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Contracting Institutions and Firm Integration Around the World*

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Abstract

Firm integration is fundamentally shaped by contractual frictions. But do better contracting institutions, reducing these frictions, induce firms to be more or less deeply integrated? To address this question, this paper exploits unique micro data on ownership shares across more than 200,000 firm pairs worldwide, including domestic and cross-border ownership links. We uncover a new stylized fact: Firms choose higher ownership shares in subsidiaries located in countries with better contracting institutions. We develop a Property-Rights Theory of the multinational firm featuring partial ownership that rationalizes this pattern and guides our econometric analysis. The estimations demonstrate that better contracting institutions favor deeper integration, in particular in relationship-specific industries.

JEL classifications: F21, F23, D02, D23, L14, L23.
Keywords: firm integration, contracting institutions, multinational firms, Property-Rights Theory, ownership shares.

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1 Introduction

A key decision made by each and every firm around the world is its choice of ownership and control over the activities that are essential for its business, ranging from R&D to sales. Since the pioneering work of Coase (1937), a vast theoretical literature has evolved around this integration decision. The consensus view in this literature is that the single most important determinant of firm integration is contractual incompleteness, resulting from the fact that courts cannot fully verify and enforce complex contracts between business partners. More specifically, Gibbons (2005) distills from this literature four seminal theories of the firm, all of which attribute a fundamental role to contractual frictions in shaping firm integration.[1] In fact, according to these theories, the integration decision would become entirely obsolete if any contract, no matter how complex, could be perfectly enforced. Yet, despite the paramount importance of contractual frictions, it remains an open question whether a reduction in these frictions leads to more or less integration.

Empirically, firms face different degrees of contractual frictions, since the quality of contracting institutions varies substantially across countries. The World Bank estimates that a standardized lawsuit is completed within 164 days in Singapore, while a comparable lawsuit lasts 1,300 days (almost eight times as long) in Greece. These large international differences can be informative about how contractual frictions shape firm integration decisions. Indeed, we observe that firms choose different degrees of integration across countries, even within the same multinational group. Airbus SE, for instance, was the sole owner of the aircraft components producer Premium Aerotec GmbH in Germany, maintained a 79% share in EADS PZL Warszawa-Okęcie SA in Poland, and held a minority share of 34% in Sopeçaero Ltda in Brazil in 2014. To what extent do these patterns depend systematically on the contracting environment in the three countries? More generally, do better contracting institutions induce firms to be more or less deeply integrated?

This paper provides a first global investigation of how contracting institutions shape integration decisions across firm pairs. Clearly, the countries in the above-mentioned example differ along various dimensions, and therefore, it is an empirical challenge to distinguish the role of contracting institutions from these other country characteristics. To this end, we exploit detailed micro data on global ownership links from the Orbis database, which provides an unparalleled view on firms' integration decisions around the world. These data are unique in combining three key features: a high degree of granularity, precise measurement of ownership, and global coverage. First, information is available at the disaggregation level of the *firm pair*, at which the actual integration decision is made. Second, integration decisions are measured directly and precisely by *ownership shares*,

[1] These theories are the Transaction-Cost Theory, which goes back to Coase (1937) and was further developed by Williamson (1971, 1975, 1985), the Property-Rights Theory by Grossman and Hart (1986) and Hart and Moore (1990), the Incentive-System Theory (Holmstrom and Milgrom, 1991, 1994; Holmstrom, 1999), and the Adaptation Theory (Simon, 1951; Williamson, 1975).

which vary continuously and allow us to distinguish marginal differences in the forces shaping firm integration.[2] And third, the data have *vast international coverage*, including both domestic and international ownership linkages that involve more than 200,000 subsidiaries from 101 countries around the world. Notably, the data encompass multinational firms, which own subsidiaries in multiple countries, thereby providing particularly valuable variation for our analysis. This dataset allows us to exploit the large international differences in the quality of contracting institutions to understand how contracting frictions shape firms' integration decisions.

The paper makes three contributions. First, we establish a novel stylized fact in the global micro data: Firms integrate their subsidiaries more deeply (i.e., they choose higher ownership shares and are more likely to opt for full ownership) in countries with better contracting institutions. This positive correlation is evident in the raw data and it prevails after controlling for various observable factors and several dimensions of unobserved heterogeneity in our firm-pair data. Furthermore, contracting institutions turn out to be one of the most important predictors of firm integration among a large set of country-specific factors (such as the level of development, geography, and other institutional characteristics). This empirical regularity calls for a theoretical explanation.

Our second contribution is to develop a theoretical model, based on the seminal Property-Rights Theory (PRT) of the multinational firm by Antràs (2003), that rationalizes the stylized fact and guides our subsequent econometric analysis. Our model describes how a firm's headquarters (HQ) chooses the optimal ownership share in a production facility (producer). The producer needs to invest into partially contractible inputs and the degree of input contractibility depends on the quality of contracting institutions in his country.[3] Furthermore, these inputs are partially relationship-specific, i.e., they can be sold on the outside market only at a discount. The degree of relationship specificity varies across industries and determines the value of inputs on the outside market (henceforth, 'outside option'). This setup implies that the producer faces a hold-up problem and makes inefficiently low investments. The HQ's integration decision minimizes the inefficiency by solving the key trade-off in our model: A higher ownership share increases the HQ's *fraction* of the surplus at the expense of reducing the producer's investment incentives, which reduces the overall *size* of the surplus.

The model's first key prediction serves to explain the stylized fact described above: The HQ's optimal ownership share is increasing in the quality of contracting institutions in the producer's country. Intuitively, if courts can enforce contracts on a wider range of inputs, the HQ can contractually secure a greater surplus, hence the need for incentivizing the producer's investments decreases. Consequently, the HQ optimally chooses deeper integration in order to reap a larger

[2] While a large share of firm pairs in our data are fully integrated, partial integration is the most prevalent case (see Section 3.1 for details).

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

fraction of the surplus. In other words, good contracting institutions substitute for the need to incentivize the producer by leaving ownership rights to him, and hence they induce the HQ to choose a higher ownership share.

Our theoretical model further delivers a second key prediction: The positive effect of contracting institutions on the optimal ownership share is magnified by a higher relationship specificity. The rationale for this positive interaction effect is as follows: In industries with a high degree of relationship specificity, inputs have little value on the outside market. Therefore, the producer's potential outside option is relatively small and of little importance for his underinvestment. Consequently, any increase in the ownership share, reducing the producer's outside option, has only a weak negative effect on his investment incentives. It follows that an improvement in contracting institutions allows the HQ to disproportionately increase the optimal ownership share in highly relationship-specific industries. Intuitively, contracting institutions have more leverage if investments are highly relationship-specific.

Our third contribution is to conduct a rigorous empirical test of the impact of contracting frictions on firm integration. We exploit the model's second prediction and our detailed micro data to test how the interaction between contracting institutions and relationship specificity affects the integration decision. This approach allows us to control for any country-specific factors by fixed effects, thereby addressing first-order concerns related to omitted variables (such as cultural traits or informal institutions). Moreover, we can comprehensively control for both country-pair and industry-pair specific confounding factors through high-dimensional fixed effects and identify the interaction effect across different subsidiaries owned by similar parent firms from the same country and industry. We find a positive interaction effect of country-level contracting institutions and industry-level relationship specificity on the depth of integration, which is both statistically and economically significant. The same pattern is identified both in a linear model and using a non-linear discrete choice estimator. These findings support the second key prediction of our model.

The positive interaction effect of contracting institutions and relationship specificity is robust to addressing several challenges to identification. 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 integration to differ arbitrarily across industries, by including interaction terms of these country characteristics with subsidiary industry dummies (following Levchenko, 2007). Our rich micro data further allow us to demonstrate that our results are not confounded by firm heterogeneity among subsidiaries or HQ. In an ambitious within-firm specification, we confirm the positive interaction effect across different subsidiaries owned by the same HQ. To address the possibility that selection into different countries may be driven by factors correlated with the determinants of firm integration, we estimate a two-stage selection model à la Heckman (1979). Next, 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 (similar to Nunn, 2007). Our main result also proves robust to using alternative measures of our dependent variable (including ownership dummies analyzed using non-linear methods) as well as a variety of proxies for the quality of contracting institutions and relationship specificity. Finally, we vary our estimation sample along various dimensions. The robustness of our main finding to all of these checks lends strong support to our model.

Related literature. Our paper contributes to the literature studying multinational firms integration decisions through the lens of the PRT. Following the seminal contributions by Antràs (2003) and Antràs and Helpman (2004), this literature has almost exclusively focused on a *binary* choice between integration and arm's length contracting.[4] As a notable exception, Cui (2011) allows for joint ventures as a third organizational mode and uses this framework to study the role of ownership restrictions in the *discrete* choice between sole ownership, joint ownership, and outsourcing. Our paper further generalizes the PRT by modeling the integration decision as a *continuum* and allowing for any ownership share between 0% and 100% as an equilibrium outcome. The key value added of our approach is that the allocation of ownership shares between 1% and 99%, which we observe in our data, can be consistently rationalized by the same set of factors as the choice between complete integration (100%) and non-integration (0%).[5]

Our theoretical framework is closely related to Antràs and Helpman (2008), who devise a PRT of the firm featuring partial contractibility to show that a HQ's optimal *revenue share* is increasing in the quality of contracting institutions in the subsidiary's country. While this result is conceptually in line with our first key prediction, it is important to note that the optimal revenue share in their model is a latent variable, which cannot be enforced by the courts and is not directly chosen by the firms. By contrast, the optimal *ownership share* in our model constitutes an enforceable choice variable that can be directly mapped to equity shares observable in the data. The novel feature of our framework is that ownership shares continuously affect the distribution of surplus between business partners in case a relationship is terminated (i.e., their outside options), which in turn affects incentives within the relationship.

The empirical literature testing the PRT of the multinational firm has faced the major challenge that "data on the integration decisions of firms are not readily available" (Antràs, 2014, p. 5). In

[4]This dichotomy is rooted in the original PRT by Grossman and Hart (1986) and Hart and Moore (1990), which delivers a counterfactual prediction that shared ownership is always dominated either by sole ownership or non-integration (see, e.g., Holmstrom, 1999; Halonen, 2002).

[5]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., 2019) or simultaneously contributing to a single production stage (Schwarz and Suedekum, 2014), but they do not consider partial integration of a *single* firm. Alternative approaches to modeling partial integration of a single firm in the PRT framework are discussed by Bircan (2013), Eppinger and Ma (2020), and Kukharskyy (2020).

the absence of international micro data on integrated and non-integrated firm relationships, researchers have pursued two main approaches to studying the organization of multinational firms. The first is to exploit intra-firm trade data. Several papers have used industry- or product-level data on intra-firm import shares from the U.S.[6] The bulk of this literature has focused on technological determinants of intra-firm trade, such as input intensities, firm productivity, or the position of production stages in the value chain. To the best of our knowledge, only Antràs (2015) and Bernard et al. (2010) consider interaction terms of country-level contracting institutions and industry-level measures of specificity or contractibility, but their findings do not reveal a coherent pattern. Researchers have also exploited firm-level data on intra-firm trade from individual countries.[7] Among these studies, the contribution closest to our work is by Corcos et al. (2013), who investigate the role of contracting institutions (among other factors) and find a positive relationship between contract enforcement in the foreign country and the share of French intra-firm imports, in line with the PRT.

The second prevalent approach to measuring firm integration combines information on multiple activities (primary and secondary industry codes) at the firm level with U.S. input-output tables at the industry level to calculate the propensity of firms to integrate certain activities. This 'vertical integration index' was introduced by Acemoglu et al. (2009) to study the relationship between contracting institutions and vertical integration in a large international cross-section of firms.[8] This relationship turns out to be insignificant, but the authors find more vertical integration in countries that have both higher contracting costs and greater financial development. In our main empirical analysis, we fully account for these country-level determinants of integration using fixed effects and focus on the interaction of contracting institutions with an industry's relationship specificity.

We propose a third and complementary approach to measuring firm integration by using information on ownership shares across firm pairs. The key advantage of our approach is that the unit of observation in our analysis is the firm *pair*—the level at which the integration decision is made. Investigating ownership shares is important not only because partial ownership is prevalent in the data, but also because the optimal degree of integration has relevant implications for firm performance (see Eppinger and Ma, 2020). Compared to studies of intra-firm imports, which exploit

[6] See, e.g., Antràs (2003, 2015), Antràs and Chor (2013), Bernard et al. (2010), Herkenhoff and Krautheim (2020), Nunn and Trefler (2008, 2013), and Yeaple (2006).

[7] See Tomiura (2007) for Japan; Berlingieri et al. (2018), Carluccio and Bas (2015), Carluccio and Fally (2012), Corcos et al. (2013), and Defever and Toubal (2013) for France; Kohler and Smolka (2014, 2018) for Spain; and Bolatto et al. (2019) for Slovenia.

