(1-s)$ of $m(i)$, $i \in [\mu,1]$. This 'zero-sum' notion of outside options builds on the idea of residual control rights by Grossman and Hart (1986), who argue that, "if one party gets rights

[14]Our modeling of relationship-specificity presupposes the existence of a perfectly competitive outside market. The assumption that M's inputs have a lower value for a tertiary party (as compared to the current relationship) reflects the idea that an outside buyer would have to incur additional costs to customize these inputs to her production process. This reduced-form approach can be rationalized by a richer model of the outside market along the lines of Grossman and Helpman (2001, 2002).

of control, then this diminishes the rights of the other party to have control" (p. 693).[15]

The timing of events is as follows. In t_1, H chooses the ownership share s in M.[16] In t_2, H stipulates the amount of contractible inputs to be produced by M and commits to compensating him for the associated production costs. In t_3, M invests into non-contractible inputs and provides the amount of contractible inputs stipulated in the ex-ante contract. In t_4, the parties bargain over the surplus from the relationship. In t_5, final goods are produced and sold, and the revenue is distributed among the parties according to the agreements reached in t_2 and t_4. In the following section, we solve this game by backward induction.

2.2 Equilibrium

Before characterizing the subgame perfect equilibrium of the game outlined above, it is instructive to consider first the *hypothetical* case of complete contracts. If courts could perfectly verify and enforce investments into all intermediate inputs, the parties would stipulate the amount of $m(i), i \in [0,1]$, which maximizes the joint surplus:

$$\max_{\{m(i)\}_{i=0}^{1}} \pi = R - \int_0^1 m(i)\mathrm{d}i.$$

Solving this maximization problem using equations (1) and (2) yields the first-best (FB) amount of inputs:

$$m(i) = \alpha R \equiv m^{FB} \quad \forall i \in [0,1], \tag{3}$$

whereby $R = D\alpha^{\frac{\alpha}{1-\alpha}}$ is obtained from plugging equations (2) and (3) into equation (1) and solving the resulting expression for R.

Consider now the relevant case of contractual incompleteness, introduced in Section 2.1. In t_4, each party obtains his or her outside option plus a fraction of the quasi-rent (Q), defined as follows:

$$Q = R - (1-\rho)(1-s)\int_\mu^1 m(i)\mathrm{d}i - \left[(1-\rho)s\int_\mu^1 m(i)\mathrm{d}i + (1-\rho)\int_0^\mu m(i)\mathrm{d}i\right], \tag{4}$$

whereby R is given by equation (1). The second term on the right-hand side represents M's outside option, which is equal to the outside value $(1-\rho)$ of the fraction $(1-s)$ of non-contractible inputs $m(i), i \in [\mu, 1]$. The term in the square brackets denotes H's outside option and consists of the outside value of the fraction s of non-contractible inputs, as well as the outside value of contractible inputs $m(i), i \in [0, \mu]$.

In t_3, M anticipates the outcome of Nash bargaining from period t_4 and chooses the amount of non-contractible inputs which maximizes her payoff from the ex-post negotiations net of production costs of these inputs:[17]

$$\max_{\{m(i)\}_{i=\mu}^{1}} \pi_M = (1-\rho)(1-s)\int_\mu^1 m(i)\mathrm{d}i + (1-\beta)Q - \int_\mu^1 m(i)\mathrm{d}i. \tag{5}$$

[15] The reader familiar with Antràs and Helpman (2004, 2008) will notice two differences in our modeling of outside options compared to their approach. First, while M's outside option in Antràs and Helpman (2004, 2008) is set to zero regardless of the ownership structure, it is equal to zero in our framework only under full integration (i.e., $s = 1$). Second, if the bargaining breaks down, H in the current framework cannot produce final goods on her own (cf. also footnote 13).

[16] Following Grossman and Hart (1986) and Hart and Moore (1990), we do *not* assume a direct cost of acquisition of (a larger share of) M. Our results remain qualitatively unchanged if we introduce a fixed cost of integration into the model.

[17] Note that contractible inputs do not enter M's maximization problem, since they are chosen by H in t_2, and M is fully compensated for the associated production costs.

Using equations (1), (2), and (4), the solution to this maximization problem yields the optimal amount of non-contractible (n) inputs:

$$m(i) = \delta\alpha R \equiv m_n \qquad \forall i \in [\mu, 1], \tag{6}$$

as a function of revenue, obtained from plugging equations (2) and (6) into equation (1):

$$R = \left(\left[\exp \int_0^{\mu} \ln m(i) \mathrm{d}i \right]^{\alpha} (\delta\alpha)^{\alpha(1-\mu)} D^{1-\alpha} \right)^{\frac{1}{1-\alpha(1-\mu)}}, \tag{7}$$

whereby

$$\delta \equiv \frac{1-\beta}{1-\beta+s(1-\rho)+\rho\beta}. \tag{8}$$

Since $0 < \delta \leq 1$ for all $\beta \in (0,1)$ and $\rho, s \in [0,1]$, it can be seen immediately from the comparison of equations (3) and (6) that $m_n \leq m^{FB}$ for any given level of R. Intuitively, M anticipates ex-post hold-up with respect to non-contractible inputs and underinvests into these inputs compared to the first-best level.

The magnitude of M's underinvestments into non-contractible inputs (the size of m_n) depends crucially on the ownership share and the degree of relationship-specificity. Since these dependencies are key to understanding the main predictions derived in the next section, we formulate:

Lemma 1. *For any given level of revenue, the subsidiary's investments into non-contractible inputs (i) decrease in the ownership share, and (ii) this negative effect is mitigated by a higher relationship-specificity.*

Proof. For part *(i)*, note that $\frac{\partial m_n}{\partial s}\big|_R < 0$ is implied by $\frac{\partial \delta}{\partial s} < 0$ from equation (8). For part *(ii)*, the cross partial-derivative of m_n with respect to s and ρ is $\frac{\partial^2 m_n}{\partial s \partial \rho}\big|_R = \frac{1-(1-\rho)(s-\beta)}{[1+(1-\rho)(s-\beta)]^3}\alpha(1-\beta)R$. Since $(s-\beta) \in (-1,1)$ for all $s \in [0,1]$ and $\beta \in (0,1)$, we immediately have $\frac{\partial^2 m_n}{\partial s \partial \rho}\big|_R > 0$ for all $\alpha \in (0,1)$, $\rho \in [0,1]$, and $R > 0$.

The intuition behind the first part of Lemma 1 derives from the fact that an increase in s ceteris paribus decreases M's outside option, and thereby worsens his ex-post bargaining position. If M expects to receive a smaller payoff ex-post, his ex-ante incentives to invest into m_n decrease. To understand the second part of Lemma 1, consider two different industries, one with a very high relationship-specificity (ρ approaching one) and one with a low relationship-specificity (ρ close to zero). In the highly relationship-specific industry, M's investments have only a small value on the outside market. Hence, a change in the ownership share s has little effect on M's outside option and on his payoff (see equation (5)). In other words, if the relationship-specificity is high, H can increase the ownership share without reducing M's investment incentives too much at the margin. By contrast, in an industry with a low degree of relationship-specificity, there is potentially much to gain for M on the outside market. Thus, any change in the ownership share affecting this relatively large outside option has a substantial impact on M's payoff. As a result, an increase in the ownership share strongly aggravates the underinvestment problem if the relationship-specificity is low. Generalizing this argument for all values of ρ, we conclude that a higher relationship-specificity mitigates the negative effect of an increased ownership share on the subsidiary's investment incentives.

Consider now H's optimization problem. In t_2, the HQ stipulates the amount of contractible inputs that maximizes her payoff from Nash bargaining net of the compensation for these inputs:

$$\max_{\{m(i)\}_{i=0}^{\mu}} \pi_H = (1-\rho)s(1-\mu)m_n + (1-\rho)\int_0^{\mu} m(i)\mathrm{d}i + \beta Q - \int_0^{\mu} m(i)\mathrm{d}i, \tag{9}$$

subject to M's participation constraint (PC), obtained from plugging equation (6) into equation (5):

$$\pi_M = (1-\beta)Q - (1-\mu)\left[1-(1-\rho)(1-s)\right]m_n \geq 0, \tag{10}$$

whereby Q and m_n are given by equations (4) and (6), respectively.[18] In our baseline analysis, we assume that M's PC is fulfilled and non-binding (i.e., $\pi_M > 0$), and solve the unconstrained maximization problem from equation (9). There are two reasons for this approach. First, it allows us to illustrate the HQ's key trade-off in the simplest possible manner. Second, we show in Appendix A.1 that M's PC is slack for the vast majority of relevant parameter values. Intuitively, the need to incentivize M typically implies a more stringent upper bound on the optimal ownership share than the PC would. Nevertheless, we verify in Section 2.4.1 that our key predictions are qualitatively unchanged if the PC is binding and H solves the optimization problem from equation (9) with equation (10) as an equality constraint.

Using equations (4), (6), (7), and (8) in equation (9), and solving H's maximization problem for the optimal number of contractible (c) inputs, we obtain:

$$m(i) = \omega\alpha R \equiv m_c \qquad \forall i \in [0,\mu], \tag{11}$$

as a function of revenue, obtained from inserting equation (11) into equation (7):

$$R = \delta^{\frac{\alpha(1-\mu)}{1-\alpha}} \omega^{\frac{\alpha\mu}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} D, \tag{12}$$

whereby

$$\omega \equiv \frac{s\alpha(1-\rho)(1-\mu) - \beta^2(1-\rho)\left[1-\alpha(1-\mu)\right] + \beta\left[1+s(1-\rho)-\alpha(1+s)(1-\mu)(1-\rho)\right]}{\left[1-\alpha(1-\mu)\right]\left[\rho+\beta(1-\rho)\right]\left[1-\beta+s(1-\rho)+\rho\beta\right]}. \tag{13}$$

In t_1, H chooses the optimal ownership share by solving the following maximization problem:

$$\max_s \pi_H = (1-\rho)s(1-\mu)\delta\alpha R - \rho\mu\omega\alpha R + \beta[R-(1-\rho)(1-\mu)\delta\alpha R - (1-\rho)\mu\omega\alpha R], \tag{14}$$

keeping in mind M's PC from equation (10). Plugging equations (8), (12), and (13) into equation (14), we obtain from the first-order condition the optimal ownership share:

$$s^*(\mu,\rho) = \frac{1+\beta^2(1-\rho) - 2\beta - \alpha(1-\beta)(1-\mu)[1-\beta(1-\rho)]}{(1-\rho)[\beta+\alpha(1-\beta)(1-\mu)]}. \tag{15}$$

Plugging this ownership share as well as equations (8), (12), and (13) into equation (14), it can be shown that H's maximum profits from the relationship are positive for all admissible parameter values.

[18] The HQ also accounts for M's incentive compatibility constraint (ICC), which ensures that M utilizes non-contractible inputs $(1-s)(1-\mu)m_n$ within the current relationship rather than selling them on the outside market. Formally, the ICC is fulfilled whenever M's payoff from Nash bargaining is not smaller than his ex-post outside option, i.e., $(1-\rho)(1-s)(1-\mu)m_n + (1-\beta)Q \geq (1-\rho)(1-s)(1-\mu)m_n$. Notice that $Q \geq 0$ is a sufficient condition for M's ICC to hold. Since this condition is implied by M's PC from equation (10), the ICC may be ignored whenever the PC is fulfilled.

2.3 Comparative statics and testable predictions

In this section, we use comparative statics analysis to derive testable predictions regarding the effect of contracting institutions on the optimal ownership share. The relationship between s^* and μ is summarized in

Proposition 1. *The optimal ownership share increases in the quality of contracting institutions.*
Proof. $\frac{\partial s^*}{\partial \mu} = \frac{\alpha(1-\beta)^2}{(1-\rho)[\beta+\alpha(1-\beta)(1-\mu)]^2} > 0 \ \forall \ \alpha, \beta \in (0,1), \mu \in [0,1], \rho \in [0,1)$.

To understand the intuition behind this result, consider the trade-off faced by H when choosing s^*. On the one hand, a higher ownership share increases the HQ's outside option, and thereby raises H's profits specified in equation (9). On the other hand, a higher s^* reduces M's payoff (see equation (5)) and aggravates the ex-post hold-up from the viewpoint of M. This worsens M's ex-ante underinvestment in non-contractible inputs (see the first part of Lemma 1), and reduces the revenue from equation (7). Simply put, by choosing a higher ownership share in the subsidiary, the HQ trades off a larger *fraction* of surplus against a larger surplus *size*. When contracting institutions improve, the range of non-contractible inputs shrinks. This reduces the need for incentivizing M by giving him residual control rights. Hence, H optimally retains a larger share of the surplus for herself by choosing a higher ownership share s^*.

Figure 2(a) illustrates the positive relationship between s^* and μ derived in Proposition 1.[19] In an environment of poor contracting institutions, where μ is below some threshold $\underline{\mu}$, the HQ optimally chooses an ownership share of zero in order to provide maximal incentives for M. For $\mu \in (\underline{\mu}, \overline{\mu})$, the optimal ownership share increases monotonically in μ, reflecting the fact that better contracting institutions can enforce contracts on a wider range of inputs, and thereby substitute for the need to incentivize M's investment. For very high institutional quality, above the threshold $\overline{\mu}$, the HQ maximizes her share of the surplus by choosing full ownership. It should be noted that, for some parameter combinations, $\underline{\mu}$ may lie below zero and $\overline{\mu}$ may exceed one. If $\underline{\mu} < 0$ and $\overline{\mu} > 1$, the optimal ownership share s^* lies strictly within the unit interval and it is strictly increasing in the quality of contracting institutions for all values of μ.

Consider next the interaction effect between μ and ρ in their impact on s^*, which is summarized in

Proposition 2. *The positive effect of contracting institutions on the optimal ownership share is stronger in industries with a higher degree of relationship-specificity.*
Proof. $\frac{\partial^2 s^*}{\partial \mu \partial \rho} = \frac{\alpha(1-\beta)^2}{(1-\rho)^2[\beta+\alpha(1-\beta)(1-\mu)]^2} > 0 \ \forall \ \alpha, \beta \in (0,1), \mu \in [0,1], \rho \in [0,1)$.

The intuition behind this key result builds on the insights from Proposition 1 and Lemma 1: According to Proposition 1, the optimal ownership share is monotonically increasing in the quality of contracting institutions. Also, Lemma 1 shows that the negative effect of a higher ownership share on M's investments into non-contractible inputs is mitigated in highly relationship-specific industries. Hence, if contracting institutions improve, H increases the optimal ownership share more strongly in industries with a higher degree of relationship-specificity, where the adverse effect of a higher s^* on M's investments is less severe.

[19] As depicted in the figure, the second-order derivative of s^* with respect to μ is positive: $\frac{\partial^2 s^*}{\partial \mu^2} = \frac{2\alpha^2(1-\beta)^3}{(1-\rho)[\beta+\alpha(1-\beta)(1-\mu)]^3} > 0$. The threshold values $\underline{\mu} = \frac{\beta[2-\alpha(2-\rho)]-\beta^2(1-\alpha)(1-\rho)+\alpha-1}{\alpha(1-\beta)[1-\beta(1-\rho)]}$ and $\overline{\mu} = \frac{\beta[3(1-\alpha)-\rho(1-2\alpha)]-\beta^2(1-\alpha)(1-\rho)+\alpha(2-\rho)-1}{\alpha(1-\beta)[2-\rho-\beta(1-\rho)]}$ can easily be derived from $s^*(\underline{\mu}) = 0$ and $s^*(\overline{\mu}) = 1$, respectively.