[8] Their approach has been adopted to study the impact of prices (Alfaro et al., 2016) and downstreamness (Alfaro et al., 2019) on vertical integration. Note that recent evidence on U.S. 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. In this paper, we do not rely on I-O tables to identify vertical links. 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.

data from individual countries, our analysis encompasses subsidiaries and headquarters from many countries around the world. Compared to Acemoglu et al. (2009), we examine international ownership linkages and exploit the fact that parent and subsidiary firms located in different countries are governed by different contracting institutions.[9] The truly global nature of our analysis and its theory-driven focus on contracting institutions sets our paper apart from previous studies of ownership shares of multinationals from individual countries, such as the U.S. (Asiedu and Esfahani, 2001; Desai et al., 2004) or Japan (Raff et al., 2009).

As highlighted by Antràs (2015), the link between contracting institutions and integration not only provides an important angle for testing the PRT, but it also allows for discriminating between this theory and the Transaction-Cost Theory (TCT) by Williamson (1985). The TCT posits that, due to contractual frictions, relationships between non-integrated parties are plagued by hold-up problems; integration eliminates these hold-up problems at the expense of an exogenous governance cost. Since good contracting institutions constitute an alternative means to alleviate the hold-up problems, the TCT in its simplest form predicts less integration in countries with better contract enforcement—the opposite of the PRT's prediction.[10] Our econometric analysis based on global micro data lends strong support to the PRT and thereby contributes to the literature seeking to contrast alternative theories of the firm (see Gibbons, 2005; Klein, 2005; Whinston, 2003).

We also relate to an empirical literature in international economics that studies the role of institutions as a source of comparative advantage. In their review of this literature, Nunn and Trefler (2014) conclude that the state-of-the-art approach to identifying the effect of a given institutional factor on trade is by interacting it with an industry-specific measure of sensitivity to this factor, while controlling for all other country and industry determinants via fixed effects (see also Chor, 2010). In particular, Berkowitz et al. (2006), Costinot (2009), Levchenko (2007), and Nunn (2007) explain bilateral trade flows by an interaction term of countries' contracting institutions and industry-specific measures of relationship specificity or complexity. We take this approach to the micro level and show that contracting institutions shape not only international trade but also the ownership structures of multinational firms.[11]

The remainder of the paper is organized as follows. Section 2 sets up our theoretical model and develops two key predictions for optimal ownership shares. Section 3 describes the ownership data and our empirical strategy. Section 4 presents the estimation results. Section 5 concludes.

[9] This feature of the data is particularly important in view of the prediction derived by Antràs and Helpman (2008), who show that, in a PRT world, the quality of contracting institutions governing investments by the HQ has the opposite effect on firm integration compared to contracting institutions governing investments by the subsidiary.

[10] See Chapter 6 in Antràs (2015) for a formal treatment of this argument.

[11] Recently, Boehm (2020) has demonstrated that the quality of contracting institutions is also a key determinant of domestic trade in intermediate inputs and that this matters for aggregate productivity.

2 Theoretical model

2.1 Setup

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 also 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 (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 the final good implies the following iso-elastic demand for a single variety: $x = Dp^{-1/(1-\alpha)}$, where x and p denote quantity and price, respectively, $D > 0$ is a demand shifter, and $\alpha \in (0, 1)$ 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 using 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 from 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 following Cobb-Douglas production function:

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

We assume that the producer M is indispensable for the production of x, in the sense that H cannot manufacture final goods without M.[13] Note that the model is general enough to describe either a horizontal relationship, in which x is a final good, or a vertical relationship, in which x is reinterpreted as an intermediate input supplied by M to H (as in Antràs, 2003).

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 ex ante in an enforceable contract, while investments into the remaining inputs

[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 rationalized by the fact that H lacks either the production capacity or the expertise required to assemble the final good (or both). This is the reason why the two parties need to form a relationship in the first place.

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. Clearly, there might also be technological factors that affect the degree of contractibility μ. Our modeling 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 poor contracting institutions.

Against the backdrop of contractual incompleteness, H chooses her ownership in M when the relationship is formed. We generalize the standard PRT approach, which considers the binary choice between integration and arm's length contracting, by modeling the integration decision as a continuum. More specifically, H chooses the optimal ownership share $s \in [0, 1]$ in M, where $s = 1$ represents the case of full integration and $s = 0$ describes an arm's length relationship.

We assume that M's inputs must be customized to H's blueprint, and are therefore 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, where $\rho \in [0, 1]$ 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 from the relationship ex post, i.e., after M's investments are sunk. Following the PRT approach, we assume that these negotiations take place irrespective of the ownership structure (i.e., even under full integration) and they take the form of generalized Nash bargaining. More precisely, each party obtains his or her outside option (i.e., the payoff in case of a breakdown of the relationship) plus a fraction of the ex-post surplus from the relationship (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 H and M fail to agree in bargaining, the relationship breaks down and the intermediate inputs can be sold on the outside market. Each party's outside option depends on the fraction

[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 (2002).

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 $s \in [0, 1]$ in M. More specifically, H controls the fraction s of non-contractible inputs, while M controls the remaining share $(1 - s)$ of $m(i)$, $i \in [\mu, 1]$. Therefore, a change in the ownership share effectively shifts residual control rights between the two parties: A higher s increases H's outside option but reduces the outside option of M.

Our modeling of outside options allows us to rationalize the continuous ownership shares observed in the data. Furthermore, this modeling approach is appealing for two reasons. First, our 'zero-sum' notion of outside options reflects the original idea of residual control rights by Grossman and Hart (1986), who argue that, "if one party gets rights of control, then this diminishes the rights of the other party to have control" (p. 693).[15] Second, the idea that H and M receive outside options proportional to their ownership shares constitutes a reasonable approximation to reality. To see this, note that the hypothetical 'relationship breakdown' in our model is best illustrated in practice by a voluntary liquidation process, which can be invoked by shareholders to end the operation of a (solvent) company. As a general rule, once the company's assets are sold and its outstanding debt is paid off, the remaining surplus from such a voluntary liquidation is distributed between the shareholders in proportion to their shares of stock.[16]

Our treatment of the integration decision as a continuous choice variable raises an important question: In practice, equity shares of 50% (or slightly greater) and of 100% are particularly frequently observed in the data (see Section 3.1). How can this salient feature of the data be rationalized within our framework? A model-consistent explanation for this pattern is that, depending on the institutional environment, a firm may be able to exercise its residual control rights over non-contractible inputs only if its equity share reaches or exceeds some critical threshold (such as 50% or 100%). To the extent that equity shares correspond to voting shares in the firm's decision-making body, this is the case if the relevant vote requires an absolute majority or unanimity, respectively.[17] These considerations suggest that, under certain conditions, the optimal ownership share may be viewed as a latent variable with the corresponding observed choices of different ownership categories, such as minority, marginal majority, supermajority, and full ownership. We accommodate

[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, in the current framework H cannot produce final goods on her own (see also footnote 13).

[16]See, e.g., https://www.law.cornell.edu/cfr/text/26/1.331-1 and https://www.law.cornell.edu/uscode/text/26/332 for the case of the U.S. Similar regulations apply to "members' voluntary liquidation" (MVL) in the EU, see https://www.lexisnexis.com/uk/lexispsl/tax/document/393781/55KG-P041-F18C-C30S-00000-00/Members%27-voluntary-liquidation-%28MVL%29_overview (all links accessed on April 16, 2021).

[17]Arguably, there may be other relevant decisions for which obtaining equity shares (and hence voting shares) above a certain threshold may be crucial, but formalizing such considerations lies beyond the scope of our model.

this view and allow for non-linearities in the integration decision in our empirical analysis.

The timing of events is as follows. In t_1, H chooses the ownership share s in M.[18] 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 described above, it is instructive to consider first the *hypothetical* case of complete contracts (i.e., $\mu = 1$). If courts could perfectly verify and enforce investments into all intermediate inputs, the parties would agree on 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:

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

where $R = D\alpha^{\frac{\alpha}{1-\alpha}}$. Note that, in this case of complete contracts, the optimal ownership share is indeterminate and the integration decision becomes obsolete, reflecting the essential role of contractual frictions in understanding firm integration, which we have stressed in the introduction.

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:

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

where 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

[18]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. Also notice that our benchmark model does not include 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 a zero optimal ownership share, regardless of the quality of contracting institutions. To generate a non-trivial trade-off in the ownership choice, our model does not include transfers.

$m(i), i \in [\mu, 1]$. 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 that maximizes her payoff from the ex-post negotiations net of production costs of these inputs:[19]

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

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:

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

where

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

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)*, $\frac{\partial^2 m_n}{\partial s \partial \rho}\big|_R = \frac{1-(1-\rho)(s-\beta)}{[1+(1-\rho)(s-\beta)]^3}\alpha(1-\beta)R$. 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 $R > 0$.

[19]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.

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 marginal 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):

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

where Q and m_n are given by equations (4) and (6), respectively.[20] 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.3 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 Appendix A.3 that our key predictions are qualitatively unchanged if the PC is binding and H solves the optimization problem from equa-

[20]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.

tion (9) with equation (10) as an equality constraint.

After plugging equations (4), (6), (7), and (8) into 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:

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

where

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

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 s^* 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.

2.3 Comparative statics and key predictions

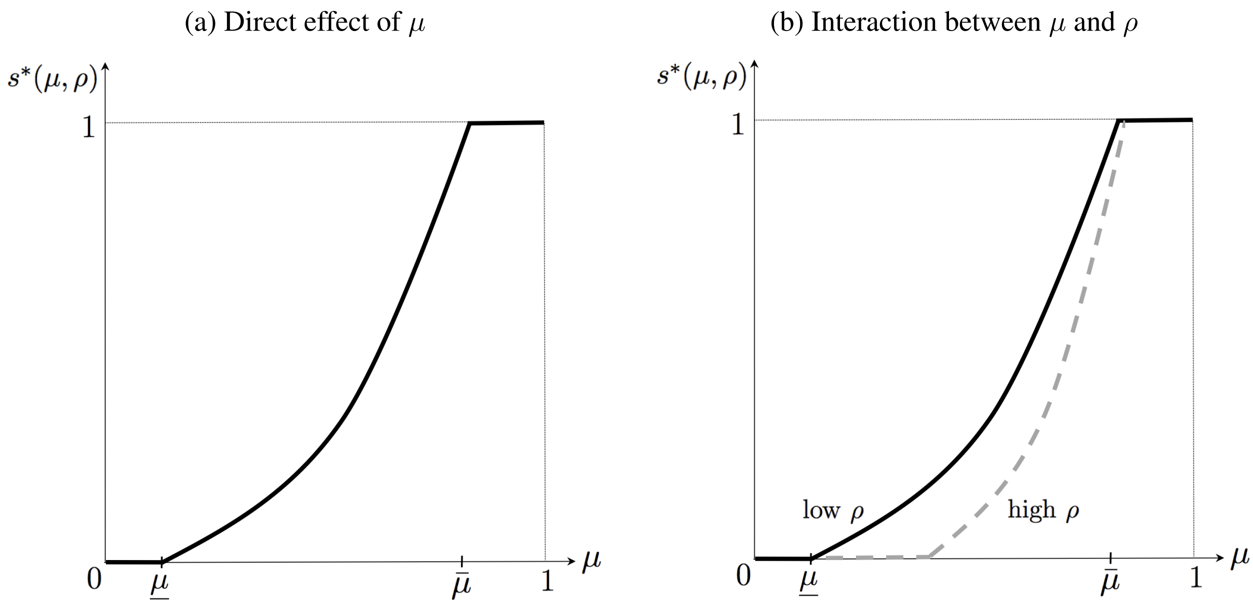
In this section, we use comparative statics analysis to derive two key predictions regarding the effect of contracting institutions on the optimal ownership share. The relationship between s^* and μ is summarized in

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 H's outside option, and thereby raises her 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 total revenue from equation (7). Simply put, by choosing a higher ownership share in the subsidiary, the HQ trades off a larger *fraction* of the 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. As a result, H optimally retains a larger fraction of the surplus for herself by choosing a higher ownership share s^*.

Figure 1(a) illustrates the positive relationship between s^* and μ established in Proposition 1.[21] In an environment of poor contracting institutions, where μ is below the 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 fraction 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, but also in these cases, the optimal ownership share s^* lies within the unit interval and it is strictly increasing in the quality of contracting institutions for all values of μ.

Figure 1: Optimal ownership share s^*



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

[21] 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.

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 if these inputs are highly relationship-specific. 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. In other words, contracting institutions have more leverage in relationship-specific industries.

Figure 1(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. The more specific M's investments, the less does an increase in the optimal ownership share disincentivize these investments. Hence, H can better 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 ambiguous. In the case depicted in Figure 1(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. 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 investments. On the other hand, an increase in ρ enlarges the surplus that M can obtain within the relationship (the quasi-rent from equation (4)), which improves his investment incentives.[22] Importantly, the positive interaction effect of μ and ρ on s^* summarized in Proposition 2 holds regardless of the direct effect of relationship specificity on the ownership share.

To sum up, our model based on the PRT provides a theoretical rationale for the stylized fact that firms are more integrated in countries with better contracting institutions (Proposition 1), and it further delivers the testable prediction that relationship specificity magnifies the positive effect of contracting institutions on firm integration (Proposition 2).