FIGURE 2: *Optimal ownership share s^**

(a) *Direct effect of μ* (b) *Interaction between μ and ρ*

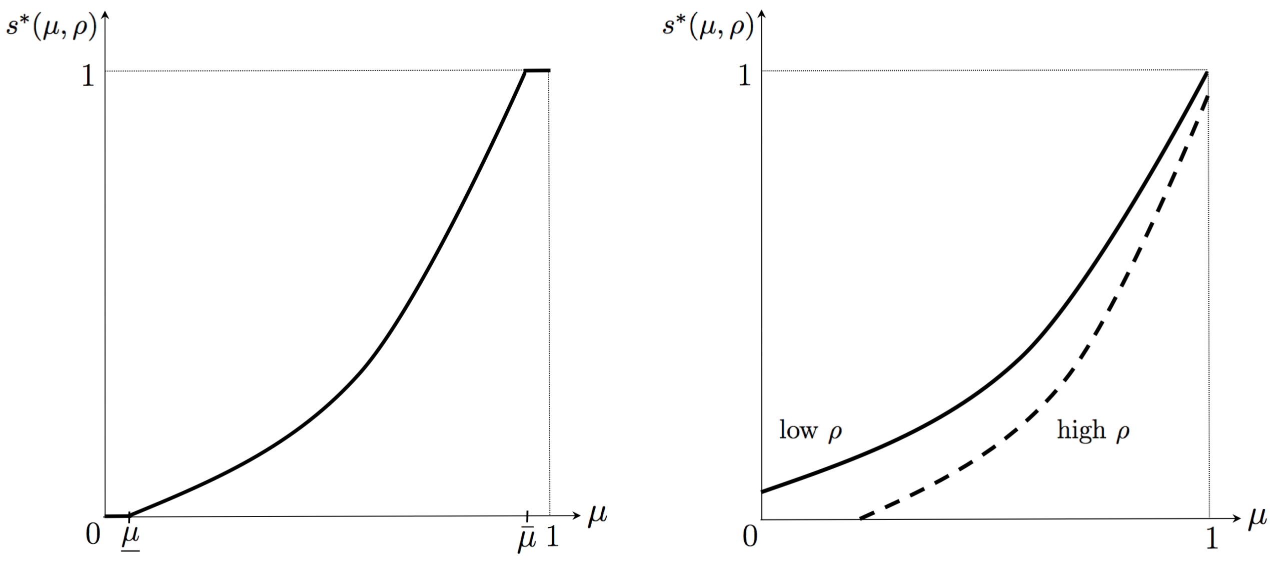


Figure 2(b) illustrates the interaction effect between contracting institutions μ and relationship-specificity ρ. It plots the optimal ownership share s^* as a function of μ for a low value of ρ (solid line) and for a high value of ρ (dashed line). Reflecting Proposition 2, the line is steeper for the highly relationship-specific industry at all levels of μ. The more specific M's investments, the less does an increase in the optimal ownership share disincentivize these investments. Hence, H can exploit an improvement in institutional quality by increasing her ownership share more strongly in the highly relationship-specific industry.

Note that, while the effect of ρ on the *slope* of $s^*(\mu)$ is clear-cut, its effect on the *level* of s^* is a priori ambiguous. In the case depicted in Figure 2(b), the dashed line lies strictly below the continuous line. However, for alternative parameter combinations, it may lie strictly above this line or intersect it once in the unit interval.[20] This ambiguity is explained by the interplay of two opposing effects: On the one hand, an increase in relationship-specificity ρ decreases M's outside option and reduces his ex-ante investments. On the other hand, a rise in ρ increases the surplus that M can obtain within the relationship (the quasi-rent from equation (4)), which improves his investment incentives. The relative magnitude of these opposing effects depends on M's bargaining power $(1-\beta)$.[21] In particular, if M's bargaining power is relatively low (the case depicted in the figure), he puts a high weight on his outside option compared to the quasi-rent. As a result, the net effect of an increase in relationship-specificity is that it provides disincentives, which must be compensated by a lower ownership share. In the alternative case, if M has a relatively high bargaining power, the positive effect of an increase in relationship-specificity on the quasi-rent dominates, which incentivizes M's ex-ante investments and allows H to retain a higher ownership share. Importantly, the positive interaction effect of μ and ρ on s^* predicted by Proposition 2 holds regardless of which case prevails.

[20] Evaluating $\frac{\partial s^*}{\partial \rho}$ at the lower ($\underline{\mu}$) and upper ($\overline{\mu}$) threshold values of μ reported in footnote 19 yields $\frac{\partial s^*}{\partial \rho}|_{\mu=\underline{\mu}} = -\frac{\beta}{1-\rho} < 0$ and $\frac{\partial s^*}{\partial \rho}|_{\mu=\overline{\mu}} = \frac{1-\beta}{1-\rho} > 0$. Bearing in mind Proposition 1, there is a unique threshold $\hat{\mu}$ such that the dashed line is underneath the solid line for $\mu < \hat{\mu}$, and it lies above the solid line for $\mu \geq \hat{\mu}$. Solving $\frac{\partial s^*}{\partial \rho} = 0$ for μ yields the cutoff $\hat{\mu} = \frac{\alpha(1-\beta)+2\beta-1}{\alpha(1-\beta)}$. Since $\hat{\mu}$ is not restricted to the unit interval, the dashed line may cross the solid line at $\mu < 0$, $\mu > 1$, or $\mu \in [0, 1]$.

[21] Formally, m_n from equation (6) increases in ρ if and only if $\beta < s$, and it decreases in ρ if this inequality if reversed.

2.4 Extensions and discussion

Before turning to an empirical test of Propositions 1 and 2, it is worth pausing to discuss their generality. In Section 2.4.1, we show that our main predictions continue to hold if M's participation constraint is binding, whereas considering ex-ante transfers would yield uninteresting results. In Section 2.4.2, we provide a generalization of the benchmark framework that incorporates joint production and allows us to relate our results to the seminal contributions by Antràs (2003) and Antràs and Helpman (2004). Finally, Section 2.4.3 provides a brief discussion of the predictions by the Transaction-Cost Theory regarding the effect of contracting institutions on firm boundaries, which are diametrically opposed to those of the PRT.

2.4.1 Participation constraint and ex-ante transfers

Recall that our baseline results were derived under the assumption that M's PC from equation (10) is not binding for any optimal ownership share given by equation (15). In Appendix A.1, we provide a sufficient condition for M's PC to be non-binding and show that it is fulfilled for the vast majority of relevant parameter values. Nevertheless, we verify that our main theoretical results continue to hold also in those cases for which M's PC is binding. A tedious but straightforward analysis of H's maximization problems from equations (9) and (14), subject to M's PC from equation (10), yields the optimal ownership share:

$$s^*_{\text{PC}} = \frac{1-\beta-\alpha(1-\mu)[1-\beta(1-\rho)]}{\alpha(1-\rho)(1-\mu)}.$$

It can be verified that both the first-order derivative of this share with respect to μ as well as the cross-partial derivative with respect to μ and ρ are positive for all $\alpha, \beta \in (0,1), \mu, \rho \in [0,1)$:

$$\frac{\partial s^*_{\text{PC}}}{\partial \mu} = \frac{1-\beta}{\alpha(1-\rho)(1-\mu)^2} > 0, \quad \frac{\partial^2 s^*_{\text{PC}}}{\partial \mu \partial \rho} = \frac{1-\beta}{\alpha(1-\rho)^2(1-\mu)^2} > 0.$$

Hence, Propositions 1 and 2 continue to hold in case of a binding PC.

Notice that our benchmark analysis does not allow for ex-ante lump sum transfers (side payments), which are frequently assumed in the literature to ensure that the entire surplus from the relationship accrues to one party (the HQ). As shown in Appendix A.2, allowing for these transfers in the present context would result in an uninteresting case of zero optimal ownership shares, regardless of the quality of contracting institutions. To understand the intuition behind this result, recall the key trade-off faced by H in our model: By choosing a higher ownership share, H weighs a higher share of surplus against a larger surplus size. If she can extract the entire surplus from M via ex-ante transfers, this trade-off vanishes and H's only objective is to maximize the surplus size. Since both M's investments in non-contractible inputs and the overall revenue decrease in s (see equations (6) and (7)), H's optimal ownership share in the presence of ex-ante transfers is always equal to zero. To generate a non-trivial trade-off from the viewpoint of the HQ, the baseline model does not allow for ex-ante transfers.

2.4.2 HEADQUARTER INTENSITY

So far, we have assumed that all investments required for production are borne solely by M. One might wonder whether our predictions extend to the case in which both parties invest into relationship-specific and non-contractible inputs, resulting in a two-sided hold-up problem. To tackle this question, we introduce an element of joint production by assuming the Cobb-Douglas production technology from Antràs and Helpman (2004):

$$x = \left(\frac{h}{\eta}\right)^{\eta}\left(\frac{m}{1-\eta}\right)^{(1-\eta)}, \tag{16}$$

whereby h represents headquarter services provided by H, and $\eta \in (0,1)$ captures the relative importance of headquarter services in the production process (henceforth, headquarter intensity or HI). Each unit of h is produced with one unit of labor. Without loss of generality, we normalize H's unit production costs to one. As in the benchmark model, we assume that M produces a continuum of manufacturing inputs $m = \exp\left[\int_0^1 \ln m(i)\mathrm{d}i\right]$, whereby only the fraction $\mu \in [0,1]$ of the inputs $m(i)$ is contractible, while the remaining fraction $(1-\mu)$ cannot be verified and enforced by the courts. As before, we also assume that the parties can recoup a fraction $(1-\rho)$ of the production costs of manufacturing inputs on the outside market, whereby $\rho \in [0,1]$ captures the degree of relationship-specificity. To keep our model simple, we assume that headquarter services h are fully non-contractible and entirely relationship-specific. The timing of the game is identical to the one presented in the main text, apart from the period t_3, in which H now provides headquarter services, while M simultaneously and non-cooperatively invests into non-contractible manufacturing inputs and provides the amount of contractible manufacturing inputs stipulated in period t_2. This set-up implies a two-sided hold-up problem and ex-ante underinvestment by both parties. As shown in Appendix A.3, solving the model yields the following optimal ownership share:

$$s^*_{\text{HI}} = \frac{1+\beta^2(1-\rho)\big[1-\alpha[1-\mu(1-\eta)]\big]-2\beta-\alpha\big[1-\mu(1-\eta)-\beta[2-\rho(1-\eta)-\mu(2-\rho)(1-\eta)]\big]}{(1-\rho)\Big[\beta-\alpha\left[\beta\big(1-\mu(1-\eta)\big)-(1-\eta)(1-\mu)\right]\Big]}. \tag{17}$$

Before discussing the effect of contracting institutions on the optimal ownership share, two remarks are in order. First, since s^*_{HI} from equation (17) reduces to s^* from equation (15) for $\eta = 0$, the equilibrium presented in this section generalizes the results of the one-sided hold-up game analyzed in Section 2.2. Second, the optimal ownership share increases in the headquarter intensity η for all permissible values of $\alpha, \beta, \eta \in (0,1)$, $\mu \in [0,1]$, and $\rho \in [0,1)$:

$$\frac{\partial s^*_{\text{HI}}}{\partial \eta} = \frac{\alpha(1-\alpha)(1-\mu)(1-\beta)^2}{(1-\rho)\Big[\beta-\alpha\left[\beta\big(1-\mu(1-\eta)\big)-(1-\eta)(1-\mu)\right]\Big]^2} > 0.$$

This result squares well with the findings by Antràs and Helpman (2004) and the general logic of the PRT: As the headquarter intensity increases (i.e., manufacturing inputs become relatively less important in the production process), the need for incentivizing M decreases and the relative attractiveness of integration increases. Given that firm boundaries in the current framework constitute a continuous choice variable, our results complement the previous literature that has modeled firm boundaries as a binary decision between integration and arm's-length contracting.

Consider now the effect of contracting institutions on the optimal ownership share. Both the first-order derivative of s^*_{HI} with respect to μ, as well as the cross-partial derivative of s^*_{HI} with respect to μ and ρ are positive for all permissible parameter values:

$$\frac{\partial s^*_{\text{HI}}}{\partial \mu} = \frac{\alpha(1-\alpha\eta)(1-\eta)(1-\beta)^2}{(1-\rho)\Big[\beta - \alpha\left[\beta\big(1-\mu(1-\eta)\big) - (1-\eta)(1-\mu)\right]\Big]^2} > 0, \quad \frac{\partial^2 s^*_{\text{HI}}}{\partial\mu\partial\rho} = \frac{1}{(1-\rho)}\frac{\partial s^*_{\text{HI}}}{\partial \mu} > 0.$$

Hence, Propositions 1 and 2 continue to hold in the extended model in which both parties invest into relationship-specific and non-contractible inputs.[22]

2.4.3 Transaction-Cost Theory and Other Theories of the Firm

How do contracting institutions affect firm boundaries under the alternative assumptions of the TCT? And how does this effect depend on the relationship-specificity of the subsidiary's industry? Since these questions have been treated theoretically by Antràs (2015), we abstain from developing the TCT model in this paper, but rather provide a brief discussion of his results. According to the TCT, contracting institutions and relationship-specificity play no role under *integration* because the HQ can enforce the integrated producer's ex-ante investments by fiat (at the expense of exogenous governance costs). Yet, under *arm's-length contracting*, an improvement of contracting institutions increases the HQ's profits, in particular in industries with higher degrees of relationship-specificity.[23] Intuitively, a higher quality of contracting institutions mitigates the ex-post hold-up that plagues commercial transactions between independent parties and alleviates the ex-ante underinvestment into relationship-specific inputs. This effect is particularly pronounced in industries with high degrees of relationship-specificity since the hold-up problem in those industries is relatively more severe. As a result, the relative attractiveness of integration vs. arm's-length contracting under the TCT *decreases* in the quality of contracting institutions, and it decreases more strongly in highly relationship-specific industries (see equation (8.8) in Antràs, 2015). Notice that these TCT-based predictions point in the opposite direction compared to those suggested by the PRT, i.e., Propositions 1 and 2.[24] Since the TCT delivers the alternative hypotheses to the null hypotheses from the PRT, testing our theoretical predictions empirically allows us to discriminate between these two alternative theories of the firm.

[22] We have also explored the interaction effect $\frac{\partial^2 s^*_{\text{HI}}}{\partial\mu\partial\eta}$, but the sign of this cross-partial derivative turns out to be ambiguous.

[23] These results are reported in equation (5.14) in Antràs (2015) and are formally derived in his Appendix 2.

[24] Although the TCT predictions in Antràs (2015) are derived for a binary (rather than a continuous) integration decision, one can easily envision a simple extension of his model in which the HQ's profits are a convex combination of profits under integration (I) and arm's-length contracting (A), $\pi = s^*\pi_I + (1-s^*)\pi_A$, whereby the optimal ownership share $s^* \in [0,1]$ governs the weight of π_I vs. π_A in the HQ's profit function. Hence, when π_A increases due to an improvement in contracting institutions, the HQ has an incentive to reduce s^* in order to reap a higher π.

3 Empirical Implementation

3.1 Econometric specifications

The point of departure for our econometric specifications is the optimal ownership share predicted by our model in equation (15). To concentrate on the effect of contracting institutions and their interaction with relationship-specificity, we specify econometric models that are linear in parameters, while relying on large sets of fixed effects to control for the other determinants of ownership shares from the theoretical model. We implement our empirical tests of Propositions 1 and 2 in two steps.

As a first step, we investigate Proposition 1 by estimating the following econometric model:

$$S_{hm} = \gamma \cdot C_\ell + \boldsymbol{\varphi} \cdot \mathbf{X}_{hm} + \varepsilon_{hm}, \tag{18}$$

where S_{hm} denotes the share in subsidiary m (active in industry i and country ℓ) that is owned by headquarters h (which may be active either in the same or in a different industry and country, respectively). The explanatory variable of primary interest is the quality of contracting institutions C_ℓ in the subsidiary's country ℓ, and γ is the key parameter to be estimated. The vector $\mathbf{X}_{hm}$ contains sets of control variables (with associated coefficient vector $\boldsymbol{\varphi}$), which vary by specification, and ε_{hm} is an error term. In our preferred specification, $\mathbf{X}_{hm}$ includes observable characteristics of the subsidiary's country, of the ownership structure, and proxies for bilateral investment costs specific to the country pair, as well as full sets of fixed effects (FE) for the subsidiary's industry and the HQ's country-industry. These FE play an important role in absorbing other determinants of S_{hm} according to our theory: the demand elasticity (reflected in α), relationship-specificity (ρ), and headquarter intensity (η), to the extent that these variables are industry-specific; as well as the country-industry-specific component of the HQ's bargaining power (β). The specific list of all variables, their measurement, and the data sources are detailed in Section 3.2.

As shown in Proposition 1, based on the PRT we expect a positive effect of the quality of contracting institutions on the ownership share, reflected in $\gamma > 0$. That is, for subsidiaries located in countries with better contracting institutions, we should observe ceteris paribus higher degrees of integration. Intuitively, firms in such countries can write enforceable contracts on a larger share of the subsidiary's inputs, and hence, there is less need to incentivize a subsidiary's ex-ante investments by giving him residual control rights.[25] However, we caution against interpreting the estimated coefficient as a causal effect of contracting institutions. While we control for various confounding factors, there remains a concern regarding omitted variables specific to the subsidiary's country, such as cultural characteristics or other features of the institutional environment, that may be correlated with C_ℓ and also affect S_{hm}. Hence, we interpret our estimates $\hat{\gamma}$ as conditional correlations.

We make progress towards identifying the causal effect of contracting institutions on firm boundaries by estimating the differential effect of contracting institutions across industries that differ in their relationship-

[25] A negative estimate of γ would lend support to the alternative hypothesis suggested by the TCT (see Section 2.4.3).

specificity. To test this interaction effect, we set up the econometric model:

$$S_{hm} = \beta_1 \cdot (C_\ell \times R_i) + \beta_2 \cdot C_\ell + \beta_3 \cdot R_i + \boldsymbol{\phi} \cdot \mathbf{Y}_{hm} + e_{hm}, \tag{19}$$

where we are mainly interested in the interaction term of contracting institutions C_ℓ in the subsidiary's country ℓ and the relationship-specificity R_i of the subsidiary's industry i. This approach allows us to address the concern regarding omitted variables by including subsidiary country FE in the vector of control variables $\mathbf{Y}_{hm}$, in addition to all of the elements of $\mathbf{X}_{hm}$ from equation (18). In our preferred specification of equation (19), we further control for country-pair FE to absorb all unobserved features of bilateral investment costs. The parameters to be estimated are $\beta_j, j \in \{1, 2, 3\}$, and the vector $\boldsymbol{\phi}$, and e_{hm} denotes the error term.

As derived formally in Proposition 2, the PRT predicts a positive interaction effect, i.e., $\beta_1 > 0$. Intuitively, a higher relationship-specificity mitigates the negative effect of the ownership share on the subsidiary's investments, and therefore allows the HQ to increase her ownership share more strongly in response to better contracting institutions. Thus, cross-country differences in institutional quality should have a stronger positive effect on the ownership share in industries with a higher degree of relationship-specificity.[26]

By exploiting the interaction between country-level institutions and industry-level technological characteristics, equation (19) resembles a difference-in-differences model, where we control for the respective first differences with country and industry FE. It is reminiscent of the econometric models traditionally used to assess the effect of institutions on international trade patterns, as discussed by Nunn and Trefler (2014).[27] However, there are two crucial differences between our model and this approach. First, by looking at ownership shares, we examine the intensity of investment links instead of trade flows. Second, our micro data analysis exploits variation across different subsidiary countries and industries within a given HQ's country-industry cell (and even within HQ in some robustness checks), in contrast to the analysis of comparative advantage, which is typically conducted at the aggregate level of industries and countries.[28]

We estimate both models by Ordinary Least Squares (OLS) due to the well-known complications that arise in non-linear models when interpreting interaction terms (see Ai and Norton, 2003), as in the case of our main variable of interest.[29] We compute two-way cluster-robust standard errors following the procedure suggested by Cameron et al. (2011).[30] First, we cluster at the level of the key explanatory variable, i.e., the level of the subsidiary's country in equation (18) and the subsidiary's country-industry level in equation (19). Second, we cluster at the level of the HQ in all OLS estimations to account for interdependencies across a given HQ's ownership decisions.

Before turning to the description of the data sources, three comments on the empirical implementation of our model are in order. First, while the key mechanism of the PRT is well understood in organizational

[26] Note that the TCT yields the opposite prediction for the sign of the interaction effect (see Section 2.4.3).

[27] Acemoglu et al. (2007), Costinot (2009), Levchenko (2007), and Nunn (2007) show that contracting institutions can constitute a source of comparative advantage in international trade.

[28] Ma et al. (2010) and Wang et al. (2014) are recent exceptions analyzing the role of institutions for firm-level exports.

[29] In a robustness check, we allow for non-linearities using an ordered logistic regression model (see Section 4.3.5).

[30] Estimations are implemented using the Stata routine `reghdfe` provided by Correia (2014), which efficiently absorbs our high-dimensional FE and allows for both multi-way clustering of standard errors as well as the use of instrumental variables.

economics, it has typically been applied to discrete ownership choices between integration and arm's-length contracting. A novelty of our approach lies in considering varying intensities of integration across firm pairs. However, one may be skeptical of whether *marginal* changes in owners' equity *shares* can indeed have significant effects on the incentives of the subsidiary's manager. Direct evidence for the relevance of this mechanism is provided for instance by Baker and Gompers (1999) using data on the equity shares held by CEOs in newly public firms. The authors show that reductions in the CEO's equity share due to the participation of venture capitalists or due to an initial public offering significantly reduce the CEO's incentives.

Second, and related, our theoretical model assumes that both parties' residual control rights change in response to a marginal increase in the ownership share at any point in the unit interval. In practice, however, particular thresholds of ownership shares (e.g. 50% or 100%) may be critical for obtaining residual control rights. We exploit the full variation in ownership shares in our main analysis but address the possibility of non-linearities by considering a discrete choice across ownership categories in a robustness check in Section 4.3.5.

Third, by approximating the contractibility μ of the subsidiary's investments with the quality of contracting institutions in the subsidiary's country, we have implicitly assumed that courts in this country are responsible for enforcing the subsidiary's investment decisions. This assumption indeed seems to reflect the prevailing legal practice in many countries.[31] It seems possible, however, that μ may also be affected by the quality of contracting institutions in the HQ's country – either directly, if courts in the HQ's country rule over contracts between the two firms; or indirectly, if multinationals transfer their institutional practices to their subsidiaries (see Chari et al., 2010). Note that we control for the potentially confounding role of contracting institutions in the HQ's country via FE.

3.2 Data sources

All data on firms and firm pairs used in our analysis are taken from the Orbis database provided by Bureau van Dijk (BvD). Most importantly, we observe firms' direct ownership shares (in percent) in their subsidiaries in 2014, which we use as our measure of S_{hm}.[32] We further exploit information on the firms' main activities (industry affiliations in the form of four-digit NAICS 2012 codes), their founding years, employment, and key balance sheet items in 2013. The three key advantages of the Orbis database for our purpose are the availability of firm-pair specific ownership information, its large international coverage, and the fact that it includes both domestic and international ownership links. The database is unique in encompassing

[31] For instance, the European Council Regulation (EC) No 44/2001 (see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:012:0001:0023:en:PDF) cites the default legal principle that "jurisdiction is generally based on the defendant's domicile" (in our context, the subsidiary's country). This principle typically applies to contracts between firm pairs within the EU (and potentially also to cases in which one of the two firms is an EU resident), unless specified otherwise by the contracting parties. Also, the Chinese Law on Sino-Foreign Equity Joint Ventures explicitly stipulates that "All activities of an equity joint venture shall be governed by the laws and regulations of the People's Republic of China" (see http://english.mofcom.gov.cn/article/lawsdata/chineselaw/200301/20030100062855.shtml, both accessed on May 10, 2017).

[32] These data were provided by BvD in the form of two customized data extractions in 2014 (for balance sheets and other firm variables) and 2015 (for ownership shares). The exact date of the ownership information varies by observation and depends on the latest information available, but it refers to the year 2014 in the majority of cases. We additionally have biannual information on ownership shares for the years 2004, 2006, 2008, 2010, and 2012, which we use in robustness checks.

all three of these features.[33]

Our sample includes firms that are classified by BvD as medium, large, and very large. We consider only those HQ that are classified as 'industrial companies', thereby excluding pension funds, public authorities, and financial companies. Furthermore, we restrict our analysis to direct ownership shares of at least 10%, a conventional threshold for direct investment. We implement these sample restrictions because we are interested in HQ that have a (potentially long-term) economic interest in the target firm – as described by our model – and do not merely invest due to (short-term) portfolio considerations. The resulting sample includes information on direct ownership shares for 605,547 firm pairs of 288,450 headquarters from 113 countries owning 562,243 subsidiaries in 126 countries in the cross-section of 2014. The median HQ has only a single subsidiary, which is typically located in the same country; yet, one third of all HQ owns shares in at least two subsidiaries, and 11% of them are multinational firms owning foreign subsidiaries (which make up around one fifth of the observations in our data). In this sample, the mean ownership share is 75%, with a standard deviation of 30. Full ownership is most common (46% of all firm pairs) and 18% of the ownership shares range between 50 and 51%. We explicitly address these distributional features in Section 4.3.5.

We take the 'rule of law' index from the Worldwide Governance Indicators (Kaufmann et al., 2010) as our baseline measure of the quality of a country's contracting institutions C_ℓ. This measure is a weighted average of a number of variables that reflect experts' and practitioners' assessments of the effectiveness and predictability of judicial quality and the enforcement of contracts in a given country and year. We use this index as our main measure since it is available for a large number of countries and is well-established in the literature as a valid proxy for the quality of a country's contracting institutions (see e.g. Antràs, 2015; Nunn, 2007; Nunn and Trefler, 2014). However, we test the sensitivity of our results to using a wide range of alternative proxies for the quality of contracting institutions, which we describe in Section 4.3.1. Table B.1 provides a full list of subsidiary countries in our data, ranked by the rule of law index. The table shows that both the number of subsidiaries and the average ownership shares tend to be lower in countries with poor contracting institutions.

Our industry-level measure of relationship-specificity R_i is taken from Antràs and Chor (2013), who compute it from the Rauch (1999) classification of products by their degree of horizontal differentiation.[34] This classification distinguishes three categories of goods: (i) homogenous (traded on an organized exchange), (ii) reference-priced (not sold on an organized exchange, but reference prices are quoted in trade publications), and (iii) differentiated (all residual goods). For each industry, our baseline measure of R_i is calculated as the share of product codes in the industry that are classified as differentiated or reference-priced.[35] The idea underlying this approach is that, unlike homogenous goods, differentiated goods are

[33] The Orbis ownership data have previously been used to study the international transmission of shocks through multinationals (Cravino and Levchenko, 2017), the hierarchical complexity of business groups (Altomonte and Rungi, 2013), and the effect of managerial culture on firm boundaries (Kukharskyy, 2016; Gorodnichenko et al., 2017).

[34] These data are available on the authors' websites at the six-digit 2002 U.S Input-Output industry classification level. We map them to the four-digit NAICS 2012 level using official correspondence tables provided by the Bureau of Economic Analysis: http://www.bea.gov/industry/xls/2002DetailedItemOutput.xls and by the US Census Bureau: http://www.census.gov/eos/www/naics/concordances/concordances.html (both accessed on April 4, 2016).

[35] Due to ambiguities for some goods, there are two versions of the Rauch (1999) classification, a 'conservative' and a 'liberal' one, whereby the former maximizes and the latter minimizes the number of goods that are classified as differentiated. Following

customized to the specific needs of a buyer-seller relationship. The more differentiated goods there are within a given industry, the thinner is the outside market for the typical goods produced in this industry, and hence, the higher is the relationship-specificity. The size of the sample for our main regression analysis is reduced by the availability of the Rauch relationship-specificity measure for the subsidiary's industry. Summary statistics for the main estimation sample are provided in Table B.2.

The vectors of control variables $\mathbf{X}_{hm}$ and $\mathbf{Y}_{hm}$ include, in addition to various sets of FE, the following observable characteristics of the subsidiary's country and industry, the ownership structure, and the country pair, which may affect the depth of integration. For the subsidiary's country, we take the log of GDP as a measure of country size; the log of GDP per capita as a proxy for the income and wage level; the log of the endowment ratio (K_ℓ/L_ℓ), defined as the real capital stock divided by employment (average hours worked by employed persons), as a measure of relative factor abundance; and the average years of schooling as a proxy for the human capital stock (Barro and Lee, 1996). These variables are taken from the Penn World Tables (version 8.1; see Feenstra et al., 2013) for the year 2010. To control for industry-level differences in capital intensity, we include the log of the capital-to-employment ratio (K_i/L_i) of the median firm by industry in the Orbis dataset for the year 2013, along with a Heckscher-Ohlin-type interaction term of the industry's capital intensity with the endowment ratio: $\ln\,(K_i/L_i)\times\,\ln\,(K_\ell/L_\ell)$. We further control for three variables capturing the nature of the ownership structure: (i) the number of subsidiaries of the HQ, (ii) the number of shareholders of the subsidiary, and (iii) a dummy indicating domestic (as opposed to international) ownership links.[36] The first two variables capture the complexity of the business group (cf. Altomonte and Rungi, 2013; Schwarz and Suedekum, 2014). The motivation for including the third variable is that international ownership may involve additional fixed costs that affect the ownership shares. We proxy for bilateral investment costs by using a set of standard gravity control variables from the CEPII dataset (Head et al., 2010): the distance between the most populous cities in log kilometers, the time zone difference in hours, and indicator variables for countries sharing a common border, official language, or (current or past) colonial link.

Finally, the vectors $\mathbf{X}_{hm}$ and $\mathbf{Y}_{hm}$ also include control variables for other characteristics of the institutional environment in the subsidiary's country. These characteristics, such as financial development or intellectual property rights protection, are correlated with the quality of contracting institutions, and they may also affect the integration decision. To ensure that the rule of law index does not pick up the effects of other types of institutions, we control for them using a set of proxies that have previously been used in the international economics literature (see e.g. Nunn and Trefler, 2014; Javorcik, 2004): financial development, approximated by the sum of private credit and stock market capitalization divided by GDP from the World Bank's Global Financial Development Database (GFDD) in 2012; labor market flexibility, defined as one

Alfaro et al. (2015) and Antràs and Chor (2013), we use the liberal classification in our baseline analysis and the conservative version in robustness checks. Also, reference-priced goods may be understood as either differentiated or homogenous. We treat reference-priced goods as differentiated in our baseline analysis and classify them as non-differentiated in robustness checks.

[36] Due to missing observations for the variables provided in Orbis, we define the number of subsidiaries (shareholders) as the maximum value of the number of subsidiaries (shareholders) reported by BvD (which may include non-manufacturing firms, public entities, or private persons) and the number of subsidiaries (shareholders) actually observed in the database.

minus the rigidity of employment index from the World Bank's Doing Business Reports (based on Botero et al., 2004), averaged over the period 2004-2009 (the years when the index was reported); the index of intellectual property rights (IPR) protection developed by Park (2008) in 2010 (the last available year); and the expropriation risk score in the first quarter of 2014, based on expert assessments by the information services company IHS Markit.[37]

4 Estimation Results

4.1 Ownership shares and contracting institutions

Table 1 summarizes our estimation results for different specifications of equation (18). It substantiates the fact illustrated in Figure 1(a) that subsidiaries are more deeply integrated in countries with better contracting institutions. Column 1 reports a positive unconditional correlation between the ownership share and the rule of law index, which is highly significant. The coefficient estimate increases as we successively add control variables for characteristics of the subsidiary's country and industry, the ownership structure (column 2), and bilateral investment costs (column 3).[38] Ownership shares tend to be lower in countries with a more educated population, while the other country characteristics are insignificant. The industry's capital intensity enters negatively, while the Heckscher-Ohlin interaction term is weakly positive. Domestic ownership links are characterized by lower shares than international links, presumably reflecting the idea that investing abroad is associated with additional fixed costs, which are only worth paying in case of a substantial stake in a foreign company. The average ownership share also decreases (somewhat mechanically) in the number of shareholders. Most proxies for bilateral investment costs seem to have no significant effect on ownership shares, but we find a stable negative correlation with the common language dummy.