2.4 Model extension

In Appendix A.1, we provide a generalization of our benchmark model that incorporates joint production along the lines of the PRT of the multinational firm in Antràs (2003) and Antràs and Helpman (2004). Specifically, we allow the HQ to invest into relationship-specific, non-contractible inputs (headquarter services), which results in a two-sided hold-up problem.

In this extended model, we verify the positive link between headquarter intensity and firm integration, which is a key result in Antràs and Helpman (2004). Intuitively, as the headquarter

[22] The relative magnitude of these opposing effects depends on M's bargaining power $(1-\beta)$. Formally, m_n from equation (6) increases in ρ if and only if $\beta < s$, and it decreases in ρ if this inequality is reversed.

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. In our framework, this results in a marginal increase in the continuous ownership share (as opposed to the increase in the likelihood of choosing integration over outsourcing). Importantly, we show that our main predictions continue to hold in the extended model.

3 Data and empirical strategy

3.1 Ownership data

Our global micro data on ownership links are taken from the Orbis database provided by Bureau van Dijk (BvD). This database provides information on firms' ownership shares (in %) in their subsidiaries in the cross-section of 2014. The three key advantages of the Orbis database for our purpose are the availability of firm-pair specific ownership information, its vast international coverage, and the fact that it includes both domestic and international ownership links. The database is unique in encompassing all three of these features.[23] We also observe the countries, main activities (industry affiliations in the form of four-digit NAICS 2012 codes), and founding years for both HQ and subsidiaries as well as employment and key balance sheet items for a subset of firms.

We restrict the sample on the subsidiary side to countries hosting at least ten subsidiaries and exclude likely tax havens (mostly small island states; see Appendix B for details). In the main analysis, we consistently focus on subsidiaries whose main activity is in goods producing sectors for which our preferred measure of relationship specificity is available (see Section 3.2).[24] On the HQ side, we consider only industrial companies (i.e., we exclude banks, hedge funds, etc.). We further restrict our sample for the main analysis to ownership shares of at least 10%, which is a conventional threshold for direct investment. These restrictions are implemented since 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. Appendix B provides further details on the Orbis data.

The resulting sample includes all essential information on 230,296 firm pairs of 133,357 headquarters (in 131 countries) holding ownership shares in 194,017 subsidiaries (in 101 countries). The availability of data on covariates reduces the sample used in parts of the regression analysis

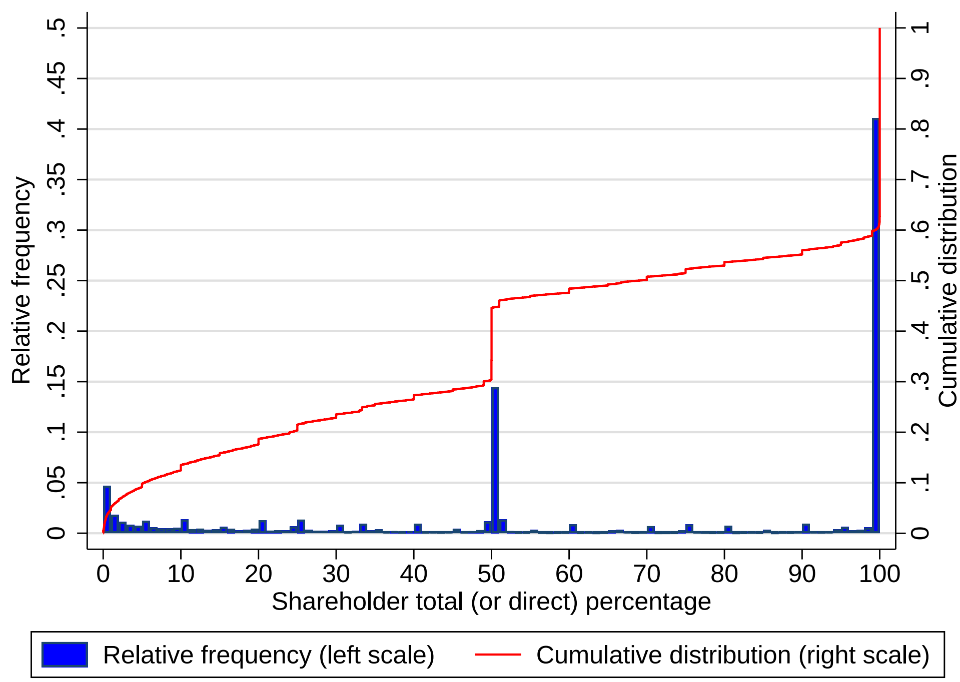
[23] The Orbis ownership data have previously been used to study the international transmission of shocks through multinationals (Cravino and Levchenko, 2017), the hierarchical complexity of business groups (Altomonte and Rungi, 2013), as well as the role of downstreamness (Del Prete and Rungi, 2017), managerial culture (Kukharskyy, 2016; Gorodnichenko et al., 2017), and knowledge capital (Kukharskyy, 2020) for firm integration.

[24] These sample restrictions are implemented since our theory seems less immediately applicable to service sector subsidiaries, and since we want to ensure that the estimation samples are largely comparable throughout our empirical analysis, including those parts which do not require a measure of relationship specificity.

below. The median HQ has only one subsidiary, which is typically located in the same country. Around one quarter of all HQ own shares in at least two subsidiaries, and close to one fifth of them are multinational firms owning foreign subsidiaries (corresponding to around 35% of all observations in the sample). The fact that we observe multiple international ownership links for some firms proves to be particularly useful for our analysis.

Figure 2 illustrates the distribution of ownership shares in the full sample, including also ownership shares below 10% to obtain a complete picture. Full ownership is the most common organizational form observed in the data, chosen by 37% of all firm pairs. Note that the highest bin in Figure 2 further includes a number of observations with shares just below 100%. Yet, the majority of observations are characterized by shared ownership. Among these, ownership shares of 50% to 51% are most frequently chosen (15% of all observations). Despite these two peaks in the distribution, there is considerable variation in the observed ownership shares. Around 31% of all observations are minority shares and the remaining 17% encompass majority shares above 51% and below 100%. The mean ownership share is 64%, with a standard deviation of 37 percentage points. Based on these features of the data, we select appropriate estimation methods in Section 3.3.

Figure 2: Distribution of ownership shares



Note: The figure shows the relative frequency (left scale) and cumulative distribution (right scale) of ownership shares across 263,186 firm pairs.

3.2 Measurement of contracting institutions and relationship specificity

In this section, we discuss how the key explanatory variables in the model are mapped to data. Proposition 1 predicts that ownership shares are higher for a greater contractibility μ of the subsidiary's inputs, and Proposition 2 predicts that this association is stronger the higher the degree of relationship specificity ρ of the subsidiary's inputs. This suggests regressions of the ownership share on a proxy for μ and an interaction term $\mu \times \rho$. We have throughout associated μ with the quality of contracting institutions in the subsidiary's country and interpreted ρ as a characteristics pertaining to the subsidiary's industry. While this mapping of μ and ρ to their empirical proxies appears to be most consistent with our theoretical model, two remarks are in order.

First, one may argue that the contractibility μ also depends on the characteristics of the subsidiary's industry. Similarly, it is conceivable that the (reduction of the) value of non-contractible inputs on the outside market ρ is a function of country-specific characteristics as well. We address these concerns in our main empirical investigation by including subsidiary country and industry fixed effects (FE), which account for the direct effects of subsidiary country and industry characteristics on the degree of integration. Second, by mapping the contractibility μ of the subsidiary's investments to the quality of contracting institutions in the subsidiary's country, we have implicitly assumed that it is *this* country's courts that are responsible for enforcing the subsidiary's investment decisions. This assumption indeed seems to reflect the prevailing legal practice in many countries.[25] 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). A virtue of our data is that it includes international ownership links, which allows us to control for the potentially confounding role of contracting institutions in the HQ's country via FE.

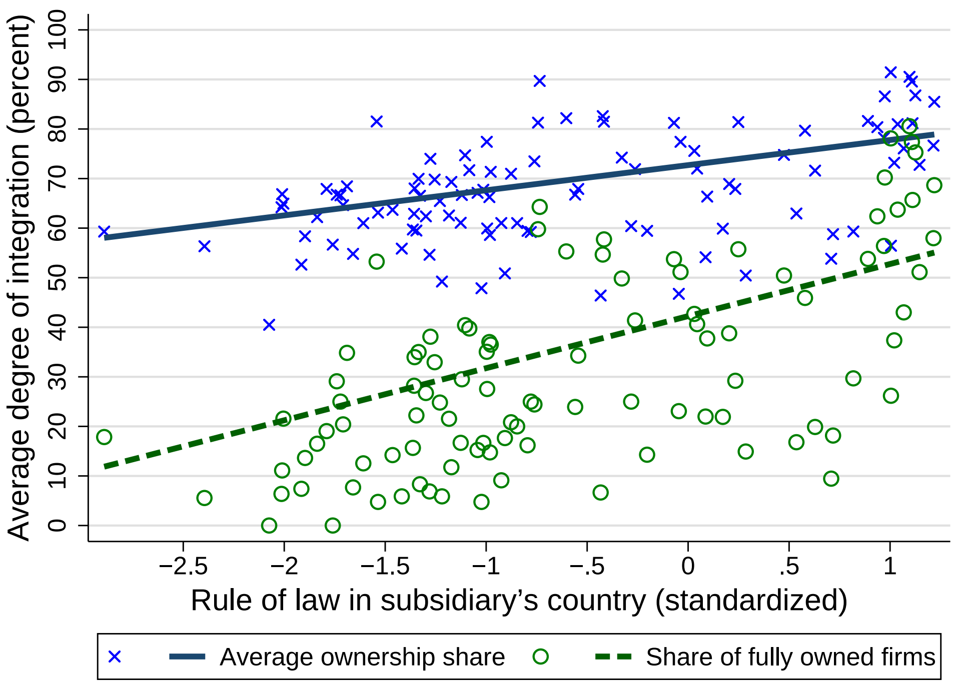
As our baseline measure of the quality of contracting institutions μ, which we denote by C_ℓ for subsidiary country ℓ, we use the 'rule of law' index from the Worldwide Governance Indicators (Kaufmann et al., 2010). This measure is a weighted average of a number of variables that reflect experts' and 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

[25]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).

valid proxy for the quality of contracting institutions (see, e.g., Antràs, 2015; Nunn, 2007; Nunn and Trefler, 2014). However, we test the sensitivity of our main empirical results to using a wide range of alternative proxies. Appendix B provides a list of all subsidiary countries included in our sample, ranked by the rule of law index. Contracting institutions are rated highest in Scandinavian countries; Ecuador and Nigeria are found at the bottom of the ranking.

Figure 3 illustrates the cross-country correlation between the depth of firm integration and the rule of law index in the subsidiary's country. It displays two alternative measures of firm integration: the average ownership share (crosses) and the share of fully owned firms (circles). As indicated by the univariate regression lines, both measures are positively correlated with the rule of law index, with p-values below 1%. This illustrates the stylized fact discussed in the introduction: Subsidiaries in countries with better contracting institutions are more deeply integrated. While the simple correlation in the data may be driven by a variety of forces, we show in Section 4.1 that it prevails after controlling in multivariate regression analysis for many other factors influencing firms' integration decisions.

Figure 3: Firm integration and contracting institutions



Note: The figure plots two measures of firm integration (average ownership shares and the share of fully owned firms) against the rule of law index in the subsidiary's country. The lines are obtained from univariate regressions of firm integration on the rule of law index in which each country-level observation is weighted by the underlying number of firm pairs. For the solid line, the dependent variable is the ownership share; the estimated slope parameter is 5.071 with a p-value of 0.001, and the R^2 is 0.250. For the dashed line, the dependent variable is a full ownership dummy, the estimated slope parameter is 10.508 with a p-value of 0.000, and the R^2 is 0.295. These p-values are based on robust standard errors. The sample is based on 230,296 firm pairs with subsidiaries located in 101 different countries.

Our baseline measure of relationship specificity ρ, which we denote by R_j for subsidiary industry j, is taken from Antràs and Chor (2013), who compute it from the Rauch (1999) classification of products by their degree of horizontal differentiation.[26] 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_j is calculated as the share of product codes in the industry that are classified as differentiated or reference-priced.[27] The idea underlying this approach is that, unlike homogenous goods, differentiated goods are 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.

3.3 Estimation methods

In principle, several alternative approaches to estimating the empirical relationship between firm integration and contracting institutions are possible. In this context, the researcher faces choices along two key dimensions: First, one needs to decide on how to measure firm integration, the dependent variable. Second, and related, one needs to choose the method of estimation. This section provides a brief discussion of the available alternatives and explains our choice of methods.

Concerning measurement, a straightforward approach is to use the continuous ownership share as the dependent variable. This approach acknowledges the fact that any ownership shares between 0% and 100% are observed in practice (see Figure 2) and allows us to exploit all available variation in firm integration in the data. However, Figure 2 also reveals two salient points in the ownership distribution at 50% and 100%, indicating that these may be critical ownership thresholds and may involve non-linearities (as briefly discussed in Section 2.1). This feature of the data suggests that one should also consider categorical outcome variables, such as an indicator variable for full ownership, or a (discrete) ordered response variable that distinguishes multiple ownership categories, e.g., minority, marginal majority, supermajority, and full ownership. This comes at the cost of ignoring some of the observed variation in integration choices.