The positive correlation between the depth of integration and the quality of contracting institutions is also confirmed in columns 4-5 of Table 1, where we control for unobservable factors using large sets of FE. After adding FE for the subsidiary's country, the HQ's country, and the HQ's industry in column 4, the point estimate is reduced almost by half, but it remains highly significant. The estimate is very similar when we further include HQ country-industry FE in column 5. In column 6, we control for several other dimensions of institutional quality in the subsidiary's country, namely financial development, labor market flexibility, IPR protection, and expropriation risk. The results indicate that ownership shares are higher in more financially developed countries, those with better IPR protection, and (perhaps surprisingly) countries with higher expropriation risk. Most importantly, the estimated coefficient for the rule of law index remains positive and significant at the one percent level. This preferred estimate suggests that firms choose ownership shares which are higher by around 11 percentage points in countries with a rule of law index that is higher by one standard deviation (in the cross-country sample in 2014).

[37]The score assesses the "risk that the government will expropriate or nationalise assets". A key advantage of the country risk scores by IHS Markit is that they distinguish the risk of expropriation by the government from the risk that the judicial system may not enforce contracts between private parties, which we exploit in a robustness check.

[38]The number of observations declines with more demanding specifications in Table 1 because control variables are missing for some firm pairs and observations are dropped if they are fully explained by the FE.

TABLE 1: *Ownership shares and contracting institutions*

Dependent variable: ownership share	Plain	Control variables		Fixed effects (FE)		Other
		subsidiary	bilateral	3 FE	2 FE	institutions
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law (subsidiary country)	5.639***	13.78***	13.41***	7.657***	7.439***	11.12***
	(2.130)	(3.552)	(3.298)	(1.727)	(1.761)	(2.540)
ln GDP (subsidiary country)		1.868	3.264	0.528	0.180	-0.626
		(3.450)	(3.061)	(0.906)	(1.008)	(3.995)
ln GDP per capita (subsidiary country)		-6.764	-6.286	-2.913	-2.265	0.606
		(4.790)	(4.847)	(2.931)	(3.034)	(7.956)
ln (K_ℓ/L_ℓ) (subsidiary country)		-8.084	-9.103	-2.932*	-2.413	-2.715
		(5.954)	(5.582)	(1.556)	(1.640)	(4.978)
ln years of schooling (subsidiary country)		-48.31**	-45.47*	-25.72**	-26.66**	-57.51***
		(23.27)	(24.42)	(10.47)	(10.70)	(14.92)
ln (K_i/L_i) (subsidiary industry)		-5.132**	-4.753*			
		(2.578)	(2.625)			
ln $(K_\ell/L_\ell)\times$ ln (K_i/L_i) (subsidiary)		0.639*	0.585*	0.168	0.106	0.0570
		(0.339)	(0.347)	(0.173)	(0.170)	(0.159)
Domestic ownership link dummy		-8.920***	-15.01***	-8.432***	-7.779***	-3.942**
		(1.995)	(4.333)	(1.602)	(1.564)	(1.917)
Number of subsidiaries (headquarters)		-0.0158*	-0.0134	-0.00854	-0.0137*	-0.0114
		(0.00863)	(0.00877)	(0.00629)	(0.00705)	(0.00777)
Number of shareholders (subsidiary)		-0.787**	-0.788**	-0.770**	-0.739**	-0.665**
		(0.366)	(0.367)	(0.360)	(0.347)	(0.318)
ln distance			-1.186	0.0639	-0.114	1.552
			(2.376)	(0.681)	(0.663)	(1.022)
Time zone difference (hours)			-1.084*	-0.330	-0.271	-0.335
			(0.646)	(0.422)	(0.409)	(0.340)
Common border dummy			-1.298	0.672	0.533	1.622
			(2.909)	(1.076)	(0.990)	(1.321)
Common language dummy			-5.979***	-4.279**	-4.518**	-3.301*
			(1.801)	(1.808)	(1.714)	(1.708)
Colonial link dummy			1.981	1.759	1.882	1.005
			(1.907)	(2.351)	(2.228)	(2.328)
Financial development (subsidiary country)						0.0441***
						(0.0137)
Labor market flexibility (subsidiary country)						-6.369
						(4.508)
IPR protection (subsidiary country)						8.078*
						(4.466)
Expropriation risk (subsidiary country)						11.21***
						(2.195)
Subsidiary industry fixed effects (FE)	no	no	no	yes	yes	yes
Headquarters country and industry FE	no	no	no	yes	nested	nested
Headquarters country-industry FE	no	no	no	no	yes	yes
Observations	605,547	525,653	524,597	524,206	522,792	433,108
R^2	0.026	0.127	0.133	0.229	0.265	0.278

The table reports estimates of (variations of) equation (18). Standard errors clustered by subsidiary country and by HQ are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

We interpret this result as indicative evidence for Proposition 1, which predicts that firms choose deeper integration of their subsidiaries located in countries with better contracting institutions. However, despite the large set of control variables included in our preferred specification from column 6 of Table 1, there may be unobserved country-specific factors that are correlated with contracting institutions and firm boundaries. Hence, these regressions cannot identify the causal effect of contracting institutions on ownership shares. This caveat notwithstanding, we can state that after controlling for a wide range of relevant covariates and a host of unobservables, we continue to find a positive correlation between the quality of contracting institutions in the subsidiary's country and the depth of integration, in line with the PRT.

Before turning to the analysis of the interaction effect, we briefly pause to compare our results to the existing literature. Note that the implications of our estimates differ from Acemoglu et al. (2009), who find no significant correlation between their firm-level index of vertical integration and various proxies for contracting institutions. One potential explanation is that they examine (primary and secondary) activities that are fully integrated within the *same firm*, whereas we examine partial ownership shares *across* firms. However, besides these conceptual differences, the discrepancy in results may also be explained by the confounding role of contracting institutions in the HQ's country. To see this, note that Acemoglu et al. (2009) examine the degree of vertical integration of a given firm by examining input-output relationships between its various economic activities, all of which are presumably located in the same country. Yet, as shown by Antràs and Helpman (2008), contracting institutions have the opposite effect on firm boundaries depending on whether they affect the contractibility of a HQ's or a subsidiary's inputs. If both the subsidiary and the HQ are located in the same country, a single country-level proxy for contracting institutions may confound these opposing effects. Our data features two important advantages that enable us to resolve this issue: They include international ownership links as well as multiple links for some firms. This allows us to fully control for contracting institutions in the HQ's country by FE. Provided that the HQ's investments are fully governed by contracting institutions in the HQ's country, we can identify the positive relationship between contracting institutions in the subsidiary's country and the depth of integration.

4.2 Ownership shares, contracting institutions, and relationship-specificity

In Table 2, we provide empirical evidence supporting the idea that better contracting institutions have a stronger positive effect on ownership shares for subsidiaries producing highly relationship-specific inputs, as predicted by Proposition 2. The table develops our preferred specification of equation (19) step by step. In column 1, we examine the correlation without any control variables, which reveals a positive estimate of the interaction term. It suggests that the positive correlation between the rule of law index and ownership shares is concentrated in industries with high relationship-specificity, in line with Figure 1(b).

In column 2, when we control for the observable variables from the third column of Table 1, the point estimate for the interaction term becomes smaller and insignificant.[39] However, significance is restored as we add FE for the HQ's country and industry along with subsidiary industry FE in column 3. As an important step towards identification, we add subsidiary country FE in column 4. Note that this specification is superior to simple cross-country regressions, as it identifies the effect of country-level institutions across industries with varying degrees of relationship-specificity after controlling for any unobservable country characteristics. We control for further potential confounding factors, such as international differences in financing conditions of a given industry, by adding HQ country-industry FE in column 5. Finally, to account

[39]For relationship-specificity, we find insignificant estimates with switching signs, which is not surprising given the ambiguity predicted by our model (see Section 2.3). The coefficient estimates for the control variables are not reported to save space. We choose not to include the additional institutional measures from column 6 of Table 1 because they would substantially reduce the sample and are subsequently controlled for via subsidiary country FE.

TABLE 2: *Ownership shares, contracting institutions, and relationship-specificity*

Dep. var.: ownership share	Plain	Controls	3 FE	4 FE	Cty-ind. FE	Pair FE
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law × specificity (subsidiary)	6.975***	3.327	2.748**	2.464**	3.476***	3.432***
	(1.634)	(2.270)	(1.172)	(1.085)	(0.973)	(0.909)
Rule of law (subsidiary country)	-1.703	7.734***	4.924***			
	(1.502)	(2.261)	(1.200)			
Specificity (subsidiary industry)	-2.090	0.197				
	(1.324)	(2.160)				
Control variables from Table 1	no	yes	yes	yes	yes	yes
Subsidiary industry FE	no	no	yes	yes	yes	yes
Subsidiary country FE	no	no	no	yes	yes	nested
Headquarters country and industry FE	no	no	yes	yes	nested	nested
Headquarters country-industry FE	no	no	no	no	yes	yes
Country-pair FE	no	no	no	no	no	yes
Observations	230,937	187,716	187,587	187,587	186,092	186,110
R^2	0.024	0.128	0.228	0.242	0.288	0.295

The table reports estimates of (variations of) equation (19). Standard errors clustered by subsidiary country-industry and by HQ are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

for unobserved bilateral factors like cultural differences or ethnic ties, we include country-pair FE to arrive at our preferred specification in column 6. In all of the regressions with FE, we find a significantly positive estimate for the interaction effect. The estimated size of the effect is quite stable across all specifications in columns 2 through 6. A quantitative interpretation of the preferred estimate suggests that an improvement in contracting institutions by one standard deviation would increase the ownership share by 3.4 percentage points *more* for a subsidiary in a highly relationship-specific industry (composed of differentiated goods only) compared to a subsidiary in a non-specific (homogenous) industry.

Our estimation results provide strong support for Proposition 2, and hence for the PRT. In line with this theoretical prediction, we find that firms choose ceteris paribus deeper integration of subsidiaries in countries with better contracting institutions, and this effect increases in the relationship-specificity of the subsidiary's industry. Intuitively, there is less need to incentivize the subsidiary's ex-ante investments if contracting institutions are better and courts are able to enforce contracts on a wider range of issues. This mechanism is more pronounced for subsidiaries producing relationship-specific inputs, since the adverse effect of a higher ownership share on the subsidiary's underinvestment is mitigated in industries with higher degrees of relationship-specificity. Therefore, contracting institutions have a disproportionately positive effect on the integration decision in relationship-specific industries.

As mentioned in the introduction, the only empirical analysis to date that has studied the interaction effect of contracting institutions and relationship-specificity on firm boundaries is by Antràs (2015, see his Table 8.9). Using the ratio of intra-firm imports to arm's-length imports by U.S. industries as a dependent variable, he finds a negative and significant interaction effect, which is however not robust to more stringent testing. In particular, the estimate is rendered insignificant after controlling for interactions of GDP per capita with industry dummies. We propose three possible explanations for the difference between these inconclusive results and our positive estimates, which are robust to the same test and several other checks, as shown in the next section. First, since our sample covers HQ in many countries, while Antràs (2015) considers only U.S. imports, the differences may be explained by particular features of the U.S. economy. Second, larger ownership shares do not necessarily translate into higher intra-firm trade volumes. In particular, the U.S. data classify all firm pairs with ownership shares exceeding 6% as related parties, and there might be large trade volumes between partially integrated firms. Third, and related, compositional effects within industries may mask the positive interaction effect that we have identified at the level of firm pairs.[40]

4.3 Robustness analysis

This section discusses the following challenges to identification: measurement of key explanatory variables, potentially remaining confounding factors, robustness across samples, selection into production countries, non-linearities in ownership decisions, and the possibility of reverse causality. We use several variations of our preferred specifications as well as alternative estimation techniques to find that our main results are remarkably robust to addressing each of these challenges.

4.3.1 Alternative measurement of key variables

As a first step, Table 3 experiments with alternative measures of our key explanatory variables. In Panel A, we reestimate equation (18) using several alternative proxies for the quality of contracting institutions C_ℓ, and in Panel B, we employ the same proxies to estimate the interaction effect in equation (19). All regressions are based on our preferred specifications from the final columns of Tables 1 and 2, respectively. We use the following proxies for contracting institutions, which are described in detail in Table B.3 and defined such that a higher value indicates better institutional quality: the index of contract enforcement between private parties by IHS Markit (column 1), the law and order component of the International Country Risk Guide by Political Risk Services (PRS, column 2), the inverse distance to the frontier in enforcing contracts from the World Bank's Doing Business (WBDB) database (column 3), the index of legal formalism developed by Djankov et al. (2003, column 4), the index of property rights freedom by the Heritage foundation (column 5), and the enforceability of contracts measure by Business Environmental Risk Intelligence (BERI, column 6). As reported in Panel A, the conditional correlation with the ownership share is estimated to be positive for each of the six proxies for contracting institutions, and it is highly significant in four cases. An even clearer picture emerges from Panel B. The estimated interaction effects of our alternative proxies for contracting institutions with relationship-specificity are positive and significant at the five percent level in all cases (and at the one percent level in all but one case). This allows us to conclude that our main estimation results are robust to using a wide range of alternative measures of the quality of contracting institutions.

In Panel C of Table 3, we examine alternative measures of relationship-specificity. The first three columns use variants of the Rauch (1999) classification. In column 1, we reclassify referenced-priced goods as non-differentiated (instead of differentiated), but adhere to the liberal classification. Next, we use the conservative (rather than liberal) variant of the classification, alternatively denominating referenced-priced

[40]While Antràs (2015) controls for productivity dispersion within industries, this term approximates only one of several relevant dimensions of micro-level heterogeneity that we account for in Section 4.3.2.

TABLE 3: *Alternative measurement of key variables*

Dep. var.: ownership share	IHS Markit	PRS	WBDB	Djankov	Heritage	BERI
	(1)	(2)	(3)	(4)	(5)	(6)
A. First-order effect for alternative measures of contracting institutions						
Contracting institutions	11.56***	4.836	1.270	3.528**	10.45***	8.080***
	(3.597)	(3.119)	(1.169)	(1.707)	(2.063)	(2.056)
Observations	433,108	433,108	433,108	430,271	433,108	426,996
R^2	0.276	0.275	0.275	0.279	0.278	0.282
B. Interaction effect for alternative measures of contracting institutions						
Contracting institutions × specificity	4.314***	3.816***	2.344***	2.449***	3.427***	1.765**
	(1.523)	(0.896)	(0.862)	(0.759)	(0.925)	(0.866)
Observations	185,650	186,110	186,110	184,829	186,110	173,621
R^2	0.295	0.295	0.295	0.296	0.295	0.297
C. Interaction effect for alternative measures of relationship-specificity						
	Rauch specificity measures			Relationship duration		
	diff.	conserv.	diff. & cons.	baseline	HQ firm FE	2 firm FE
Rule of law × specificity (alternative)	1.135*	1.667***	3.401***			
	(0.598)	(0.620)	(1.292)			
Rule of law × relationship duration				1.388***	1.778***	2.887*
				(0.481)	(0.456)	(1.692)
Relationship duration				0.909	1.789***	2.552
				(0.571)	(0.516)	(2.100)
HQ firm FE	no	no	no	no	yes	yes
Subsidiary firm FE	no	no	no	no	no	yes
Observations	186,110	186,110	186,110	523,322	362,339	19,679
R^2	0.295	0.295	0.295	0.281	0.615	0.846

Panel A reports estimates of equation (18), including all control variables and FE from column 6 of Table 1. Panels B and C report estimates of equation (19), including all control variables and FE from column 6 of Table 2. Panels A and B use the alternative measures of the quality of contracting institutions listed in the header, which are described in Table B.3. Panel C uses alternative measures of relationship-specificity described in the text. Standard errors clustered by subsidiary country and by HQ (Panel A) or by subsidiary country-industry and by HQ (Panels B and C) are reported in parentheses. Asterisks indicate significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

goods as differentiated (column 2) or non-differentiated (column 3). Again, all three regressions confirm the significantly positive interaction effect. In columns 4 to 6, we use a proxy for relationship-specificity that is specific to the firm pair. We compute the number of years in which a given firm pair is consecutively observed in our biannual data for 2004-2014, normalized by the maximum number of observed years, and call this measure the 'relationship duration'. This approach builds on the recent theoretical work by Martin et al. (2016), which suggests that the duration of firm relationships may serve as a revealed measure of their specificity. Intuitively, long-term relationships are more likely to involve relationship-specific investments that have a lower value on the outside market. We compute the relationship duration for all firm pairs in our data and can therefore estimate our preferred specification with the alternative measure in a much larger sample (see column 4). The estimated interaction effect is positive and significant, as predicted by Proposition 2. Since the relationship duration is specific to the firm pair, our setup further allows us to control for firm-specific effects. To this end, we gradually add firm FE for the HQ (column 5) and the subsidiary (column 6) to our specification. While this narrows down our sample to firms with multiple ownership links, it allows us to control for unobservable firm characteristics that may affect the integration decision, such as the managers' time preferences (see Kukharskyy, 2016). We find a highly significant interaction effect within HQ, which remains significant at the ten percent level even when identified from variation within headquarters *and* within subsidiaries. These estimates strongly corroborate our main findings.