[26] These data are available on the authors' websites at the six-digit 2002 U.S Input-Output (IO 2002) industry classification level. We map them to the four-digit NAICS 2012 codes in Orbis using official correspondence tables provided by the U.S. Census Bureau (via NAICS 2002 and NAICS 2007) http://www.census.gov/eos/www/naics/concordances/concordances.html (accessed on April 4, 2016) and a manually created correspondence table between IO 2002 and NAICS 2002 codes.

[27] Due to ambiguities for some goods, there are two versions of the Rauch (1999) classification, a 'conservative' and a 'liberal' one, where the former maximizes and the latter minimizes the number of goods that are classified as differentiated. Following Alfaro et al. (2019) and Antràs and Chor (2013), we use the liberal classification in our baseline analysis and the conservative version in a robustness check. 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.

Concerning estimation methods, the simplest and most widely used approach is estimation by Ordinary Least Squares (OLS). There are two key advantages of OLS estimation in our context. First, with OLS there are readily implemented solutions for incorporating high-dimensional FE, which play an important role for identification, and for multi-level clustering of standard errors (see Section 3.4 for more details on both points). Second, the interaction effect of contracting institutions and relationship specificity is directly estimated as the coefficient on the interaction term of these two variables, while non-linear models require evaluating marginal effects at certain values of the covariates to be informative about the interaction effect (see Ai and Norton, 2003). The obvious downsides of OLS are that it does not account for the fact that the ownership share is a fractional response variable bounded between zero and one, and the linearity assumption does not allow for marginal effects (e.g., of contracting institutions) to vary along the ownership distribution.

Among the non-linear methods, a fractional response model can be applied to the ownership share to address the first of these shortcomings. A binary probit or logit regression is applicable to a binary ownership variable. Using an outcome variable that distinguishes multiple discrete ownership options necessitates the use of an ordered response model such as the ordered logit model. All of these non-linear models suffer from the drawbacks that they do not allow for the inclusion of our preferred set of high-dimensional FE (due to computational constraints) and the illustration of our key interaction effect becomes more involved. Furthermore, for the ordered logit model we can only implement one-dimensional clustering of standard errors.

Our aim is to adopt a broad approach, using the full range of the methods discussed above. We exploit the benefits of OLS estimation in our baseline analysis and many important robustness checks, hence we formulate the econometric specifications in the subsequent section as linear models. Since the availability of continuous variation in ownership shares is one of the key benefits of the Orbis dataset, we use these shares as our default measure of firm integration. Given the prevalence of full ownership, we also consider a full ownership dummy. The linear regressions are complemented by fractional logit regressions (using ownership shares), logit regressions (using full ownership dummies), and ordered logit regressions (using ownership categories).

3.4 Econometric specifications

Our empirical strategy proceeds in two steps. First, motivated by Proposition 1, we set up an econometric model to assess the empirical relationship between firm integration and the quality of contracting institutions in the subsidary's country. Second, to test Proposition 2, we estimate the differential effect of contracting institutions on firm integration depending on relationship specificity.

3.4.1 Contracting institutions and firm integration

To examine whether better contracting institutions are associated with deeper integration, as predicted by Proposition 1, and to explore the determinants of firm integration more broadly, we estimate the following econometric model:

$$S_{HM} = \varphi C_\ell + \boldsymbol{\chi}\mathbf{X}_{ij\ell} + \alpha_i + \alpha_j + \alpha_k + \xi_{HM}, \tag{16}$$

where S_{HM} denotes a measure of ownership by headquarters H (active in industry i and country k) in subsidiary M (active in industry j and country ℓ). We consider two alternative measures of S_{HM} in the baseline analysis of the linear model: the (continuous) ownership share and a (discrete) dummy variable indicating full ownership. An ordered logit model, analyzing a discrete choice between ownership categories, is explicitly formulated in Appendix C.1 and used in a complementary analysis. The explanatory variable of primary interest is the quality of contracting institutions C_ℓ in the subsidiary's country ℓ, and φ is the key parameter to be estimated. The vector $\mathbf{X}_{ij\ell}$ contains a set of other explanatory variables (with associated coefficient vector $\boldsymbol{\chi}$), and ξ_{HM} is an error term.

The high granularity of our data allows us to control for a host of unobservable factors by including full sets of fixed effects (FE) for the subsidiary's industry (α_j), the HQ's industry (α_i), and the HQ's country (α_k). The two sets of industry FE absorb various technological determinants of firm integration, such as the role of product differentiation and market power. To some extent, the industry FE also control for the headquarter intensity of production, which plays a key role in Antràs (2003) and Antràs and Helpman (2004) and is typically approximated in the empirical literature by industry-level capital intensity, skill intensity, or R&D intensity.[28] Furthermore, one may argue that the level of development or the quality of contracting institutions in the HQ's country can also affect the integration decision. HQ country FE control for any such effects.

The vector $\mathbf{X}_{ij\ell}$ includes various other observable factors that may affect the depth of firm integration: characteristics of the subsidiary's country and industry as well as proxies for bilateral investment costs specific to the country pair. 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 9.0; see Feenstra et al., 2015)

[28] It should be noted that the industry FE do not fully account for the role of headquarter intensity, which describes the *relative* importance of both parties' contributions to production and hence depends on both firms' industries. To address this issue, we include industry-pair FE in the linear models of our main analysis below. However, it turns out that this large number of FE is computationally infeasible in non-linear models, and since we intend to present comparable results across different estimation methods, we do not include industry-pair FE in equation (16).

for the year 2014. We further include an interaction term $\ln(K_j/L_j) \times \ln(K_\ell/L_\ell)$, defined as the log of the capital-to-employment ratio (K_j/L_j) of the median firm by industry times the log of the relative capital endowment of subsidiary's country, to control for Heckscher-Ohlin-type confounding factors.

We further control for other characteristics of the institutional environment in the subsidiary's country 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 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 prior to 2014); and to these we add the risk of a contractual breach by the government (state contracting risk) as well as the expropriation risk score, both based on expert assessments by the information services company IHS Markit in the first quarter of 2014.[29]

We proxy for bilateral investment costs by including a dummy variable indicating domestic (as opposed to international) ownership links and 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, and (current or past) colonial link.

We estimate equation (16) for the ownership share and the full ownership dummy as alternative dependent variables, both by OLS and by (fractional) logit. In our complementary analysis of a discrete choice between ownership categories, we use an ordered logit model. For the sake of comparability, we standardize all explanatory variables to obtain mean values of zero and standard deviations of one in the estimation sample. The resulting standardized marginal effects allow us to compare the relative importance of different explanatory variables for firm integration. Inference is based on two-way cluster-robust standard errors following the procedure suggested by Cameron et al. (2011).[30] First, we cluster at the level of the subsidiary's country, at which the key explanatory variables are varying. Second, we cluster at the level of the HQ to account for interdependencies across a given HQ's ownership decisions.

[29] A key advantage of the country risk scores by IHS Markit is that they distinguish the risk of contractual breach and expropriation by the government from the risk that the judicial system may not enforce contracts between private parties, which we exploit as an alternative for the rule of law measure in a robustness check.

[30] OLS 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. Logit and fractional estimations are implemented by the Stata commands `cgmlogit` and `cgmflogit`, respectively.

3.4.2 Interaction effect of contracting institutions and relationship specificity

Our theoretical model provides us with a new angle for identifying the effect of contracting institutions on firm integration. It suggests that the positive effect of contracting institutions on ownership shares should be more pronounced in industries characterized by a high relationship specificity (see Proposition 2). To test this interaction effect, we set up the following econometric model:

$$S_{HM} = \gamma(C_\ell \times R_j) + \boldsymbol{\psi}\mathbf{Y}_{ij\ell} + \delta_{ik} + \delta_{ij} + \delta_{k\ell} + \varepsilon_{HM}, \tag{17}$$

where S_{HM} represents the ownership share (in percent) of headquarters H in subsidiary M, and $C_\ell \times R_j$ is the key interaction term of contracting institutions C_ℓ in the subsidiary's country ℓ and relationship specificity R_j of the subsidiary's industry j, with coefficient γ. We include control variables $\mathbf{Y}_{ij\ell}$ (with coefficient vector $\boldsymbol{\psi}$) and a large number of fixed effects by the HQ's industry i and country k (denoted by δ_{ik}), by the HQ-subsidiary industry pair (δ_{ij}), and by country pair ($\delta_{k\ell}$), all of which are discussed below. ε_{HM} denotes the error term.

Proposition 2 predicts a positive interaction effect, i.e., $\gamma > 0$. 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 subsidiary industries with a high relationship specificity.

Importantly, since the main explanatory variable in equation (17) varies by country and industry of the subsidiary, we can control for unobserved heterogeneity across subsidiary countries by FE. In our preferred specification, displayed in equation (17), these country-specific effects are nested within the country-pair FE $\delta_{k\ell}$, which additionally control for heterogeneity across HQ countries as well as any (observable or unobservable) country pair-specific factors, such as bilateral investment costs. The industry-pair FE δ_{ij} account for important industry-specific and industry pair-specific factors, including headquarter intensity and relationship specificity itself. Note that by including the FE δ_{ik}, we identify the interaction effect across different subsidiaries owned by very similar firms, which are headquartered in the same country and industry. The vector of control variables $\mathbf{Y}_{ij\ell}$ (with associated coefficient vector $\boldsymbol{\psi}$) includes the elements of $\mathbf{X}_{ij\ell}$ from equation (16) that are not absorbed by the FE.

By exploiting the interaction between country-level institutions and industry-level technological characteristics, equation (17) resembles a difference-in-differences model, where we control for the respective first differences by 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).[31] 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 country-industry cell, in contrast to the analysis of comparative advantage, which is typically conducted at the aggregate level of industries and countries.[32]

In our main analysis, we estimate equation (17) by OLS for the reasons discussed in Section 3.3. To directly map our theoretical prediction to the data, and to exploit all observable variation in firm integration, we focus on the continuous ownership share as our preferred dependent variable. We again investigate an ordered logit model of a discrete choice between ownership categories in a complementary analysis (for the details of this model specification, see Appendix C.1). In robustness checks, we further consider dummy variables indicating full ownership or majority ownership as dependent variables. Standard errors are two-way clustered whenever feasible (following Cameron et al., 2011)—first at the level of the key explanatory variable, i.e., the subsidiary's country-industry, and second at the level of the HQ.

4 Estimation results

4.1 Contracting institutions and firm integration

Table 1 summarizes our estimation results for different specifications of equation (16). It substantiates the stylized fact illustrated in Figure 3: Subsidiaries located in countries with better contracting institutions are more deeply integrated by their parent companies.

Whether we examine the continuous ownership share (columns 1 and 2) or a dummy indicating full ownership (columns 3 and 4), both the OLS and the logit estimates demonstrate that better contracting institutions are associated with deeper firm integration.[33] The estimates suggest that average ownership shares are ceteris paribus higher by 4.1–4.3 percentage points for subsidiaries in a country with a rule of law index that is higher by one standard deviation. Similarly, the probability of full ownership is higher by 7.6–9.2% if contracting institutions are better by one standard deviation.[34]

Not only are contracting institutions positively associated with firm integration after controlling

[31] Acemoglu et al. (2007), Berkowitz et al. (2006), Costinot (2009), Levchenko (2007), and Nunn (2007) show that contracting institutions can constitute a source of comparative advantage in international trade.

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

[33] To enable fractional logit estimations and allow for comparability across estimation methods, we denoted ownership shares in Table 1 as shares ($S_{HM} \in [0.1, 1]$) rather than percentages ($S_{HM} \in [10, 100]$, as in the rest of the paper).

[34] To provide two illustrative examples: A one standard deviation improvement in the rule of law index is approximately equivalent to Lithuania adopting Canadian standards in contract enforcement, or Nicaragua improving its contracting institutions to the level of Croatia.

Table 1: Contracting institutions and other determinants of ownership

	(1)	(2)	(3)	(4)
	Ownership share		Full ownership dummy	
	OLS	Fractional Logit	OLS	Logit
Subsidiary country characteristics				
Rule of law	0.0431**	0.0407**	0.0756**	0.0923**
	(0.011)	(0.022)	(0.032)	(0.025)
ln GDP	-0.0132*	-0.0128	-0.0114	-0.0139
	(0.079)	(0.178)	(0.476)	(0.479)
ln GDP per capita	-0.0183	-0.0181	-0.0128	-0.0160
	(0.542)	(0.636)	(0.838)	(0.838)
ln (K_ℓ/L_ℓ)	-0.0174	-0.0199	-0.0522	-0.0585
	(0.502)	(0.537)	(0.345)	(0.390)
ln years of schooling	0.0252	0.0285	0.0582	0.0662
	(0.156)	(0.181)	(0.143)	(0.164)
Financial development	0.0307***	0.0354***	0.0766***	0.0879***
	(0.000)	(0.000)	(0.000)	(0.000)
Labor market flexibility	-0.0273***	-0.0302**	-0.0709***	-0.0849***
	(0.007)	(0.019)	(0.007)	(0.005)
IPR protection	0.0145	0.0150	0.0199	0.0290
	(0.346)	(0.357)	(0.526)	(0.451)
State contracting risk	0.0305**	0.0324**	0.0479	0.0624*
	(0.035)	(0.029)	(0.106)	(0.086)
Expropriation risk	0.00479	0.00113	0.00518	0.00885
	(0.632)	(0.919)	(0.807)	(0.717)
Subsidiary country-industry interaction				
ln $(K_\ell/L_\ell)\times$ ln (K_i/L_i)	-0.00478	-0.00541	-0.000831	0.000532
	(0.405)	(0.331)	(0.921)	(0.959)
Country-pair characteristics				
Domestic ownership link dummy	-0.119***	-0.155***	-0.217***	-0.263***
	(0.000)	(0.000)	(0.000)	(0.000)
ln distance	-0.0256**	-0.0378***	-0.0609**	-0.0780**
	(0.048)	(0.005)	(0.017)	(0.012)
Time zone difference	-0.00356	-0.00531	-0.00790	-0.0134*
	(0.264)	(0.133)	(0.169)	(0.068)
Contiguity	-0.00608**	-0.00789**	-0.00927*	-0.00966
	(0.019)	(0.022)	(0.091)	(0.119)
Common language	0.00270	0.000483	0.0137*	0.0214**
	(0.543)	(0.930)	(0.094)	(0.022)
Colonial link	-0.00331**	-0.00416**	-0.00556**	-0.00666**
	(0.037)	(0.030)	(0.044)	(0.037)
(Pseudo) R^2	0.152	0.075	0.176	0.140

The table reports estimates of equation (16) with the ownership share as the dependent variable in columns 1 and 2, and with the full ownership dummy as the dependent variable in columns 3 and 4. Columns 1 and 3 report standardized coefficients from OLS regressions. Columns 2 and 4 report standardized marginal effects (evaluated at the sample means) from (fractional) logit regressions. All regressions control for FE by HQ country, by HQ industry, and by subsidiary industry. The estimation sample includes 193,604 observations (firm pairs) with subsidiaries located in 58 different countries. The p-values reported in parentheses are based on two-way clustered standard errors by HQ and by subsidiary country. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

for various other factors, but they turn out to be clearly among the most important correlates. Since the table reports standardized marginal effects, we can evaluate the relevance of contracting institutions to other factors by comparing the size of these estimates.[35] Across all four columns, the standardized marginal effect of rule of law is of a similar (absolute) magnitude as those estimated for financial development, labor market institutions, or state contracting risk, and it has the highest point estimate among all country-level determinants of ownership in three of these regressions.

Of the other covariates considered, only the domestic ownership link dummy consistently has a stronger effect on integration. Domestic links are characterized by lower ownership shares than international links, presumably reflecting the fact 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 marginal effect of distance is negative and of similar quantitative importance as rule of law; contiguity (negative), colonial link (negative), and common language (positive for full ownership) are also statistically significant correlates of firm integration.

Ordered logit model. As discussed in Section 3.3, the integration decision may alternatively be viewed as a discrete choice between ownership categories, instead of a continuous choice. To accommodate this view, and to account for the peaks in the empirical distribution of ownership shares (see Figure 2), we now revisit the link between contracting institutions and firm integration in an ordered discrete choice model. Specifically, we estimate an ordered logit model with the dependent variable taking four different values that indicate ownership shares S_{HM} falling into the following four categories: $S_{HM} \in [10, 50)$, $S_{HM} \in [50, 51)$, $S_{HM} \in [51, 100)$, and $S_{HM} = 100\%$. We include the same covariates and FE as in equation (16) and Table 1.

The most insightful representation of the ordered logit results involves evaluating the marginal effects of the covariates on the probability of the four different outcomes. Thus, we need to present these results separately from those for the other methods, and we focus on the role of contracting institutions to avoid repetition of our previous insights regarding the control variables. Table 2 lists the marginal effects of rule of law on the different ownership categories as predicted by the ordered logit model, with all covariates evaluated at their sample means. Note that these are the marginal effects on the probability of choosing one ownership category relative to the respective other three categories, hence they sum up to one. The estimated marginal effect of rule of law is negative and significant on the probability that minority shares $S_{HM} \in [10, 50)$ are chosen. It is negative and marginally significant for $S_{HM} \in [50, 51)$ and close to zero for greater majority shares $S_{HM} \in [51, 100)$. As column 4 shows, the marginal effect of rule of law on the probability of full ownership ($S_{HM} = 100\%$) is significantly positive, in line with our results from Table 1. These

[35]Note that we use the conventional terminology of "marginal effects" without intending any causal interpretation of these estimates. For OLS estimates, these are standardized coefficients and for logit regressions they are standardized marginal effects computed at the sample means of all variables.

results describe a monotonic relationship between rule of law and ownership categories. They are fully consistent with Proposition 1 and complement our previous findings: Better contracting institutions in the subsidiary's country are on average associated with a shift from minority to full ownership.

Table 2: Ordered logit regression results on the role of contracting institutions

	$S \in [10, 50)$	$S \in [50, 51)$	$S \in [51, 100)$	$S = 100\%$
Rule of law	-0.0389**	-0.0235*	-0.00334	0.0658**
	(0.0169)	(0.0138)	(0.00249)	(0.0299)

The table reports marginal effects of rule of law estimated from an ordered logit model, computed at the sample means of all covariates. The dependent variable takes on four values, indicating ownership shares S_{HM} in the categories $S_{HM} \in [10, 50)$, $S_{HM} \in [50, 51)$, $S_{HM} \in [51, 100)$, and $S_{HM} = 100\%$. The same control variables as in Table 1 are included but not reported due to space considerations. All regressions control for FE by HQ country, by HQ industry, and by subsidiary industry. The estimation sample includes 193,604 observations (firm pairs). Standard errors reported in parentheses are clustered by subsidiary country. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

4.2 Main estimation results

Table 3 shows our main estimation results on how the interaction effect between the quality of contracting institutions in the subsidiary's country and relationship specificity in the subsidiary's industry shape firm integration. The table develops our preferred specification of equation (17) step by step.

In column 1, we examine the correlation without any control variables, which reveals a positive and highly significant estimate of the interaction effect γ. It suggests that the positive correlation between the rule of law index and ownership shares is concentrated in industries with high relationship specificity. The coefficient of rule of law at zero relationship specificity is approximately zero; the coefficient of relationship specificity (for which the model delivers an ambiguous prediction) is positive but also not significantly different from zero. In column 2, we add all control variables from Table 1, namely all observables as well as FE by subsidiary industry (which absorb the direct effect of relationship specificity), HQ country, and HQ industry.[36] The point estimate of γ becomes smaller but continues to be highly significant.

As an important step towards identification, we add in column 3 subsidiary country FE (which absorb the direct effect of rule of law). Note that this specification constitutes a substantial improvement over 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 (observable or unobservable) country characteristics. The positive interaction effect is confirmed.

[36]The coefficient estimates for the control variables are not reported due to space considerations.

Table 3: Ownership shares, contracting institutions, and relationship specificity

Dep. var.: Ownership share	(1)	(2)	(3)	(4)	(5)	(6)
Rule of law × Relationship specificity	5.613***	3.679***	4.018***	3.981***	3.446***	3.290***
	(1.499)	(0.825)	(0.753)	(0.720)	(0.715)	(0.690)
Rule of law	-0.0590	0.812				
	(1.351)	(1.070)				
Relationship specificity	2.771					
	(1.784)					
Control variables from Table 1	no	yes	yes	yes	yes	yes
Subsidiary industry fixed effects	no	yes	yes	yes	nested	nested
HQ country and HQ industry fixed effects	no	yes	yes	nested	nested	nested
Subsidiary country fixed effects	no	no	yes	yes	nested	nested
HQ country-industry fixed effects	no	no	no	yes	yes	yes
Industry-pair fixed effects	no	no	no	no	yes	yes
Country-pair fixed effects	no	no	no	no	yes	yes
Observations	230,296	193,770	228,205	226,133	221,280	222,458
R^2	0.028	0.153	0.163	0.226	0.267	0.278

The table reports OLS estimates of (variations of) equation (17). 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.

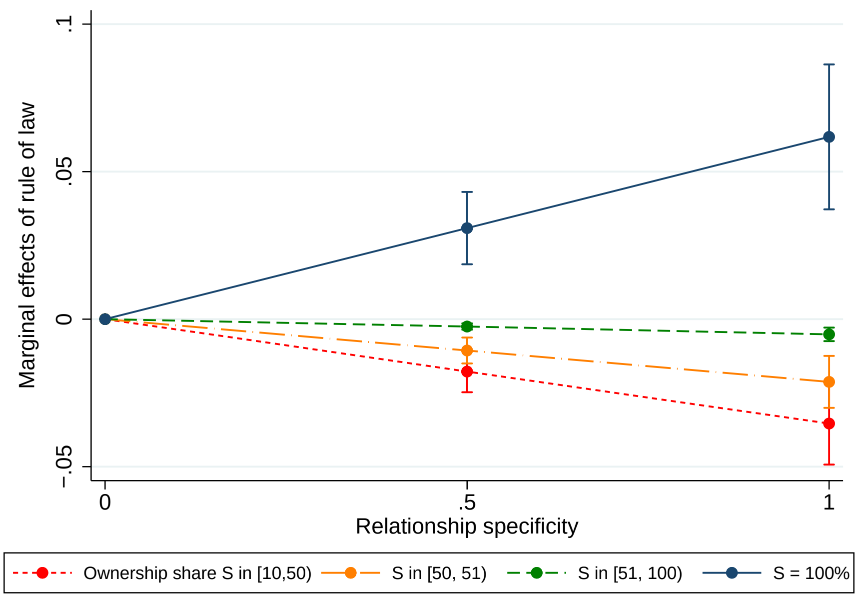
In column 4, we include HQ country-industry FE to control for potential confounding factors such as international differences in financing conditions of a given industry. In column 5, we add industry-pair FE to the regression, which comprehensively account for headquarter intensity as the relative importance of the HQ's relative to the subsidiary's contribution to the production process. These FE also control for the relative up- vs. downstreamness of the two firms. Finally, to arrive at our preferred specification in column 6, we further add country-pair FE to account for unobserved bilateral factors, such as cultural differences or ethnic ties. In all of these regressions, we estimate a significantly positive 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 in column 6 suggests that an improvement in rule of law by one standard deviation would increase the average ownership share by 3.3 percentage points *more* for a subsidiary in a highly relationship-specific industry (producing only differentiated goods) compared to a subsidiary in a non-specific (homogenous goods) industry.

Our estimation results provide strong support for Proposition 2, derived from our PRT model. 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, the HQ's optimal ownership share is higher with better contracting institutions because there is less need to incentivize the subsidiary's investments via ownership rights. This mechanism is more pronounced in highly relationship-specific industries, where any increase in ownership has a smaller adverse effect on the investment incentives of the subsidiary. Therefore, the quality of contracting institutions has a disproportionately positive effect on the depth of firm integration in relationship-specific industries.

Ordered logit model. Motivated by the discussion in Section 3.3, we now apply the ordered logit estimator to assess the interaction effect of contracting institutions and relationship specificity in a non-linear setting. As in Section 4.1, we reformulate the ownership decision as a discrete choice between ownership categories: $S_{HM} \in [10, 50)$, $S_{HM} \in [50, 51)$, $S_{HM} \in [51, 100)$, and $S_{HM} = 100\%$. We include the same covariates and FE as in column 3 of Table 3. Note that, in this regression, the higher-order FE from our preferred linear model are computationally infeasible (because there are, e.g., 8,710 industry pairs) and standard errors are clustered only by subsidiary country-industry.

Figure 4: Ordered logit regression results on interaction effects



Note: The figure depicts estimated marginal effects of rule of law by relationship specificity from the ordered logit regression model, alongside 95% confidence intervals. The regression includes the same covariates and fixed effects as in column 3 of Table 3. All other covariates are evaluated at the sample means. Standard errors are clustered at the subsidiary country-industry level. The number of observations is 228,232.

To illustrate the key interaction effect predicted by the ordered logit model, we compute the marginal effects of rule of law C_ℓ on the probability of the different ownership categories, evaluated at different levels of the relationship specificity (relative to $R_j = 0$) and at the sample means of all other covariates. These marginal effects, shown in Figure 4, confirm our previous insight that better contracting institutions are associated with a shift from minority to full ownership. In addition, we see that this effect is concentrated in highly relationship-specific industries, in line with Proposition 2 and the linear regression results.

4.3 Robustness analysis

In this section, we explore the robustness of our main empirical finding. In these robustness checks, we focus on extending the OLS regression specified in equation (17), since the linear model can be extended in straightforward ways (e.g., to include many more fixed effects or two-stage estimation) and the OLS results on the interaction effect are more easily summarized (in a single coefficient).

We begin by addressing potential concerns related to remaining omitted variables (Section 4.3.1) and selection (Section 4.3.2). Section 4.3.3 tackles the possibility of reverse causality via instrumental variables; in this context, we also discuss a complementary propensity score matching approach. Finally, we vary our measurement of key variables (Section 4.3.4) and our estimation sample (Section 4.3.5). We find strong empirical support for Proposition 2 in all robustness checks.