4.3.2 Additional control variables

In this section, we return to our baseline measures and account for potentially confounding factors by including additional control variables in our preferred specifications. We start by controlling for a variety of differential effects of subsidiary country and industry characteristics, then explicitly account for firm heterogeneity, and finally control for remaining unobservables, including HQ firm FE.

Table 4 first addresses the possibility that country-specific variables may have differential effects across industries. Even after controlling for country FE, the interaction effect in equation (19) might be confounded by other characteristics of the subsidiary's country, such as economic development or other institutions, which are positively correlated with the quality of contracting institutions. If these country characteristics affect the firms' integration decisions and if they have a different effect in more specific industries, this may bias our estimates. Moreover, subsidiary country characteristics may affect the ownership decisions through channels other than relationship-specificity. To account for all of these channels, we adopt a very general approach that controls for *arbitrary* effects of country-specific factors across industries. We begin by controlling for the differential effects of economic size and economic development by adding two full sets of interaction terms of subsidiary industry dummies with GDP and GDP per capita in the subsidiary's country to our main specification of equation (19). This approach was first developed by Levchenko (2007) for studying exports and adopted by Antràs (2015) in a context similar to our paper. Column 1 of Table 4 shows that our main interaction effect is fully robust to this important robustness check. In columns 2-3, we proceed analogously by controlling for interaction terms of subsidiary industry dummies with proxies for endowments (capital-labor ratio and human capital) and the quality of other types of institutions (financial development, labor market flexibility, IPR protection, and expropriation risk) in the subsidiary's country, respectively.[41] We find that these tests do not alter our previous conclusions, as the estimated main interaction effect maintains a similar magnitude as in the baseline regression and is always significant at conventional levels.

It is also conceivable that technological features of the subsidiary's industry have varying effects on ownership shares across country characteristics other than the ones considered in columns 1-3. To the extent that these technological features are reflected in the capital intensity of the subsidiary's industry, we can control for them very generally through interaction terms of capital intensity with subsidiary country dummies. Our main finding is confirmed after adding these control variables in column 4 of Table 4. We can apply an even more stringent tests by combining several of the aforementioned sets of interaction terms in a single regression. Note that including all of the above interaction effects makes inference impossible due to the large number of covariates. We therefore report the results of regressions including two different combinations of

[41] These variables are defined in Section 3.2.

TABLE 4: *Controlling for differential effects of subsidiary country and industry characteristics*

Dep. var.: ownership share	GDP	Endowments	Institutions	Industry K/L	Combination 1	Combination 2
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law × specificity	3.318**	3.907***	4.499**	3.402***	3.073*	4.641***
	(1.472)	(1.251)	(1.867)	(0.909)	(1.815)	(1.664)
Observations	186,110	186,110	152,642	186,110	157,166	156,707
R^2	0.298	0.298	0.309	0.296	0.307	0.307

The table reports estimates of equation (19). All regressions include the control variables and fixed effects from column 6 of Table 2. In addition, we control for interactions of a full set of subsidiary industry dummies with the following characteristics of the subsidiary country: GDP and GDP per capita in column 1, endowments (capital-labor ratio and human capital) in column 2, and other institutions (financial development, labor market flexibility, IPR protection, and expropriation risk) in column 3. Column 4 includes interactions of a full set of subsidiary country dummies with the subsidiary industry's capital intensity. In column 5, we control for interactions of industry dummies with GDP per capita, the capital-labor ratio, and financial development, as well as interactions of industry capital intensity with country dummies. In column 6, we control for interactions of industry dummies with human capital, financial development, and expropriation risk, as well as interactions of industry capital intensity with country dummies. Standard errors clustered by subsidiary country-industry and by HQ are reported in parentheses. Asterisks indicate significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

interaction terms (though other combinations yield similar results). The specification reported in column 5 includes four sets of variables that seem a priori most important: interaction terms of industry dummies with GDP per capita, the capital-labor ratio, and financial development, as well as interaction terms of country dummies with industry-level capital intensity. In the last column, we continue to control for arbitrary effects of industry capital intensity across subsidiary countries, but add interactions of industry dummies with the set of country characteristics that are individually significant in Table 1: human capital, financial development, and expropriation risk. We continue to find a significantly positive interaction effect between contracting institutions and relationship-specificity in these highly demanding specifications and conclude that differential effects of other relevant country and industry characteristics cannot explain our main findings.

Table 5 addresses potentially remaining concerns about omitted variables related to the characteristics of the individual firms. While we have abstracted from firm heterogeneity in our theoretical model, differences across firms – both headquarters and subsidiaries – may potentially play a role for ownership decisions. For instance, one might suspect that particularly large and productive subsidiary firms are more lucrative investment targets, therefore attracting higher ownership shares; alternatively, one might argue that large and productive firms are more likely to be listed on the stock exchange and thus characterized by widespread shareholdings. In either case, if firms producing relationship-specific goods can grow larger on average (e.g. due to market power), and if these firms tend to locate in countries with better contracting institutions (e.g. due to better infrastructure), then neglecting firm heterogeneity might bias the estimate of our main interaction effect. One could construct similar narratives for other dimensions of firm heterogeneity. For this reason, we control for the following observable characteristics of the subsidiary firm, which may be relevant for ownership shares: firm size (measured by $\ln$ *employment*), labor productivity (defined as $\ln(\textit{value added}/\textit{employment})$), the firm's age, its capital intensity (defined as $\ln(\textit{capital}/\textit{employment})$), and a shareholder dummy, indicating whether the subsidiary itself holds any shares in other firms. These variables are lagged by one year (based on unconsolidated financial accounts in Orbis in 2013), which ameliorates potential concerns regarding reverse causality. The estimation results reported in columns 1 and 2 of Table 5 strengthen our main findings, as the interaction effect is estimated to be even larger than in our main regression. They further reveal that ownership shares are in fact higher for larger, more productive, and older subsidiaries, while they are lower for subsidiaries that are more capital intensive or are shareholders themselves.

TABLE 5: *Firm heterogeneity*

Dep. var.: ownership share	Subsidiary firm controls		Headquarters firm controls		Both firm controls	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law	5.348**		6.406***		4.307**	
	(1.861)		(1.439)		(1.437)	
Rule of law × specificity		4.309**		7.446***		2.650
		(1.774)		(2.538)		(3.455)
Employment (subsidiary)	1.972***	2.650***			-0.0281	0.697***
	(0.505)	(0.165)			(0.516)	(0.263)
Labor productivity (subsidiary)	0.257	0.922***			-1.376*	-0.546
	(0.451)	(0.235)			(0.710)	(0.416)
Age (subsidiary)	0.0291**	0.0184**			0.0540***	0.0353**
	(0.0119)	(0.00887)			(0.0117)	(0.0179)
Capital intensity (subsidiary)	-0.631***	-0.355***			-1.292***	-0.856***
	(0.191)	(0.101)			(0.261)	(0.162)
Shareholder dummy (subsidiary)	-3.157***	-3.411***			-4.068***	-4.365***
	(0.383)	(0.352)			(0.456)	(0.603)
Employment (headquarters)			2.320***	2.031***	2.759***	2.373***
			(0.401)	(0.210)	(0.377)	(0.221)
Labor productivity (headquarters)			1.672***	1.649***	2.253***	2.273***
			(0.237)	(0.242)	(0.224)	(0.304)
Age (headquarters)			-0.0753***	-0.0778***	-0.0694***	-0.0682***
			(0.00791)	(0.0165)	(0.00699)	(0.0203)
Capital intensity (headquarters)			0.838***	0.677***	1.226***	0.987***
			(0.220)	(0.119)	(0.141)	(0.147)
Subsidiary dummy (headquarters)			1.505	2.156***	0.880	1.852*
			(1.389)	(0.810)	(1.509)	(1.085)
Observations	106,829	53,353	84,520	36,153	42,757	19,325
R^2	0.229	0.263	0.241	0.269	0.259	0.295

Columns 1, 3, and 5 report estimates of equation (18), including all the control variables and FE from column 6 of Table 1. Columns 2, 4, and 6 report estimates of equation (19), including all the control variables and FE from column 6 of Table 2. In addition, we control for one-year lags of the listed firm-level control variables for the subsidiary firm (columns 1-2), for the HQ (columns 3-4), and for both firms (columns 5-6). Standard errors clustered by subsidiary country and by HQ (columns 1, 3, and 5) or by subsidiary country-industry and by HQ (columns 2, 4, and 6) are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

In the next step, we control for firm heterogeneity among HQ. We include the same lagged firm characteristics as in the case of subsidiaries, except for the shareholder dummy, which is replaced by a subsidiary dummy, indicating whether the HQ itself is owned (to some degree) by other firms in our data. Columns 3 and 4 of Table 5 confirm the positive estimates for the rule of law index and its interaction effect with relationship-specificity, both of which are highly significant in this further reduced sample. Larger, more productive, and capital intensive HQ tend to own higher ownership shares; age enters negatively; and evidence on the subsidiary dummy is inconclusive. In the last two columns of Table 5, we include the control variables for both firms. We find that both the direct and the interaction effect have the predicted signs, but only the former is statistically significant. The insignificance of the interaction effect is likely to be explained by the reduced sample, which is smaller by an order of magnitude compared to our main estimation. The remaining sample covers only 21 subsidiary countries, predominantly EU members, which are characterized by similar contracting institutions, and hence little variation in the rule of law index. Thus, the lack of significance in this sample is not surprising. Given that controlling for firm variables drastically reduces our sample, we omit them in our main analysis. Most importantly, the positive point estimates for our interaction effect in these robustness checks suggest that firm heterogeneity does not cause an upward bias in our main regression.

In our main analysis, we have abstracted from political barriers to FDI. However, many countries maintain policy restrictions on foreign equity ownership. Such restrictions on foreign equity are measured by the OECD's FDI Regulatory Restrictiveness Index across 62 countries and 22 industries in 2014.[42] We modify our main estimation equations to include this index for the subsidiary's country plus an interaction term of the index with a dummy variable indicating foreign ownership relationships, since FDI restrictions are expected to have a differential effect on international investments. Unreported estimation results reveal that this robustness check leaves our main estimates for the effect of rule of law and its interaction with relationship-specificity unaffected in terms of both economic size and statistical significance.

Table 6 controls for remaining sources of unobserved heterogeneity in the data. While we have already addressed primary concerns regarding omitted variables, one can still envision more intricate narratives of potentially confounding factors. For instance, institutions in the HQ country may have a differential effect on ownership shares across industries (in addition to the direct effects that we have controlled for throughout). Similarly, the effects of other characteristics of the HQ country might vary across subsidiary industries. The most general way to address these issues is by augmenting our baseline specifications with an additional set of FE for each combination of HQ countries and subsidiary industries. The results of estimating these augmented specifications, reported in the first two columns of Table 6, support our main predictions.

So far, we have controlled for the (technological) fundamentals of both parties' industries via HQ and subsidiary FE. However, it is conceivable that industry-pair specific factors may also affect ownership shares. For instance, Antràs and Chor (2013) show that the integration decision is affected by the interaction of 'downstreamness' of the subsidiary's industry with the demand elasticity for final goods, which may be interpreted as an industry characteristic of the HQ in case the subsidiary is a vertically integrated supplier. To control for these (and other) unobservables, columns 3 and 4 of Table 6 add industry-pair FE to the previous specifications. Again, the size and significance of both key estimates hardly change, which is why these computationally intensive FE are omitted in the main analysis.

A significant advantage of our data over those used in previous studies is that we can separately identify both firms that form an ownership link – the HQ and the subsidiary. To fully exploit this advantage, we proceed by identifying the effect of contracting institutions from variation across different subsidiary countries and industries *within* the same HQ. For this purpose, we add HQ firm FE to the previous specifications (including also all previously introduced FE). This approach implicitly restricts the sample to HQ that hold ownership shares in at least two subsidiaries in different countries (or industries for the interaction effect).

[42]The data are obtained from http://www.oecd.org/investment/fdiindex.htm. We focus on foreign equity restrictions, since we find that other types of restrictions captured by the index (e.g. on screening, approval, and foreign personnel) do not affect ownership shares.

TABLE 6: *Additional unobservable effects and within-firm estimates*

Dep. var.: ownership share	HQ cty-subsid. ind. FE		+ Industry-pair FE		+ HQ firm FE	
	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law	10.82***		10.39***		7.227***	
	(2.674)		(2.651)		(2.073)	
Rule of law × specificity		3.980***		3.619***		3.603*
		(1.273)		(1.319)		(2.072)
HQ country-subsidiary industry FE	yes	yes	yes	yes	yes	yes
Industry-pair FE	no	no	yes	yes	yes	yes
HQ firm FE	no	no	no	no	yes	yes
Observations	431,348	185,125	420,630	180,361	283,334	102,055
R^2	0.299	0.321	0.337	0.356	0.656	0.679

Columns 1, 3, and 5 report estimates of equation (18), including all the control variables and FE from column 6 of Table 1. Columns 2, 4, and 6 report estimates of equation (19), including all the control variables and FE from column 6 of Table 2 plus the indicated FE. Standard errors clustered by subsidiary country and by HQ (columns 1, 3, and 5) or by subsidiary country-industry and by HQ (columns 2, 4, and 6) are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Column 5 of Table 6 shows that, within a given firm, the HQ chooses higher ownership shares in those subsidiaries that are located in countries with better contracting institutions. The within-firm estimate for the effect of rule of law is highly significant and of the same order of magnitude as in the baseline estimation. Also, as reported in column 6, the estimated interaction effect of rule of law with relationship-specificity has a similar magnitude as before, though it is estimated with less precision within HQ and only significant at the 10% level. Overall, the evidence from these highly demanding robustness checks lends further support to our main predictions.

4.3.3 SUBSAMPLES AND PANEL

In Table 7, we explore the robustness of our preferred specifications in alternative sample configurations. Panel A shows estimates of equation (18), including all control variables and FE from column 6 of Table 1, while Panel B considers the preferred specification of equation (19). In our main estimation sample, we have restricted ownership shares to a minimum of 10% to exclude small investments, which may be driven by portfolio considerations rather than lasting business interests. When increasing this threshold to 15% in column 1, we continue to find positive estimates for rule of law and the interaction effect. As noted in the introduction, a substantial share of the literature concerning the effects of contracting institutions on firm boundaries has thus far concentrated on international investments and on vertical buyer-seller relationships (see e.g. Antràs and Chor, 2013; Antràs, 2015). While our theory and empirical analysis are more general, we now show that our results are relevant to this literature, as they continue to hold even if we exclude ownership links in the domestic country or in the same industry. In the sample of foreign direct investments (FDI) in column 2, we find a slightly lower estimate for the rule of law index in the first specification, but a larger interaction effect. Both estimates are significant at the five percent level, although the sample size shrinks by a factor of five to seven. Our baseline estimates hardly change when we restrict the sample to subsidiaries active in a different four-digit NAICS industry from their owner, which we call 'vertical'

TABLE 7: *Subsamples and panel*

Dep. var.: ownership share	Subsamples				Panel	
	S≥15%	FDI	Vertical	High-income	Baseline	+ FE
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. First-order effect						
Rule of law	11.16***	7.089**	11.01***	6.829***	7.585***	7.130***
	(2.574)	(2.996)	(2.470)	(1.333)	(0.577)	(0.541)
Subsidiary industry-year FE					yes	yes
HQ industry-year & country-year FE					yes	nested
HQ industry-country-year FE					no	yes
Observations	419,766	65,220	319,236	367,874	1,917,452	1,910,195
R^2	0.294	0.192	0.269	0.307	0.224	0.259
Panel B. Interaction effect						
Rule of law × specificity	2.402***	4.505**	3.608***	3.590***	2.727**	2.297**
	(0.823)	(1.796)	(1.065)	(1.248)	(1.081)	(0.912)
Subsidiary industry-year & country-year FE					yes	yes
HQ industry-year & country-year FE					yes	nested
Country-pair FE					yes	nested
HQ industry-country-year FE					no	yes
Country-pair-year FE					no	yes
Observations	180,753	34,752	136,234	145,401	788,813	778,994
R^2	0.307	0.318	0.297	0.320	0.236	0.289

Panel A reports estimates of equation (18), including all the control variables and FE from column 6 of Table 1. Panel B reports estimates of equation (19), including all the control variables and FE from column 6 of Table 2. Column 1 includes only ownership shares of at least 15%. Column 2 restricts the sample to international ownership links (FDI). Column 3 restricts the sample to HQ and subsidiaries in different industries (vertical). Column 4 restricts the sample to high-income subsidiary countries with above-median GDP per capita. Columns 5 and 6 use the biannual panel from 2004 to 2014, controlling for the indicated time-varying FE in addition to observables. Standard errors clustered by subsidiary country and by HQ (Panel A) or by subsidiary country-industry and by HQ (Panel B) are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

relationships (column 3).[43] One might suspect that the quality of contracting institutions varies mainly between developed and developing countries, but less among OECD countries, which make up the bulk of observations in the Orbis database. To verify that our estimates are not driven by particular features of developing countries, we restrict the sample to subsidiaries located in high-income countries in column 4.[44] This approach has the additional advantage of excluding subsidiaries located in several small island states, including so-called 'offshore financial centers', where firms invest mainly for tax reasons. In this subsample, there remains substantial variation in the rule of law index, which has a standard deviation of 0.60 (compared to 0.86 in the main estimation sample). The estimated coefficients of the rule of law index and the interaction effect are positive and significant also in the high-income sample.

In the last two columns of Table 7, we turn to the full panel of ownership shares that we observe biannually for 2004-2014. By pooling these data, we substantially increase the sample and can additionally exploit

[43] This definition reflects the notion that subsidiaries active in a different industry from their parent are less likely to replicate the activity of the HQ, but instead the two firms find themselves at different positions along the (vertical) value chain. The same definition has been used for instance by Alfaro and Charlton (2009) and Fajgelbaum et al. (2015). As noted in footnote 10, our theoretical argument does not presuppose the existence of supply-use relationships between the two firms.

[44] As a threshold, we choose the median GDP per capita across all subsidiary countries from the main estimation sample. This is a very high threshold, as the country just below the median is Spain.

the time variation in ownership shares for identification. Note that we control for large sets of time-varying FE in addition to all the observable control variables from Table 1 in column 5, and we further extend the set of FE in the last column. These panel regressions confirm our positive and significant estimates for the rule of law index and the interaction effect with relationship-specificity.

4.3.4 SELECTION INTO COUNTRIES

In our main analysis, we have taken the location of the subsidiary as given and focused on the HQ's choice of the integration intensity. As predicted by our theoretical model, we find that differences in contracting institutions across countries shape the intensity of integration. However, a HQ's location choice, i.e., the selection of the production country, is also likely to be driven by contracting institutions and other country characteristics. Under certain conditions, this location choice can affect our analysis of the intensive margin of integration. In particular, one may envision that in practice, the HQ solves a two-stage decision problem, choosing first whether or not to produce in a given country, and in the second stage, deciding on the depth of integration (the optimal ownership share). Depending on what explains the location choice, such a decision structure might introduce selection bias to our estimations. Note that the direction of this bias is a priori unclear, as it depends on how the variables that drive selection in the first stage are correlated with the ownership shares and our key explanatory variables.

To address this issue, we estimate two-stage models that apply the selection correction proposed by Heckman (1979). The first-stage selection equation explains a dummy $O_{h\ell}$, which indicates whether or not we observe ownership shares (of at least 10%) of HQ h in any subsidiary in country ℓ, by the following probit regression:

$$\Pr(O_{h\ell} = 1|\mathbf{V}_{h\ell}) = \Phi\left(\boldsymbol{\nu} \cdot \mathbf{V}_{h\ell}\right), \tag{20}$$

whereby $\Pr$ denotes probability and $\Phi(\cdot)$ is the standard normal distribution function. The vector $\mathbf{V}_{h\ell}$ (with associated coefficient vector $\boldsymbol{\nu}$) includes all the country-specific and country-pair specific variables contained in $\mathbf{X}_{hm}$ from equation (18) (see column 6 of Table 1) as well as HQ country and industry FE. In addition, following the approach by Helpman et al. (2008), we include in $\mathbf{V}_{h\ell}$ a 'religious distance' variable, which captures the dissimilarity in the religious beliefs across country pairs.[45] This approach reflects the idea that similar religious beliefs may induce people to engage in economic activity and invest in the other country, while we have no reason to believe that they also affect the intensity of integration. Since the religious distance variable is excluded in the second-stage models, it contributes to identification. Given that we do not observe the HQ's business partners in countries for which the dummy $O_{h\ell}$ is equal to zero, we add one observation with $O_{h\ell} = 0$ for each country not selected by a given HQ. Since this procedure inflates the dataset with zeros, estimating equation (20) for the entire sample reaches computational limits, so we estimate it instead by HQ country or group of countries.[46] From the probabilities predicted by equation (20),

[45] Our 'religious distance' variable is taken from Spolaore and Wacziarg (2016) and represents a population-weighted measure of the similarity of religions based on a categorization by the World Christian Database (chosen to maximize country coverage in the Orbis data). We set religious distance to zero for domestic pairs.

[46] Depending on the number of observations per country in Orbis, we estimate equation (20) separately for 29 individual HQ

we compute the inverse Mills ratio (IMR), the so-called non-selection hazard. The IMR is then included in the second-stage models, given by equations (18) and (19), to correct for potential selection bias.

The estimation results from the two-stage Heckman models provide some evidence for the relevance of selection and strengthen our previous findings. The unreported first-stage probit regressions reveal for most of the HQ countries (or groups of countries) that religious distance tends to decrease the probability of an ownership link, in line with expectations. Furthermore, we find in most cases that subsidiaries are more likely to be observed in countries with a higher rule of law index. The second-stage regressions are reported in Table 8, which repeats for convenience the baseline results (from the last columns of Tables 1 and 2) in the first two columns. The added IMR in columns 3 and 4 turns out to be significant, indicating a selection bias in the absence of a correction. More precisely, the coefficient of the IMR is weakly negative in column 3, and it is positive and significant in the preferred model of column 4, which includes also country-pair FE. Most importantly, the estimates for the effects of rule of law and its interaction with relationship-specificity are positive and highly significant in these Heckman regressions. Moreover, the interaction effect is larger than the baseline estimate, indicating a downward bias due to selection. Hence, our main estimate without the selection correction is conservative in the sense that it tends to underestimate the positive interaction effect of contracting institutions and relationship-specificity on ownership shares.

TABLE 8: *Selection into countries*

Dep. var.: ownership share	Baseline		Heckman correction	
	(1)	(2)	(3)	(4)
Rule of law	11.12***		10.80***	
	(2.540)		(2.528)	
Rule of law × specificity		3.432***		3.769***
		(0.909)		(1.062)
IMR			-1.965*	1.654**
			(1.150)	(0.805)
Observations	433,108	186,110	432,954	152,567
R^2	0.278	0.295	0.278	0.303

Columns 1 and 3 report estimates of equation (18), including all the control variables and FE from column 6 of Table 1. Columns 2 and 4 report estimates of equation (19), including all the control variables and FE from column 6 of Table 2. Columns 1 and 2 repeat the baseline estimates. In columns 3 and 4, we correct for selection by including the inverse Mills ratio (IMR), predicted by probit regressions of equation (20), estimated separately for 29 HQ countries or country groups. Standard errors clustered by subsidiary country and by HQ (columns 1 and 3) or by subsidiary country-industry and by HQ (columns 2 and 4) are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

4.3.5 ORDERED LOGISTIC REGRESSION FOR OWNERSHIP CATEGORIES

There are two potential concerns related to the use of linear estimation methods in our baseline analysis. First, the linear model might not be ideally suited to explain the ownership share S_{hm}, which lies between zero and one, because it does not respect the variable's natural upper and lower bounds. As a symptom of this issue, OLS estimation may yield predicted values outside the unit interval, which is the case for a small share of observations in our preferred specification of equation (19). Second, OLS estimation does not allow for non-linear effects of the explanatory variables on ownership shares, although such non-linearities may be

countries or groups of countries, defined by the world regions indicated in Table B.1.

relevant in practice. For instance, there may be critical threshold values of the ownership share above which the owner obtains additional control rights. In terms of our model, one might envisage that full residual control rights over non-contractible inputs lie with the party that owns more than 50% of the firm. Similarly, the HQ may face additional obstacles when trying to exercise her residual control rights unless she owns 100% of the subsidiary. It is therefore conceivable that a firm's choice *between* ownership categories, such as majority and full ownership, is more sensitive to judicial quality compared to the choice of ownership shares *within* an ownership category (e.g. between 63% and 64%), implying non-linearities.

To address both of these concerns, we estimate an ordered logistic (henceforth, ordered logit) regression model using maximum likelihood methods. The dependent variable in this model is the categorical variable $\tilde{S}$, which takes on three distinct values for categories of ownership shares: 1 for minority (10-49.99%), 2 for majority (50-99.99%), and 3 for full ownership (100%). The ordered logit model, which describes the probabilities that the ownership share S_{hm} lies in each category, is specified as follows:

$$\Pr(\tilde{S} = 1|\mathbf{Z}_{hm}) = \Lambda(\chi_1 - \boldsymbol{\xi}\mathbf{Z}_{hm}) \tag{21}$$

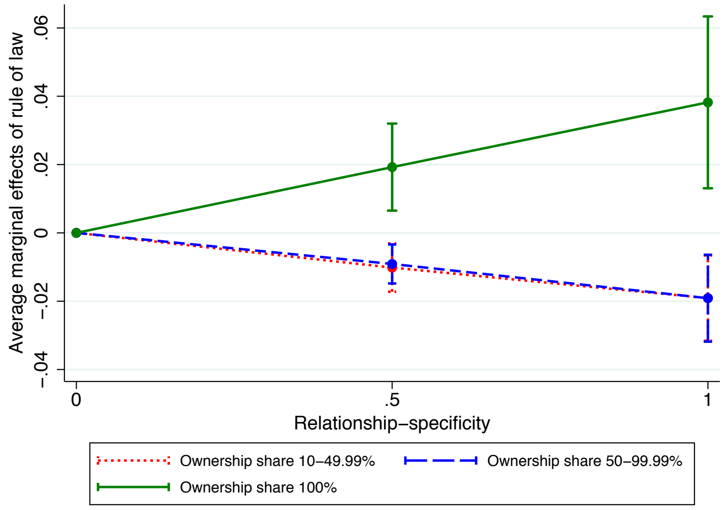
$$\Pr(\tilde{S} = 2|\mathbf{Z}_{hm}) = \Lambda(\chi_2 - \boldsymbol{\xi}\mathbf{Z}_{hm}) - \Lambda(\chi_1 - \boldsymbol{\xi}\mathbf{Z}_{hm}) \tag{22}$$

$$\Pr(\tilde{S} = 3|\mathbf{Z}_{hm}) = 1 - \Lambda(\chi_2 - \boldsymbol{\xi}\mathbf{Z}_{hm}) \tag{23}$$

where $\Lambda(\cdot)$ is the logistic function, $\mathbf{Z}_{hm}$ is the vector of all explanatory variables from the preferred specification of equation (19), and χ_1, χ_2, as well as $\boldsymbol{\xi}$ are the parameters to be estimated. This modeling approach allows us to take into account the natural upper and lower bounds of ownership shares and to address potential non-linearities. On the downside, the approach ignores the variation in ownership shares within each category, which amounts to assuming that institutions play a negligible role for explaining the choice of ownership within categories. Therefore, the ordered logit model constitutes an important robustness check, but it is not strictly preferable to our baseline approach. When estimating the model, we further need to apply two changes compared to our baseline estimation due to technical limitations. First, to keep the model computationally feasible, we cannot account for country-industry FE for the HQ, but instead include FE by HQ industry and by country pair. Second, standard errors are clustered only by the subsidiary's country-industry combination.

Figure 3 illustrates the ordered logit estimation results in terms of so-called 'average marginal effects' (AMEs) of rule of law on the probability that the ownership share lies in different categories, which are evaluated at three values of relationship-specificity (0, 0.5, and 1). These AMEs are obtained by computing the predicted effect of a marginal improvement in rule of law on the ownership share for each firm pair, at the observed levels of all other covariates, and averaging these marginal effects across all observations for a given category of relationship-specificity (using Stata's `margins` command). Consider first the solid line, representing the AMEs of rule of law on full ownership. The point estimates are significantly positive for intermediate and high relationship-specificity and increasing in the latter. By contrast, the AMEs of rule of law on minority and majority ownership (the dashed and dotted lines, respectively) are estimated

FIGURE 3: *Average marginal effects from ordered logit model for ownership categories*



Note: The figure depicts estimated average marginal effects (AMEs) of rule of law by relationship-specificity from the ordered logit regression model specified in equations (21) to (23), alongside 95% confidence intervals. The solid line represents the AMEs of rule of law on the probability of full ownership ($S_{hm} = 1$), the dashed line represents the AMEs of rule of law on the probability of majority ownership ($S_{hm} \in [0.5, 0.9999]$), and the dotted line represents the AMEs of rule of law on the probability of minority ownership ($S_{hm} \in [0.1, 0.4999]$). Standard errors are clustered at the subsidiary country-industry level. The number of observations is 187,605 and the pseudo R^2 is 0.2215.

to be negative and decreasing in relationship-specificity. Somewhat surprisingly, there is no noticeable difference in the AMEs between minority and majority ownership. Note, however, that these AMEs cannot be considered in isolation, but need to be interpreted relative to the other ownership categories. Taken together, the estimates suggest that better contracting institutions increase the propensity for HQ to choose full ownership *relative to* lower ownership shares, and this effect is stronger in industries with a higher relationship-specificity. Hence, the ordered logit estimates support our main hypotheses. They further add the insight that, empirically, better institutions particularly favor full ownership over joint ventures.

4.3.6 INSTRUMENTAL VARIABLES

Since we regress micro-level ownership shares on aggregate variables, measured at the levels of industries and countries, reverse causality does not appear to be a relevant issue when estimating equations (18) and (19). We might, however, imagine that the government of a country which has attracted many large foreign investments (in relationship-specific industries) would have particularly strong incentives to improve the quality of domestic contracting institutions. While a large bulk of foreign investment need not be reflected in high average ownership shares at the firm level, we nevertheless address the possibility of reverse causality by using instrumental variables (IV). We adopt the standard approach of using the historic origin of a country's legal system as an IV for the rule of law index (see Nunn, 2007). For this purpose, we rely on the classification of legal origins developed by La Porta et al. (1998) and revised by La Porta et al. (2008) into British common law or civil law of French, German, or Scandinavian origin.[47] We choose British com-

[47]The original classification includes the Socialist tradition as a fifth category. La Porta et al. (2008) reclassify the Socialist countries by French or German civil law, from which their legal systems originated and to which many of them reverted after the break-up of the Soviet Union. We follow this revised approach.

mon law as the base category and use three indicator variables for the other categories. Since legal origins are pre-determined, they are exogenous to ownership structures and can therefore resolve a possible reverse causality issue. In addition, the IV approach also tackles other potential biases due to omitted variables, discussed Section 4.3.2, or due to measurement error in our proxy for contracting institutions.