4.3.1 Controlling for confounding factors

Arguably, the main threat to identification of the interaction effect γ in equation (17) lies in confounding factors that are correlated with either contracting institutions or relationship specificity and are not yet fully controlled for. To address this issue, we include additional covariates and FE in our preferred specification (from column 6 of Table 3). We begin by controlling in a very general way for differential effects of subsidiary country characteristics across industries. Then we briefly discuss regressions controlling explicitly for FDI restrictions. Finally, we account for firm heterogeneity by including observable firm characteristics of the subsidiary and HQ firm FE.[37]

Flexible interaction effects. We first consider the possibility that country-specific variables may have differential effects across industries. Even after controlling for subsidiary country characteristics via FE, the interaction effect might be confounded by country-specific factors, such as economic development or other institutions, which are 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 flexible approach that controls for *arbitrary* effects of country-specific factors across industries. The results are displayed in Table 4. We begin by controlling for the differential effects of economic size and economic development by adding two sets of interaction terms of subsidiary industry dummies with GDP and GDP per

[37] We abstain from including these additional covariates and FE in the main specification because we either risk overfitting the econometric model (for the large sets of additional FE) or are left with a substantially reduced sample (in the case of firm characteristics or within-HQ estimates).

capita in the subsidiary's country to our main specification of equation (17).[38] Column 1 of Table 4 shows that our interaction effect is fully robust to this important robustness check.

We proceed analogously by controlling for interaction terms of subsidiary industry dummies with proxies for endowments (capital-labor ratio and human capital, in column 2) and of all the other types of institutions in the subsidiary's country that we have considered in Section 4.1 (financial development, labor market flexibility, IPR protection, state contracting risk, and expropriation risk, in column 3). We find that these stringent tests do not alter our previous conclusions, as the estimated interaction effect is even larger than in the baseline regression and remains highly significant.

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

Dep. var.: Ownership share	(1)	(2)	(3)	(4)	(5)
	GDP	Endowments	Institutions	Industry K/L	All interactions
Rule of law × specificity	3.887***	4.499***	7.437***	3.175***	6.767***
	(0.927)	(0.925)	(1.997)	(0.695)	(2.103)
Observations	222,458	221,910	187,835	222,458	187,835
R^2	0.281	0.281	0.285	0.280	0.289

The table reports estimates of equation (17). All regressions include the control variables and fixed effects from column 6 of Table 3. 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, state contracting risk, 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 simultaneously include all interactions from columns 1 through 4. Standard errors two-way 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.

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 through 3. Since Antràs (2003), the literature has discussed the headquarter intensity, typically proxied by an industry's capital intensity, as an important technological determinant of firm integration. While the direct effect of headquarter intensity is absorbed by industry-pair FE and while we have included an interaction term of capital intensity with the endowment ratio throughout, this variable may also have a more flexible differential effect across countries. As can be seen from column 4 of Table 4, our main finding is robust to adding a full set of interaction terms of the capital intensity of the subsidiary's industry with subsidiary country dummies.

Finally, in column 5, we conduct the most stringent test by combining all of the aforementioned sets of interaction terms in a single regression. We continue to find a significantly positive interaction effect between contracting institutions and relationship specificity in this highly demanding

[38] This approach was first developed by Levchenko (2007) for studying exports and adopted by Antràs (2015) in a context similar to our paper.

robustness check. This allows us to conclude that differential effects of other relevant country and industry characteristics are not driving our main results.

FDI restrictions. A specific type of omitted variable that one may worry about are policy restrictions on FDI, in particular foreign equity ownership restrictions. Note that, to the extent that FDI restrictions are country-specific or country-pair-specific, we have controlled for their effects through country-pair FE in our main analysis. In practice, however, FDI restrictions can also vary across industries, which leaves a potential role for them to affect our estimates. The OECD's FDI Regulatory Restrictiveness Index provides a measure of their stringency by industry for 61 countries. In a robustness check, we augment our main specification to include this measure (or alternatively, its subcomponents) plus an interaction term of FDI restrictions with a foreign ownership link dummy, since FDI restrictions are expected to have a differential effect on cross-border ownership. The estimates reported in Appendix C.2 confirm this expectation and they deliver, in a somewhat reduced sample, a highly significant positive interaction effect of the same magnitude as in our main analysis.

Firm heterogeneity. We now exploit our micro data to address potential 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 HQ and subsidiaries—may play a role in 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 various observable characteristics of the subsidiary firm, which may be relevant for ownership shares. In Table 5, we successively add these variables in two steps: First, we include two variables on which we have data for almost all firms: the subsidiary's age (since incorporation) and a shareholder dummy, indicating whether the subsidiary itself holds any shares in other firms. Second, we include other variables available for only a subset of firms: firm size (measured by $\ln \textit{employment}$), labor productivity (defined as $\ln(\textit{value added}/\textit{employment})$), and capital intensity (defined as $\ln(\textit{capital}/\textit{employment})$). All of these variables are lagged by one year, based on unconsolidated financial accounts in Orbis for 2013, which ameliorates potential concerns regarding reverse causality. As can be seen from columns 1 and 2 of Table 5, the interaction effect of rule of law and relationship specificity continues to be positive and significant after controlling for observable subsidiary firm characteristics. Furthermore, the estimates reveal that ownership shares are higher for larger, more productive, and less capital intensive subsidiaries that are not shareholders themselves, while the evidence on firm age is mixed.

Table 5: Firm heterogeneity

Dep. var.: Ownership share	(1)	(2)	(3)	(4)	(5)
	Subsidiary firm controls		HQ firm FE	Subsidiary controls + HQ FE	
Rule of law × specificity	3.168***	7.151***	2.059**	1.859*	0.182
	(0.680)	(2.021)	(0.949)	(0.950)	(3.300)
Subsidiary firm characteristics					
Age	-0.0589	0.0854		-0.230**	-0.320
	(0.105)	(0.187)		(0.112)	(0.287)
Shareholder dummy	-1.947***	-1.754***		-0.343***	0.377
	(0.117)	(0.174)		(0.120)	(0.241)
Firm size		4.116***			3.246***
		(0.300)			(0.424)
Labor productivity		0.990***			0.368
		(0.263)			(0.432)
Capital intensity		-0.879***			-0.565
		(0.306)			(0.468)
Observations	219,839	48,937	123,405	121,868	20,457
R^2	0.281	0.304	0.634	0.634	0.683

The table reports estimates of equation (17). All regressions include the control variables and FE from column 6 of Table 3. In addition, we control for one-year lags of the listed firm-level control variables for the subsidiary firm (columns 1–2), for HQ firm FE (column 3), and for the combination of both (columns 4–5). Standard errors two-way 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.

In the next step, we control for firm heterogeneity on the HQ side. Instead of including the same HQ firm characteristics as in the case of subsidiaries, we propose a more powerful test: We add HQ firm FE to our main specification. Note that this approach leverages the key advantage of our data over those used in previous studies, namely that we can identify both firms that form an ownership link—the HQ and the subsidiary. We exploit this advantage by adding HQ firm FE and thus identifying the effect of contracting institutions from variation across different subsidiary countries and industries *within* the same HQ. This approach implicitly restricts the sample to HQ that hold ownership shares in at least two subsidiaries in different countries or industries. Column 3 of Table 5 shows that the interaction effect of rule of law and relationship specificity estimated within HQ firms is positive and significant at the 5% level, and it is slightly smaller than our main estimate. In the last two columns of Table 5, we combine subsidiary firm controls and HQ firm FE in two regressions, one for the smaller and one for large set of firm controls. We continue to find a positive and marginally significant effect in column 5, but the estimate becomes small and insignificant in column 6, where the sample is however reduced more than sixfold.

4.3.2 Selection

In our main analysis, we take the location of the subsidiary as given and focus on how contracting institutions in the subsidiary's country shape the HQ's integration decision. However, the HQ's choice of production location, i.e., the selection of the country in which its subsidiary operates, 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 the HQ solves a two-stage decision problem: First, she chooses whether or not to produce in a given country, and then she decides on the degree of integration of the producer (the optimal ownership share). Depending on the determinants of the location choice, such a decision structure might introduce selection bias into our estimates. Note that the direction of this bias is a priori unclear, as it depends on how the variables that influence selection in the first stage are correlated with both firm integration and our key explanatory variables.

To address this issue, we estimate a two-stage model that applies the selection correction proposed by Heckman (1979) and, following the trade literature (Helpman et al., 2008), uses a measure of 'religious distance' between countries as an excluded variable in the selection equation. Furthermore, to allow for the incidence of selection to vary by industry, we include the predicted inverse Mills ratios interacted with subsidiary industry dummies into the second stage equation (17). Appendix C.3 describes this procedure and the estimation results in detail. In a nutshell, we find that selection is a statistically relevant issue, as the interaction terms with the inverse Mills ratio are jointly significant in the second-stage regression. However, the economic magnitude of this bias turns out to be negligible, as the estimated interaction effect of rule of law and relationship specificity remains highly significant after the selection correction and almost identical to the point estimate from our baseline specification.

4.3.3 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 equation (17). We might, however, imagine that the government of a country that 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 IV approach developed by Nunn (2007), using the historic origin of a country's legal system as an IV for the rule of law index. For this purpose, we rely on the classification of legal systems into British common law or civil law of French, German, or Scandinavian origin, which was developed by La Porta et al. (1998) and revised by La Porta et al. (2008).[39] We choose British common 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. Under the exclusion restriction, the IV approach can also eliminate other potential biases due to omitted variables, discussed in Section 4.3.1, or due to measurement error in our proxy for contracting institutions.

Table 6: Instrumental variables

Dep. var.: Ownership share	(1)	(2)
	First stage	Second stage
Rule of law × Relationship specificity		3.799***
		(1.201)
French legal origin × Relationship specificity	-1.163***	
	(0.119)	
German legal origin × Relationship specificity	-0.384***	
	(0.134)	
Scandinavian legal origin × Relationship specificity	0.451***	
	(0.113)	
Observations	222,458	222,458
R^2	0.986	0.278
F-statistic (excluded IV)		122.1
P-value of F-test		0.0000

The table reports estimation results of a 2SLS regression. Column 1 reports the first-stage estimates and column 2 reports the second-stage estimates of equation (17), in which 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 3. 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.

Table 6 reports the results of two-stages least squares (2SLS) estimation of our preferred specification of equation (17). Column 1 reports the first-stage estimation results of regressing the interaction term of rule of law × relationship specificity on a set of interaction terms of legal origin dummies and relationship specificity. It shows that these interaction effects are both individually and jointly significant, with a Kleibergen-Paap F-statistic of 122.1, which exceeds the Stock and Yogo (2002) critical values by far and points to a strong IV. The second-stage regression shown in column 2 yields a positive and significant estimate of our main interaction effect, supporting Proposition 2.

Propensity score matching. The critical assumption for the validity of the IV approach to estimating equation (17) is that the historical origins of countries' legal systems have no *differen-*

[39]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.

tial effect (by relationship specificity) on firm integration 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 integration differentially across industries. To address such a potential violation of the exclusion restriction, we continue to follow Nunn (2007) and implement a Propensity Score Matching (PSM) approach. To economize on space, here we briefly outline this approach and the results, which are described in detail in Appendix C.4.

Intuitively, the PSM approach matches the single most comparable observations involving one subsidiary from a British and one from a French legal origin country within the same industry based on observable characteristics. For the matched observations, we construct the ratio of ownership shares for the subsidiary in the British legal origin country over the one located in the French legal origin country. The logarithm of this ratio is then regressed on our preferred measure of relationship specificity. 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. This prediction is confirmed in our matched regressions for a range of alternative matching covariates, including bilateral, subsidiary country-specific and subsidiary firm-specific correlates of the ownership shares. Overall, the PSM results lend further support to our hypothesis that better contracting institutions increase the depth of integration between firms more strongly in relationship-specific industries.

4.3.4 Measurement

Our main empirical results are insensitive to the measurement of our dependent variable and the key explanatory variables. We demonstrate this by conducting a large set of robustness checks that use alternative measures of firm integration, contracting institutions, and relationship specificity. To economize on space, we briefly summarize our estimation results in this section and relegate the details to Appendix C.5.

As a first step, we examine two binary measures of firm integration in place of the continuous ownership share S_{HM} in equation (17). First, we reconsider the indicator variable for full ownership ($S_{HM} = 100\%$), as in Section 4.1. Second, we further consider an indicator variable for majority ownership ($S_{HM} \geq 50\%$). In these OLS regressions, we find a significant positive interaction effect of contracting institutions and relationship specificity on the probability of (full or majority) firm integration. We also reconsider non-linear estimation methods, in particular we apply a logit model to the full ownership dummy and a fractional logit model to the ownership share, including the same (reduced) set of fixed effects as for the ordered logit model in Section 4.2. We find that the marginal effects of rule of law estimated from both models are rising in relationship specificity, as illustrated in Appendix C.5.

While the literature has largely focused on the rule of law index as a preferred measure of the quality of contracting institutions C_ℓ, there exists a wide range of other proxies from different sources that have been used in the literature. To make sure that our main findings do not hinge on the choice of one particular measure, we explore six alternative proxies obtained from: IHS Markit, the International Country Risk Guide by Political Risk Services (PRS group), the World Bank's Doing Business database, Djankov et al. (2003), the Heritage Foundation, and Business Environmental Risk Intelligence (BERI). For all six alternative measures, the interaction effect with relationship specificity is estimated to be positive and highly statistically significant.