TABLE 9: *Instrumental variables*

	First-order effect		Interaction effect	
	First stage	Second stage	First stage	Second stage
Dep. var. in the header:	Rule of law	Ownership share	Rule of law × specificity	Ownership share
	(1)	(2)	(3)	(4)
Rule of law		13.29**		
		(5.320)		
Rule of law × specificity				3.524**
				(1.437)
French legal origin dummy	-0.587***			
	(0.155)			
German legal origin dummy	-0.0123			
	(0.0895)			
Scandinavian legal origin dummy	-0.480*			
	(0.253)			
French legal origin × specificity			-1.126***	
			(0.0774)	
German legal origin × specificity			-0.547***	
			(0.0784)	
Scandinavian legal origin × specificity			0.125*	
			(0.0730)	
Observations	433,108	433,108	186,110	186,110
Partial R^2 (excluded IV)	0.331		0.429	
F-statistic (excluded IV, Kleibergen-Paap)	11.15		110.7	
P-value of F-test	0.0000		0.0000	

The table reports estimation results of 2SLS regressions. Column 1 reports the first-stage estimates and column 2 reports the second-stage estimates of equation (18), in which we instrument rule of law by a set of legal origin dummies, including all the control variables and FE from column 6 of Table 1. Column 3 reports the first-stage estimates and column 4 reports the second-stage estimates of equation (19), where we instrument the interaction of rule of law × specificity by interactions of legal origin dummies with specificity, including all the control variables and FE from column 6 of Table 2. Standard errors clustered by subsidiary country and by HQ (columns 1-2) or by subsidiary country-industry and by HQ (columns 3-4) are reported in parentheses. Asterisks indicate significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 9 reports the results of two-stages least squares (2SLS) estimations of our preferred specifications of equations (18) and (19). The first column reports the first-stage estimation results of regressing the rule of law index on the legal origin dummies for the subsidiary's country. It shows that countries with a legal system of French and Scandinavian origin have a significantly lower rule of law index (conditional on the covariates), and that these differences explain a substantial share of the variation in judicial quality, as evidenced by a high partial R^2 of 0.33. The F-test for significance of the excluded IV yields a Kleibergen-Paap F-statistic of 11.15, exceeding the Stock and Yogo (2002) critical value for a 10% maximal IV bias relative to OLS, so legal origin serves as a strong IV. The second-stage regression in column 2 yields a positive and significant estimate for the instrumented rule of law index, confirming our previous findings. In columns 3 and 4, we instrument for the interaction term between the rule of law index and relationship-specificity in equation (19) using interactions of legal origin dummies with relationship-specificity. The first-stage regression (column 3) reveals that these interaction terms are both individually and jointly significant, with a very high F-statistic of the excluded IV and a partial R^2 of 0.43. In the second-stage regression, summarized in column 4, we find a positive and significant interaction effect of a similar magnitude as in the OLS estimations, which supports Proposition 2.

4.3.7 PROPENSITY SCORE MATCHING

The critical assumption for the validity of the IV approach to estimating equation (19) is that the historical origins of countries' legal systems have no *differential* effect (by relationship-specificity) on firm boundaries in 2014 other than through contracting institutions, conditional on all control variables. This exclusion restriction may be violated if legal origins are correlated with other cultural or institutional characteristics that also shape firm boundaries differentially across industries. Such a violation of the exclusion restriction might be the reason for the slightly larger estimate of the interaction effect in our 2SLS regression compared to OLS, which is in conflict with the upward bias of OLS that we would expect due to reverse causality.[48] To address a potential violation of the exclusion restriction, we continue to follow Nunn (2007) and implement Propensity Score Matching (PSM). The idea of PSM, which goes back to Rosenbaum and Rubin (1983, 1984), is to select observations from treatment and control groups that are similar based on observable characteristics, assuming that they are also similar in terms of unobservables.

In our application, we seek to compare similar firm pairs involving subsidiaries in countries with favorable and unfavorable contracting institutions. Therefore, we select all observations of subsidiaries located in countries whose legal system is of British origin ($L_{hm} = 1$), which has been shown to be most favorable for investors, and match them to the most comparable observation of a subsidiary located in a country with French legal origin ($L_{hm} = 0$) *in the same industry*. Comparability is determined by the propensity score, i.e., the predicted value of the indicator P_{hm}, as explained by the following probit regression:

$$P_{hm} = \Pr(L_{hm} = 1|\mathbf{W}_{hm}) = \Phi(\boldsymbol{\zeta} \cdot \mathbf{W}_{hm} + \upsilon_{hm}), \tag{24}$$

where we match observations on the variables summarized in the vector $\mathbf{W}_{hm}$ (with associated coefficients $\boldsymbol{\zeta}$), and υ_{hm} is an error term. In the baseline PSM approach, $\mathbf{W}_{hm}$ includes the following variables: GDP per capita of the subsidiary's country, capital intensity and intangible assets intensity of the HQ's industry, a dummy variable for domestic (vs. international) ownership links, and $\ln$ *employment* of the subsidiary firm.[49] Capital intensity and intangible assets intensity serve as proxies for the relative importance of the HQ's inputs in the production process, an important determinant of the severity of hold-up problems identified in the incomplete-contracts literature (see Antràs, 2015, and our model extension in Section 2.4.2). To better control for firm heterogeneity, we then vary the set of matching variables $\mathbf{W}_{hm}$ by successively adding the following characteristics of the subsidiary firm: age, capital intensity, and the shareholder dummy. Based

[48] An alternative, less problematic explanation is that the IV approach corrects for a downward bias in the OLS estimates due to measurement error or omitted variables.

[49] Capital intensity is defined as the logarithm of total capital over total employment, and intangible assets intensity is defined as the logarithm of total intangible assets over total fixed assets, both measured in the HQ's industry in 2013. The firm-level variables are defined in Section 4.3.2.

on the predicted propensity score $\widehat{P}_{hm}$ from equation (24), we match observations within a given subsidiary industry with their so-called 'nearest neighbor' (with replacement), i.e., the single observation with the most similar propensity score, while restricting observations to the common support.[50]

For the matched observations, we construct the ratio of ownership shares for the subsidiary in the British legal origin country (B) over the one located in the French legal origin country (F). The logarithm of this ratio is then regressed on our preferred measure of relationship-specificity R_i:

$$\ln\left(S_{hmB}/S_{hmF}\right) = \psi_1 + \psi_2 \cdot R_i + \xi_{hmBF}, \tag{25}$$

with coefficients ψ_1 and ψ_2, and an error term ξ_{hmBF}. Standard errors are clustered at the level of the industry i in which subsidiary m is active. Since the contracting institutions in British legal origin countries are more favorable for investors, Proposition 2 would predict higher ownership shares for subsidiaries in these countries producing more relationship-specific goods, which translates into an estimate $\widehat{\psi}_2 > 0$.

Table 10 reports our results from estimating equation (25). We start in column 1 by combining all possible observations in the same industry involving subsidiaries from a British and a French legal origin country, which results in almost 100 million pairs of observations. The regression reveals a positive estimate for the coefficient of relationship-specificity, confirming our intuition based on the PRT. However, ownership shares may differ between these pairs for a variety of reasons other than legal origins. Therefore, we restrict the analysis to matched firm-pair observations, which are similar in terms of the variables contained in $\mathbf{W}_{hm}$. For all variants of $\mathbf{W}_{hm}$, we find estimates $\widehat{\psi}_2$ which are positive and significant (at least at the ten percent level) in columns 2-5. These estimates, which lie in the range of 0.44-0.62, are smaller than in the unmatched sample. This finding is in line with the expected direction of a bias that would arise from reverse causality or from omitted variables positively correlated with contracting institutions. Overall, the PSM results lend further support to our main hypothesis that better contracting institutions increase the depth of integration between firms more strongly in relationship-specific industries.

TABLE 10: *Propensity score matching*

Dep. var.: $\ln\left(S_{hmB}/S_{hmF}\right)$	Unmatched	Baseline PSM	+ Age	+ Capital int.	+ Shareholder
	(1)	(2)	(3)	(4)	(5)
Specificity (subsidiary industry)	0.907***	0.442*	0.619***	0.504***	0.451**
	(0.310)	(0.232)	(0.228)	(0.189)	(0.195)
Observations	94,959,461	9,578	9,571	7,078	7,070
R^2	0.002	0.001	0.001	0.001	0.001

The table reports estimates of equation (25). The first column considers the unmatched sample of all possible combinations of observations involving one subsidiary in a British and one in a French legal origin country. Columns 2-5 are restricted to the sample of (nearest neighbor) pairs matched based on the propensity score predicted by variants of equation (24). In column 2, observations are matched via the following variables: GDP per capita of the subsidiary's country, capital intensity and intangible assets intensity of the HQ's industry, a dummy variable for domestic ownership links, and ln *employment* of the subsidiary firm. Columns 3-5 successively add to equation (24) the subsidiary firm variables listed in the header. Standard errors clustered by subsidiary industry are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

[50]Formally, we choose for each observation involving a subsidiary with British legal origin the observation involving a subsidiary with French legal origin in the same industry i for which the absolute difference in propensity scores is smallest. This procedure is implemented by the Stata module `psmatch2` provided by Leuven and Sianesi (2015). A similar approach has been adopted by Ma et al. (2010) using firm-level data.

5 Concluding Remarks

The fundamental role of contractual imperfections in shaping firm boundaries is widely accepted in the economic discipline. However, there is no consensus on whether reducing these imperfections eventually leads to more deeply integrated firms or a stronger reliance on markets. We contribute to this debate by developing a generalized Property-Rights Theory of the firm, which suggests that better contracting institutions increase the willingness of headquarters to obtain a larger ownership share in their subsidiaries, and that this effect is particularly pronounced in industries with a high degree of relationship-specificity. Using unique micro data on global ownership links across firm pairs, we find strong empirical support for these predictions. Our findings are confirmed for a variety of different measures of contracting institutions and relationship-specificity. They are also robust to controlling for a host of unobservable factors and industry-specific effects of economic development or other institutions. Finally, we corroborate our results by using legal origins as an exogenous source of institutional quality in instrumental variables and propensity score matching techniques.

What are the policy implications of our findings? Policymakers in developing countries may hope to attract foreign direct investment by improving the quality of domestic contracting institutions. Perhaps surprisingly, the Transaction-Cost Theory would suggest that such improvements discourage (rather than encourage) foreign ownership, since they facilitate market-based transactions and thus undermine the incentive for FDI. This paper has demonstrated that the Property-Rights Theory confirms the policymakers' intuition: Better contracting institutions should induce investors to choose higher degrees of integration. This intuition is strongly supported by our extensive empirical analysis of global firm pairs. Furthermore, we show that an improvement of contracting institutions has a particularly strong effect on the integration intensity in industries with a high degree of relationship-specificity. Since relationship-specific industries are typically also characterized by high technology and information content, improving judicial quality may entail further favorable outcomes through spillovers from FDI.

A Mathematical Appendix

A.1 Participation constraint

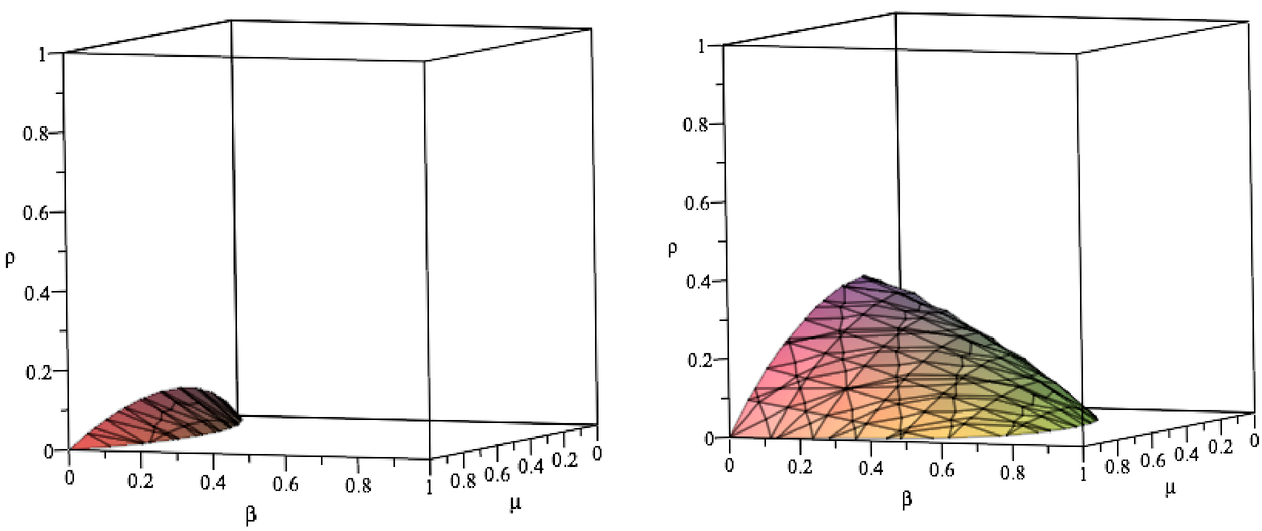
Utilizing equations (4), (6), (8), (11), (12), (13), and (15), as well as the definition of $\alpha = \frac{\sigma-1}{\sigma}$ in equation (10), we obtain after simplification the sufficient condition for which the optimal ownership share s^* from the viewpoint of H does *not* violate M's participation constraint:

$$\sigma[\rho + \beta(1-\rho)] + \mu^2(\sigma-1)^2(1-\beta)(1-\rho) - \mu(\sigma-1)\Big[\sigma\left[1-2\rho-\beta(1-\rho)\right] - (1-\beta)(1-\rho)\Big] \geq 0.$$

A tedious but straightforward analysis shows that this inequality is more likely to hold the higher ρ and β, less likely to hold the higher σ, and is ambiguously affected by a change in μ. To assess the overall likelihood of this inequality to hold for various *combinations* of parameter values, we fix the value of σ and depict all possible combinations of $\beta \in (0,1)$ and $\mu, \rho \in [0,1]$ which fulfill the above-mentioned condition with equality. The value of $\sigma = 2.25$ assumed in Figure A.1(a) is the mean value in Crozet and Koenig (2010), obtained from estimating a structural model of international trade using French firm-level data. The plane depicted in this figure illustrates the parameter combinations for which M's PC is fulfilled with equality, while it is slack (i.e., $\pi_M > 0$) for any combination of β, μ, and ρ above this plane, and it would be violated (i.e., $\pi_M < 0$) below this plane. As can be seen from Figure A.1(a), M's PC is fulfilled (and can hence be ignored) for the vast majority of parameter values. In Figure A.1(b), we choose an alternative value of $\sigma = 13$, reflecting the mean value estimated by Broda and Weinstein (2006) for five-digit industries, which may be considered a rather high value for the average elasticity of substitution. Compared to Figure A.1(a), M's PC is binding for a larger subset of the parameter space. Nevertheless, it is still non-binding for the vast majority of permissible parameter values.

Figure A.1: *Combinations of β, μ, and ρ which satisfy M's PC with equality*

(a) $\sigma = 2.25$ (b) $\sigma = 13$



A.2 EX-ANTE TRANSFERS

Assume that, after the optimal ownership share is chosen (i.e., in period t_1), H charges from M a transfer (participation fee) T. This transfer can be positive or negative, and it ensures that M is just indifferent between participating in the current relationship and obtaining his ex-ante outside option (normalized to zero).[51] Formally, the equilibrium transfer satisfies the following condition:

$$\pi_M - T = 0 \tag{A.1}$$

whereby π_M is given by equation (5). Since the transfer is conducted in t_1, it does not affect M's maximization problem in period t_3. Hence, the optimal amount of non-contractible inputs m_n continues to be given by equation (6).

Under consideration of the ex-ante transfer, H's pure profit reads $\pi_{HT} = \pi_H + T$, whereby π_H is given by equation (9) and T is determined by equation (A.1). H's objective function in period t_2 reads:

$$\max_{\{m(i)\}_{i=0}^{\mu}} \pi_{HT} = R - (1-\mu)m_n - \int_0^{\mu} m(i)\mathrm{d}i, \tag{A.2}$$

whereby m_n is given by equation (6). Notice that, in the presence of ex-ante transfers, H reaps the entire surplus from the relationship. Using equations (6), (7), and (8), the maximization problem from equation (A.2) yields the optimal amount of contractible inputs:

$$m(i) = \theta\alpha R \equiv m_c \qquad \forall i \in [0, \mu],$$

as a function of equilibrium revenue (obtained from plugging equation (A.2) into equation (7)):

$$R = \delta^{\frac{\alpha(1-\mu)}{1-\alpha}} \theta^{\frac{\alpha\mu}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} D, \tag{A.3}$$

whereby

$$\theta \equiv \frac{1 + s(1-\rho) - \beta(1-\rho) - \alpha(1-\beta)(1-\mu)}{[1-\alpha(1-\mu)]\,[1 + s(1-\rho) - \beta(1-\rho)]}. \tag{A.4}$$

In period t_1, H maximizes $\pi_{HT} = R - (1-\mu)\delta\alpha R - \mu\theta\alpha R$ via the choice of s, whereby δ, R, and θ are given by equations (8), (A.3), and (A.4), respectively. The first-order condition of this maximization problem yields the following optimal ownership share:

$$s^* = -\frac{\rho\beta}{1-\rho},$$

which is negative. To understand the intuition behind this result, notice from equation (8) that $s^* = -\frac{\rho\beta}{1-\rho}$ would fully eliminate M's underinvestment (since $\delta|_{s=s^*} = 1$). With ex-ante transfers, H obtains the entire surplus from the relationship and maximizes the overall surplus by choosing the lowest possible ownership share, which is equal to zero regardless of contracting institutions.

[51] This assumption can be justified by assuming an infinitely elastic supply of M agents competing for a given relationship.

A.3 HEADQUARTER INTENSITY

M's maximization problem in period t_3 continues to be given by equation (5). Bearing in mind the new production function from equation (16), this maximization problem delivers M's reaction function:

$$m(i) = (1-\eta)\delta\alpha R \equiv m_n \qquad \forall i \in [\mu, 1], \tag{A.5}$$

whereby δ is given by equation (8). In t_3, H chooses the amount of h which maximizes her share of the quasi-rent from equation (4) minus production costs of headquarter services: $\max \pi_H = \beta Q - h$.[52] This maximization problem yields the optimal amount of non-contractible headquarter services:

$$h_n = \eta\beta\alpha R, \tag{A.6}$$

as a function of revenue (obtained from plugging equations (16), (A.5), and (A.6) into equation (1)):

$$R = \left(\left[\exp \int_0^\mu \ln m(i)\mathrm{d}i\right]^{\alpha(1-\eta)} \beta^{\alpha\eta}\, \delta^{\alpha(1-\eta)(1-\mu)}\, \alpha^{\alpha[1-\mu(1-\eta)]}(1-\eta)^{-\alpha\mu(1-\eta)} D^{1-\alpha}\right)^{\frac{1}{1-\alpha[1-\mu(1-\eta)]}}. \tag{A.7}$$

In t_2, H chooses the amount of contractible inputs that maximizes her profit:

$$\max_{\{m(i)\}_{i=0}^{\mu}} \pi_H = (1-\rho)s(1-\mu)m_n + (1-\rho)\int_0^\mu m(i)\mathrm{d}i + \beta Q - \int_0^\mu m(i)\mathrm{d}i - h_n, \tag{A.8}$$

subject to M's participation constraint ($\pi_M \geq 0$), whereby m_n, h_n, and R are given by equations (A.5), (A.6), and (A.7), respectively. To keep the exposition as simple as possible, we assume in what follows that M's PC is fulfilled. It should be noted, however, that our results continue to hold in case of a binding PC. Utilizing equations (4), (A.5), (A.6), and (A.7) in equation (A.8), and solving H's maximization problem yields the optimal amount of contractible manufacturing inputs and the associated revenue:

$$m(i) = (1-\eta)\kappa\alpha R \equiv m_c \qquad \forall i \in [0, \mu], \qquad R = \delta^{\frac{\alpha(1-\mu)}{1-\alpha}} \kappa^{\frac{\alpha\mu}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} D, \tag{A.9}$$

whereby

$$\kappa \equiv \frac{\beta - \alpha[\beta\eta - \delta(1-\rho)(1-\mu)(s-\beta)]}{[(1-\rho)\beta+\rho]\Big[1-\alpha\left[1-\mu(1-\eta)\right]\Big]}, \tag{A.10}$$

and δ is given by equation (8).

In t_1, H chooses the optimal ownership share by solving the following maximization problem:

$$\max_s \pi_H = (1-\rho)s(1-\mu)\delta\alpha R - \rho\mu\kappa\alpha R + \beta[R - (1-\rho)(1-\mu)\delta\alpha R - (1-\rho)\mu\kappa\alpha R] - \eta\beta\alpha R.$$

Utilizing equations (8), (A.9), and (A.10) therein, we obtain from the first-order condition the optimal ownership share presented in equation (17).

[52] Recall that h is assumed to be fully relationship-specific, and hence, it does not affect H's outside option.

B Data Appendix

Table B.1: *List of countries by rule of law index and average ownership shares*

Rank	ISO	Rule of law	Subsidiaries	Average share	Rank	ISO	Rule of law	Subsidiaries	Average share
1	FIN^m	1.94	6,040	87.59	64	GHA^a	-0.19	7	80.33
2	DNK^m	1.92	10,161	80.24	65	BMU^c	-0.19	176	41.68
3	NOR^m	1.87	14,571	76.55	66	MKD^h	-0.24	321	59.43
4	NZL^b	1.84	1,946	88.55	67	MAR^a	-0.27	310	76.59
5	CHE^j	1.84	9,814	82.54	68	BGR^h	-0.29	3,277	76.78
6	SWE^m	1.81	19,203	89.27	69	BRA^c	-0.29	6,043	62.98
7	NLD	1.80	35,248	94.86	70	IND^e	-0.30	9,731	60.26
8	AUT	1.78	11,998	78.03	71	SEN^a	-0.31	60	79.16
9	AUS^b	1.75	8,016	84.45	72	TUN^a	-0.33	1	15.83
10	LUX	1.72	2,505	82.86	73	TTO^c	-0.34	5	42.00
11	SGP^f	1.71	2,115	85.47	74	LKA^e	-0.36	612	77.58
12	CAN	1.71	2,231	58.71	75	THA^f	-0.36	3,045	60.76
13	GBR^l	1.71	60,985	93.33	76	SRB^h	-0.37	1,858	76.73
14	HKG^d	1.67	4,147	82.80	77	BIH^h	-0.42	688	72.59
15	DEU	1.67	62,260	79.02	78	MHL^b	-0.43	13	51.13
16	IRL	1.62	3,582	85.58	79	ZMB^a	-0.47	9	84.73
17	LIE^j	1.57	44	95.00	80	MDA^i	-0.49	156	64.90
18	ISL^m	1.54	615	72.87	81	MWI^a	-0.51	3	40.40
19	USA	1.43	27,863	55.62	82	VNM^f	-0.52	626	59.50
20	JPN	1.41	41,368	51.73	83	JAM^c	-0.53	13	51.26
21	BEL	1.33	14,519	75.30	84	PHL^f	-0.54	1,016	69.96
22	FRA	1.28	59,175	79.59	85	CHN^d	-0.55	16,691	69.78
23	EST^i	1.18	1,644	81.87	86	COL^c	-0.56	1,059	69.88
24	MLT^n	1.02	567	60.81	87	IDN^f	-0.56	213	59.73
25	TWN^d	1.01	2,016	57.34	88	ALB^h	-0.59	125	73.26
26	CZE	0.94	7,800	83.70	89	DOM^c	-0.60	1	20.00
27	PRT^n	0.94	10,168	71.71	90	TZA^a	-0.62	30	68.97
28	ISR^g	0.91	2,405	72.28	91	MEX^c	-0.67	79	58.90
29	CYP^h	0.87	335	71.74	92	KEN^a	-0.67	12	46.17
30	BRB^c	0.86	4	56.56	93	GAB^a	-0.72	1	58.28
31	QAT^g	0.79	30	53.60	94	SLV^c	-0.73	3	50.01
32	KOR	0.79	5,764	64.97	95	BFA^a	-0.75	1	51.00
33	SVN^h	0.78	1,463	69.67	96	KAZ^g	-0.77	4,447	85.42
34	ESP	0.74	38,436	70.43	97	PER^c	-0.77	684	68.46
35	MUS^a	0.72	86	61.23	98	CUB^c	-0.79	32	57.82
36	LTU^i	0.71	1,266	81.08	99	GUY^c	-0.81	2	20.00
37	LVA^i	0.67	1,377	82.06	100	EGY^a	-0.82	250	63.14
38	POL^i	0.62	13,165	80.12	101	CIV^a	-0.83	16	73.21
39	ARE^g	0.51	201	72.85	102	NPL^e	-0.90	2	65.00
40	URY^c	0.48	3	77.67	103	PRY^c	-0.90	5	76.31
41	MYS^f	0.44	6,091	76.76	104	RUS	-0.93	36,431	70.15
42	BWA^a	0.44	5	44.57	105	BGD^e	-0.94	12	48.55
43	CYM^c	0.41	171	48.31	106	DZA^a	-0.95	91	67.44
44	OMN^g	0.38	57	40.92	107	MDG^a	-0.96	1	100.00
45	CPV^a	0.37	2	22.76	108	LBN^g	-0.98	18	67.68
46	CRI^c	0.31	5	80.49	109	PAK^e	-1.00	141	60.07
47	HUN^i	0.30	5,560	81.93	110	UKR^i	-1.01	9,969	74.00
48	JOR^g	0.28	51	47.70	111	BLR^i	-1.03	31	70.02
49	SVK	0.27	3,204	82.22	112	MOZ^a	-1.06	2	36.45
50	BHR^g	0.25	32	43.02	113	LBR^a	-1.07	2	16.16
51	GRC^h	0.14	2,299	70.38	114	ARG^c	-1.13	842	69.66
52	ITA	0.13	45,664	63.92	115	BDI^a	-1.16	1	10.00
53	HRV^h	0.11	1,708	84.46	116	GTM^c	-1.21	1	100.00
54	SAU^g	0.06	312	62.02	117	IRN^g	-1.26	14	47.10
55	GEO^g	0.00	51	88.59	118	ECU^c	-1.28	74	75.36
56	ZAF^a	-0.05	1,825	82.83	119	BOL^c	-1.30	6	51.84
57	ROU^h	-0.06	5,227	76.15	120	UZB^g	-1.31	9	48.46
58	NAM^a	-0.07	4	75.50	121	NGA^a	-1.31	21	52.40
59	KNA^a	-0.12	2	20.10	122	AGO^a	-1.32	1	51.00
60	RWA^a	-0.13	5	83.34	123	SYR^g	-1.57	2	99.98
61	MNE^h	-0.14	100	67.49	124	IRQ^g	-1.59	34	86.37
62	KWT^g	-0.16	77	57.21	125	ZWE^a	-1.65	3	36.46
63	TUR^g	-0.17	5,818	65.41	126	VEN^c	-2.13	4	70.85

The table lists ISO country codes, sorted in descending order by the rule of law index, the number of subsidiaries in our data, and the average direct ownership share by country. Lower average ownership shares are highlighted in darker shades of gray. Countries grouped by world regions for the selection model in Section 4.3.4 are indicated by: ^{a} Africa, ^{b} Oceania, ^{c} Latin America and Caribbean, ^{d} China, Taiwan, and Hong Kong, ^{e} South Asia, ^{f} South East Asia, ^{g} Central and South West Asia, ^{h} South East Europe, ^{i} Eastern Europe, ^{j} Switzerland and Liechtenstein, ^{k} France and Monaco, ^{l} UK incl. Gibraltar, ^{m} Northern Europe, ^{n} South West Europe.

TABLE B.2: *Summary statistics for main estimation sample*

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Direct ownership share (percent, Orbis)	230,937	74.805	29.813	10	100
Rule of law index (Worldwide Governance Indicators, World Bank)	230,937	0.87	0.914	-1.595	1.944
Specificity (baseline, subsidiary industry, based on Rauch, 1999)	230,937	0.949	0.162	0	1
ln GDP (subsidiary country, 2010, PWT)	230,772	14.053	1.29	7.636	16.38
ln GDP per capita (subsidiary country, 2010, PWT)	230,772	10.086	0.559	6.013	11.655
ln capital-labor ratio (K_ℓ/L_ℓ) (subsidiary country, 2010, PWT)	188,120	7.86	0.974	2.846	9.756
ln years of schooling (subsidiary country, 2010, PWT)	230,153	1.103	0.112	0.538	1.286
ln capital intensity ln (K_i/L_i) (subsidiary country, Orbis)	230,937	3.277	0.988	-3.061	8.616
ln distance (km, CEPII)	229,770	5.978	1.203	1.007	9.883
Contiguity dummy (CEPII)	229,770	0.048	0.214	0	1
Common language dummy (CEPII)	229,770	0.042	0.2	0	1
Time zone difference (hours, CEPII)	229,101	0.517	1.81	0	12
Colonial link dummy (CEPII)	229,770	0.02	0.14	0	1
Domestic ownership link dummy (Orbis)	230,937	0.798	0.402	0	1
Number of subsidiaries (headquarter, Orbis)	230,937	15.191	41.898	1	888
Number of shareholders (subsidiary, Orbis)	230,937	1.914	3.83	1	421
Financial development (subsidiary country, GFDD)	200,438	182.055	70.789	13.804	582.734
Labor market flexibility (subsidiary country, World Bank)	230,734	0.633	0.168	0.352	1
IPR protection index (subsidiary country, Park, 2008)	223,467	1.112	0.459	-2.253	1.696
Expropriation risk (IHS Markit)	230,349	-.502	0.538	-1.358	3.868
Contract enforcement (IHS Markit)	230,349	0.771	0.626	-3.179	1.481
Law and order (PRS)	230,287	0.771	0.687	-1.61	1.824
Enforcing contracts (WBDB)	230,817	0.7	0.839	-2.837	2.245
Legal formalism index (Djankov et al., 2003)	227,727	0.178	0.682	-2.174	2.667
Property rights freedom (Heritage foundation)	230,809	0.798	0.943	-1.559	1.88
Enforceability of contracts (BERI)	197,694	0.558	0.912	-1.61	1.782
Specificity (conservative, subsidiary industry, based on Rauch, 1999)	230,937	0.966	0.114	0.114	1
Specificity (differentiated, subsidiary industry, based on Rauch, 1999)	230,937	0.722	0.379	0	1
Relationship duration (years/10, Orbis)	230,937	0.255	0.306	0	1
ln employment (subsidiary, Orbis)	109,421	3.727	1.573	0	11.658
ln (value added/ employment) (subsidiary, Orbis)	57,877	4.429	1.039	-6.136	13.333
ln (capital/ employment) (subsidiary, Orbis)	100,649	2.188	2.478	-7.767	14.708
ln (value added/ employment) (subsidiary, Orbis)	134,290	0.693	0.364	0	1
Shareholder dummy (subsidiary, Orbis)	144,545	0.287	0.452	0	1
Firm age (subsidiary, Orbis)	143,679	19.495	18.241	0	813

The table reports summary statistics of all variables used in the empirical analysis for the full estimation sample of Table 2.

TABLE B.3: *Alternative proxies for the quality of contracting institutions*

Measure	Source	Description
Contract enforcement	IHS Markit	Inverse measure of the "risk that the judicial system will not enforce contractual agreements between private-sector entities" (2014, first quarter).
Law and order	Political Risk Services (PRS)	This component of the International Country Risk Guide is designed to measure "the strength and impartiality of the legal system" and "popular observance of the law" (2014).
Enforcing contracts	World Bank Doing Business (WBDB)	The distance to the frontier in enforcing contracts reflects the "time, cost and procedural complexity to resolve a standardized commercial dispute between two domestic businesses" involving "the breach of a sales contract" (2014).
Legal formalism	Djankov et al. (2003)	The index "measures substantive and procedural statutory intervention in judicial cases at lower-level civil trial courts".
Property rights freedom	Heritage foundation	The index reflects a "qualitative assessment of the extent to which a country's legal framework allows individuals to freely accumulate private property, secured by clear laws that are enforced effectively by the government" (2014).
Enforceability of contracts	Business Environmental Risk Intelligence (BERI)	Measures the "relative degree to which contractual agreements are honored and complications presented by language and mentality differences" (Knack and Keefer, 1995).

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