We also consider several alternative measures of relationship specificity R_j. In a first set of regressions, we vary our baseline measure of R_j, using alternatively the conservative or the liberal variant of the Rauch (1999) classification, and grouping the middle category of reference-priced goods alternatively with differentiated goods or with homogenous goods. For all variations of the measure, our estimate of γ is positive and significant at the 1% level. In a second set of regressions, we further experiment with two alternative proxies for relationship specificity: (i) the share of goods by industry classified as 'specified' goods according to the Broad Economic Categories Rev. 5 classification and (ii) the Harvard Product Complexity Index (PCI).[40] The estimated interaction effect of these proxies with rule of law is positive in both cases, as predicted, but it is statistically significant only for the Harvard PCI.

4.3.5 Subsamples

We have explored different subsamples in a set of robustness checks, the results of which are shown in Appendix C.6. 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 ensure that our main findings are not driven purely by developing countries with poor institutions, we examine two separate subsamples restricted to subsidiaries located in either OECD or non-OECD countries, respectively. The positive and significant interaction effect is confirmed within each subsample, though the point estimate is indeed greater for non-OECD countries.

As noted in the introduction, a substantial share of the literature studying the role of contracting institutions for firm integration has thus far focused on international investments and on vertical buyer-seller relationships (for an overview, see Antràs and Chor, 2013; Antràs, 2015). While our theory and empirical analysis are more general, we show that our results are relevant to this literature, as they continue to hold even if we (i) focus on FDI and exclude all domestic ownership links, or (ii) restrict the sample to subsidiaries active in a different four-digit NAICS industry from

[40] We thank an anonymous referee for suggesting these two alternatives. The PCI is provided by the Growth Lab at Harvard University via https://atlas.cid.harvard.edu/rankings/product (accessed on March 15, 2021).

their owner, which may be considered ‘vertical’ relationships.[41] We also show that our findings continue to hold in a broader sample including also service sector subsidiaries.

5 Concluding remarks

The fundamental role of contractual frictions in shaping firm integration is widely accepted in the economics discipline. However, there is no consensus on whether reducing these frictions eventually leads to more or less integrated firms. We contribute to this debate in three ways. First, we establish in a global cross-section of firm pairs that subsidiaries in countries with better contracting institutions are more deeply integrated by their headquarters. Second, we develop a generalized Property-Rights Theory of the firm that explains how better contracting institutions increase the willingness of headquarters to obtain a larger ownership share in their subsidiaries, and demonstrates that this effect is particularly pronounced in industries with a high degree of relationship specificity. Third, we test the model using our unique micro data on global ownership links and find strong empirical support for the positive interaction effect of contracting institutions and relationship specificity on firm integration.

What are the policy implications of our findings? Policymakers in developing countries may hope to attract FDI by improving the quality of domestic contracting institutions. Perhaps surprisingly, a transaction-cost view of the firm, in its simplest form, 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 the quality 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.

[41]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 (vertical) positions along the value chain. The same definition has been used for instance by Alfaro and Charlton (2009) and Fajgelbaum et al. (2015). As noted in footnote 8, our theoretical argument does not presuppose the existence of supply-use relationships between the two firms.

A Theory Appendix

A.1 Headquarter intensity

In the main text, 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 replacing equation (2) with the Cobb-Douglas production technology from Antràs and Helpman (2004):

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

where 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 from 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 $m = \exp\left[\int_0^1 \ln m(i)\mathrm{d}i\right]$, where 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, where $\rho \in [0, 1]$ 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 described in Section 2.1, 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 setup implies a two-sided hold-up problem and ex-ante underinvestment by both parties.

M's maximization problem in period t_3 continues to be given by equation (5). Using the joint production technology from equation (A.1), this maximization problem delivers M's reaction function:

$$m(i) = (1 - \eta)\delta\alpha R \equiv m_n^* \qquad \forall i \in [\mu, 1], \tag{A.2}$$

where 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: $\max \pi_H = \beta Q - h$.[42] This maximization problem yields the optimal amount of non-contractible headquarter services:

$$h_n = \eta\beta\alpha R, \tag{A.3}$$

as a function of revenue (obtained from plugging equations (A.1), (A.2), and (A.3) into equation (1)):

$$R = \left(\left[\exp \int_0^{\mu} \ln m(i) \mathrm{d}i \right]^{\alpha(1-\eta)} \beta^{\alpha\eta} \, \delta^{\alpha(1-\eta)(1-\mu)} \, \alpha^{\alpha[1-\mu(1-\eta)]} (1-\eta)^{-\alpha\mu(1-\eta)} D^{1-\alpha} \right)^{\frac{1}{1-\alpha[1-\mu(1-\eta)]}}. \tag{A.4}$$

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

$$\max_{\{m(i)\}_{i=0}^{\mu}} \pi_H = (1-\rho)s(1-\mu)m_n + (1-\rho)\int_0^{\mu} m(i)\mathrm{d}i + \beta Q - \int_0^{\mu} m(i)\mathrm{d}i - h_n, \tag{A.5}$$

subject to M's participation constraint ($\pi_M \geq 0$), where m_n^*, h_n, and R are given by equations (A.2), (A.3), and (A.4), respectively. To keep the exposition as simple as possible, we assume in what follows that M's PC is fulfilled and non-binding. It should be noted, however, that our results continue to hold in case of a binding PC. Utilizing equations (4), (A.2), (A.3), and (A.4) in equation (A.5), and solving H's maximization problem yields the optimal amount of contractible manufacturing inputs and the associated revenue:

$$m(i) = (1-\eta)\kappa\alpha R \equiv m_c^* \qquad \forall i \in [0,\mu], \qquad R = \delta^{\frac{\alpha(1-\mu)}{1-\alpha}} \kappa^{\frac{\alpha\mu}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} D, \tag{A.6}$$

where

$$\kappa \equiv \frac{\beta - \alpha[\beta\eta - \delta(1-\rho)(1-\mu)(s-\beta)]}{[(1-\rho)\beta+\rho]\Big[1-\alpha\left[1-\mu(1-\eta)\right]\Big]}, \tag{A.7}$$

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.6), and (A.7), we obtain from the first-order condition of this problem the optimal ownership share:

$$s_{\text{HI}}^* = \frac{1+\beta^2(1-\rho)\big[1-\alpha[1-\mu(1-\eta)]\big] - 2\beta - \alpha\big[1-\mu(1-\eta) - \beta[2-\rho(1-\eta)-\mu(2-\rho)(1-\eta)]\big]}{(1-\rho)\Big[\beta - \alpha\left[\beta\big(1-\mu(1-\eta)\big) - (1-\eta)(1-\mu)\right]\Big]}. \tag{A.8}$$

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

Before discussing the effect of contracting institutions on the optimal ownership share, two remarks are in order. First, since s^*_{HI} from equation (A.8) 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 $\rho \in [0, 1)$:

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

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.

A.2 The model with 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). This assumption can be justified by assuming an infinitely elastic supply of M agents competing for a given relationship. Formally, the equilibrium transfer satisfies the following condition:

$$\pi_M - T = 0 \tag{A.9}$$

where 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, is the same as in the baseline model.

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

reads:

$$\max_{\{m(i)\}_{i=0}^{\mu}} \pi_{HT} = R - (1-\mu)m_n - \int_0^{\mu} m(i)\mathrm{d}i. \tag{A.10}$$

Notice that, in the presence of ex-ante transfers, H reaps the entire surplus from the relationship. Using expressions for R and m_n from the baseline model, the maximization problem from equation (A.10) yields the optimal amount of contractible inputs:

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

as a function of equilibrium revenue:

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

where

$$\theta \equiv \frac{1 + s(1-\rho) - \beta(1-\rho) - \alpha(1-\beta)(1-\mu)}{[1-\alpha(1-\mu)]\,[1 + s(1-\rho) - \beta(1-\rho)]}. \tag{A.13}$$

In period t_1, H maximizes $\pi_{HT} = R - (1-\mu)\delta\alpha R - \mu\theta\alpha R$ via the choice of s, where δ is given by equation (8) and R and θ are given by equations (A.12) and (A.13), 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, recall the key trade-off faced by H in our model: By choosing a higher ownership share, H weighs a higher fraction of the surplus against a larger surplus size. If she can extract the entire surplus from M via ex-ante transfers, this trade-off vanishes and maximizing the surplus becomes H's only objective.[43] Since both M's investments in non-contractible inputs and the overall revenue decrease in s, H's optimal ownership share in the presence of ex-ante transfers is always equal to zero.

A.3 Participation constraint

To obtain a sufficient condition for which the optimal ownership share s^* from the viewpoint of H does *not* violate M's PC, we use equations (4), (6), (8), (11), (12), (13), and (15), as well as the

[43] Formally, notice from equation (8) that $s^* = -\frac{\rho\beta}{1-\rho}$ would fully eliminate M's underinvestment since $\delta|_{s=s^*} = 1$.

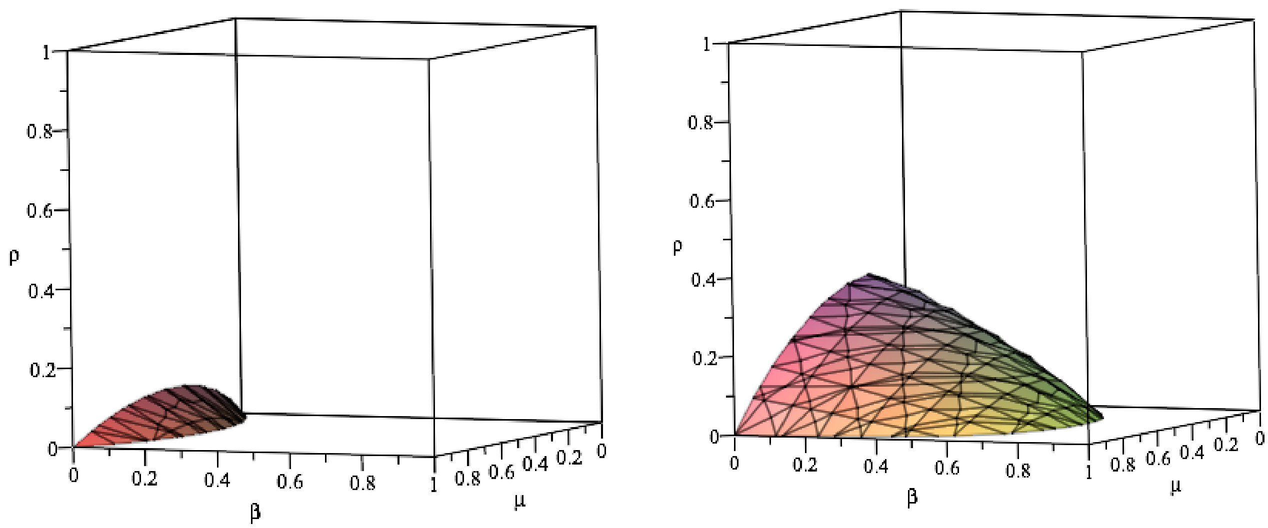
definition of $\alpha = \frac{\sigma-1}{\sigma}$ in equation (10). The resulting condition reads:

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

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.

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

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



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 slack (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.

Next, 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.

B Data Appendix

The Orbis data used in this paper were provided by Bureau van Dijk (BvD) in the form of a customized data extraction in 2015. Our sample includes subsidiary 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, e.g., pension funds, public authorities, and financial companies.

The exact date of the ownership information varies by observation and depends on the latest available information; it refers to the year 2014 in the majority of all cases. BvD reports two types of ownership shares for some shareholders: direct and total shares, the latter of which also include indirect participations. We use preferably total shares and complement them by direct shares whenever the former are missing. Robustness checks, reported in Section C.5 of this Appendix, demonstrate that using only direct ownership shares does not alter our main conclusions.

Some ownership shares are reported in broad categories, which we recode as follows: $S_{HM} = 100$ for whole ownership (coded as WO); $S_{HM} = 50.01$ for majority ownership (MO); $S_{HM} = 50.01$ for 50% plus one share (CQP1); $S_{HM} = 50$ for joint ownership (JO). We ignore the imprecision "+/-" reported for some shares. We add 0.01 percentage points for ownership shares preceded by ">", and subtract 0.01 percentage points for those preceded by "<". In a robustness check in Section C.5 of this Appendix we omit all of these recoded ownership shares that are not plain, precise numbers. Throughout the analysis we have excluded ownership shares reported as negligible (NG) because they are very likely below our 10% threshold, and we have dropped those reported as General Partners (GP) or Branches (BR) because they cannot be assigned a numeric value. We raise the ownership threshold to $S \geq 25\%$ in a robustness check in Section C.6 of this Appendix.

Our analysis sample is reduced because for some observations not all of the following crucial information is available: both firms' industry codes (required for fixed effects), ownership shares, the rule of law index in the subsidiary's country, and our preferred measure of relationship specificity in the subsidiary's industry.

In the main analysis, we consistently focus on subsidiaries whose main activity is in goods producing sectors (excluding services), for which our preferred measure of relationship specificity is available. In a robustness check in Section C.6 of this Appendix we include service sector subsidiaries.

We exclude all subsidiaries located in potential tax havens, so-called 'offshore financial centers', since these firms might not conduct any productive activities and their ownership structure might be explained by different motives than those described by our model. Our definition of tax havens follows the well-established approach used by Dharmapala and Hines (2009), with the exception that we keep five countries from their list in the sample because they may also host productive firms and hence should not be considered 'pure' tax havens. These five countries are Hong Kong, Ireland, Luxembourg, Singapore, and Switzerland. Excluding also these five subsidiary countries, or instead including all potential tax havens in the estimation sample, leaves our main empirical result unchanged, as we show in robustness checks summarized in Section C.6.

Finally, we exclude subsidiaries in countries with very low coverage of less than ten subsidiaries remaining after we have implemented all aforementioned sample selection steps.

From the full dataset, the sample used in our analysis is selected in the following steps:

Table B.1: Analysis sample selection steps

Dataset	Number of observations (firm pairs)
Full shareholders dataset	8,434,867
Shareholder is an 'industrial company'	1,761,036
Shareholder industry code available	1,247,739
Subsidiary industry code available	1,210,619
Ownership share s available and in range $s \in [10, 100]$	879,909
Subsidiary country rule of law index available	879,819
Subsidiary in goods producing sector	305,100
Subsidiary industry relationship specificity index available	230,982
Subsidiary country not an 'offshore financial center'	230,421
Subsidiary in country with at least ten subsidiaries	230,296

The resulting analysis sample corresponds to the one used in the first column of Table 3. Figure 2 additionally includes observations with $S_{HM} \in (0, 10)$. The sample is further reduced in parts of our regression analysis due to the missing information on individual covariates (especially in Table 1) and due to the dropping of singleton observations that would be perfectly predicted by the combination of fixed effects.

Table B.2: 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	1.22	1,383	85.49	52	GHA	-0.88	22	70.97
2	DNK	1.22	2,329	76.67	53	KWT	-0.91	16	50.87
3	NOR	1.15	2,845	72.76	54	TUR	-0.93	2,104	61.03
4	NZL	1.13	521	86.78	55	BGR	-0.98	1,687	71.36
5	CHE	1.11	2,293	81.16	56	BRA	-0.98	2,566	58.62
6	SWE	1.11	4,275	89.57	57	MKD	-0.98	161	66.26
7	NLD	1.10	4,117	90.53	58	IND	-1.00	3,726	59.93
8	AUT	1.07	2,634	76.08	59	MAR	-1.00	83	77.42
9	AUS	1.04	2,647	80.98	60	SEN	-1.01	21	67.75
10	LUX	1.02	149	73.19	61	TTO	-1.02	19	47.87
11	CAN	1.00	885	56.45	62	TUN	-1.04	91	67.13
12	GBR	1.00	12,173	91.44	63	SRB	-1.08	835	71.69
13	HKG	0.97	821	86.58	64	LKA	-1.10	250	74.70
14	DEU	0.97	22,665	78.21	65	BIH	-1.12	325	66.69
15	SGP	0.94	491	80.37	66	THA	-1.13	1,626	61.08
16	IRL	0.89	592	81.62	67	ZMB	-1.17	14	69.32
17	ISL	0.82	178	59.32	68	MDA	-1.18	56	62.55
18	USA	0.72	7,446	58.79	69	JAM	-1.22	16	49.23
19	JPN	0.71	7,543	53.83	70	COL	-1.23	340	65.47
20	BEL	0.63	3,132	71.61	71	PHL	-1.26	398	69.80
21	FRA	0.58	15,540	79.67	72	ALB	-1.28	38	73.99
22	CHL	0.54	282	62.95	73	IDN	-1.28	151	54.63
23	EST	0.47	676	74.78	74	VNM	-1.30	466	62.38
24	TWN	0.29	912	50.44	75	UGA	-1.33	10	66.53
25	CZE	0.25	3,109	81.40	76	TZA	-1.33	15	69.96
26	PRT	0.23	2,496	67.91	77	DOM	-1.35	25	59.51
27	ISR	0.20	1,057	68.91	78	CHN	-1.35	12,176	68.01
28	CYP	0.17	59	59.90	79	KEN	-1.36	32	62.89
29	SVN	0.09	748	66.37	80	MEX	-1.36	2,025	59.73
30	KOR	0.09	2,491	54.13	81	SLV	-1.42	16	55.87
31	ESP	0.04	9,260	72.01	82	PER	-1.46	316	63.68
32	LTU	0.03	459	75.58	83	CIV	-1.54	18	63.13
33	LVA	-0.04	379	77.42	84	KAZ	-1.54	271	81.52
34	QAT	-0.05	12	46.75	85	EGY	-1.61	224	61.01
35	POL	-0.07	4,360	81.24	86	NIC	-1.66	12	54.80
36	URY	-0.20	47	59.45	87	RUS	-1.69	14,674	68.44
37	ARE	-0.26	52	71.90	88	PAK	-1.71	87	64.64
38	BWA	-0.28	15	60.41	89	DZA	-1.72	35	66.61
39	MYS	-0.33	2,479	74.23	90	UKR	-1.74	3,487	66.75
40	HUN	-0.42	524	81.48	91	MOZ	-1.76	10	56.67
41	SVK	-0.42	969	82.60	92	BLR	-1.79	19	67.92
42	OMN	-0.43	27	46.41	93	ARG	-1.84	544	62.22
43	ITA	-0.54	15,382	67.90	94	HND	-1.90	19	58.36
44	GRC	-0.56	619	66.76	95	GTM	-1.92	27	52.64
45	HRV	-0.60	529	82.18	96	NGA	-2.00	46	64.94
46	GEO	-0.73	13	89.69	97	BOL	-2.01	29	66.86
47	ZAF	-0.74	686	81.28	98	ECU	-2.01	40	64.21
48	ROU	-0.76	2,246	73.47	99	AGO	-2.07	15	40.50
49	NAM	-0.78	10	59.22	100	ZWE	-2.40	17	56.35
50	SAU	-0.80	150	59.45	101	VEN	-2.89	71	59.31
51	MNE	-0.85	39	61.02					

The table lists ISO country codes, (sorted in descending order by) the rule of law index, the number of subsidiaries (with ownership shares of at least 10%) observed in our data, and the average ownership share by country. Lower average ownership shares are highlighted in darker shades of gray.

C Further empirical analysis

C.1 Ordered logit model

As discussed in Section 3.3, the empirical distribution of ownership shares in our data suggests that a discrete choice model may be appropriate for our analysis. We present the results of estimating ordered logit models corresponding to our two main empirical specifications in Sections 4.1 and 4.2. In this appendix, we spell out this econometric model explicitly.

The dependent variable in this model is the categorical variable $\tilde{S}$, which takes on four distinct values for categories of ownership shares S: 1 for minority (10-49.99%), 2 for marginal majority (50-50.99%), 3 for great majority (51-99.99%), and 4 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:

$$\begin{aligned}
\Pr(\tilde{S}=1|\mathbf{Z}_{HM}) &= \Lambda(\chi_1 - \boldsymbol{\xi}\mathbf{Z}_{HM}) \\
\Pr(\tilde{S}=2|\mathbf{Z}_{HM}) &= \Lambda(\chi_2 - \boldsymbol{\xi}\mathbf{Z}_{HM}) - \Lambda(\chi_1 - \boldsymbol{\xi}\mathbf{Z}_{HM}) \\
\Pr(\tilde{S}=3|\mathbf{Z}_{HM}) &= \Lambda(\chi_3 - \boldsymbol{\xi}\mathbf{Z}_{HM}) - \Lambda(\chi_2 - \boldsymbol{\xi}\mathbf{Z}_{HM}) \\
\Pr(\tilde{S}=4|\mathbf{Z}_{HM}) &= 1 - \Lambda(\chi_3 - \boldsymbol{\xi}\mathbf{Z}_{HM})
\end{aligned}$$

where $\Lambda(\cdot)$ is the logistic function, $\mathbf{Z}_{HM}$ is the vector of explanatory variables, and χ_1, χ_2, χ_3, as well as $\boldsymbol{\xi}$ are the parameters to be estimated.

To keep the model computationally feasible, we cannot include high-dimensional fixed effects in these models. In the main ordered logit regression investigating the interaction effect, illustrated in Figure 4, we thus include four sets of fixed effects by subsidiary industry, subsidary country, HQ industry, and HQ country, along with bilateral covariates and the interaction term of the subsidiary country's capital endowments ratio with the subsidiary industry's capital intensity. This is the remaining subset of all covariates that are not fully explained by the aforementioned fixed effects, corresponding to the covariates in column 3 of Table 3.

C.2 FDI restrictions

Many countries maintain policy restrictions on FDI, including on foreign equity holdings. The severity of such restrictions by country and industry is measured by the OECD's FDI Regulatory Restrictiveness Index. To account for FDI restrictions, we modify our main specification in two steps: First, we include the overall FDI restrictiveness index in the subsidiary's country-industry plus an interaction term of this index with a dummy variable indicating foreign ownership links, since FDI restrictions are expected to reduce cross-border ownership in particular. Second, we distinguish the four subcategories of the index, measuring restrictions on foreign equity holdings, screening, foreign personnel, and other restrictions, respectively. These subindices are included jointly in the regression and each interacted with the foreign ownership link dummy. Table C.1 reveals that this robustness check leaves our main estimates of the interaction effect of rule of law and relationship specificity unaffected in terms of economic size and statistical significance. FDI restrictions have the expected negative effect, especially on foreign ownership shares.

Table C.1: FDI restrictions

Dep. var.: Ownership share	(1)	(2)
Rule of law × Specificity	3.682***	2.772***
	(0.712)	(0.758)
FDI restrictions overall	-10.65***	
	(3.074)	
FDI restrictions overall × Foreign link	-11.72**	
	(5.738)	
Equity restrictions		-14.45***
		(3.523)
Equity restrictions × Foreign link		-6.358
		(6.226)
Screening restrictions		-19.10
		(15.82)
Screening restrictions × Foreign link		-72.33**
		(34.02)
Personnel restrictions		70.12**
		(34.49)
Personnel restrictions × Foreign link		-22.68
		(59.73)
Other restrictions		26.91***
		(10.39)
Other restrictions × Foreign link		-40.98*
		(20.95)
Observations	212,888	212,888
R^2	0.274	0.275

Note: The table reports estimates of equation (17), including all control variables and FE from column 6 of Table 3. The dependent variable is the ownership share. The additional control variables are explained in the text. Standard errors clustered by 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.

C.3 Selection

To address a possible selection issue (as discussed in Section 4.3.2), we estimate a two-stage selection model following 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:

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

where $\Pr$ 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 subsidiary country-specific and country-pair specific variables contained in $\mathbf{X}_{HM}$ from equation (16) (see also Table 1) as well as FE by HQ country and HQ industry.

In addition, following 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. More precisely, 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. (We set religious distance to zero for domestic pairs.) 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. This procedure inflates the dataset with zeros, resulting in more than 10 million observations for our estimation of the selection equation.

From the probabilities predicted by equation (C.1), we compute the inverse Mills ratio (IMR), the so-called non-selection hazard. The IMR is then included in the second-stage model, given by equation (17), to correct for potential selection bias. We acknowledge that the incidence of selection may differ across industries, while we have modeled in the first stage only selection into countries. However, modeling selection into all potential subsidiary country-industry pairs is computationally infeasible, since it would require inflating the dataset with around 800 million zeros to allow each HQ to choose between all of the approximately 6,000 subsidiary country-industry combinations observed in our sample. To circumvent this issue, while allowing for country-industry specific effects of selection, we include interaction terms of the IMR predicted by the procedure described above with a full set of subsidiary industry dummies in the second stage regression.

Table C.2 reports both first and second stage estimates of the selection model. The results from the first-stage probit regression reveal that religious distance tends to decrease the probability of an ownership link, in line with expectations. The coefficient of rule of law negatively correlated with the selection indicator, suggesting that countries with better contracting institutions are less likely to be selected after conditioning on the other covariates. In the second-stage regression, the interaction terms of the predicted IMR with industry dummies are jointly significant, as the F-statistic of 39.07 indicates (p-value of 0.0000), suggesting that selection may be a relevant issue. The estimate for the interaction effect of rule of law and relationship specificity is 3.310 (with a standard error of 0.800). This positive and highly significant estimate is almost identical to our baseline estimate of 3.290 from column 6 of Table 3. These findings suggest that selection does not induce a relevant bias in our setup.

Table C.2: Heckman selection model estimates

	(1)	(2)
	First stage (selection)	Second stage
	Dep. var.: $O_{H\ell}$	Dep. var.: S_{HM}
Rule of law × Relationship-specificity		3.310***
		(0.800)
Country-pair characteristics		
Religious distance	-0.588***	
	(0.0240)	
Domestic ownership link dummy	3.245***	
	(0.0240)	
ln distance	-0.0912***	
	(0.00553)	
Time zone difference	-0.0383***	
	(0.00161)	
Contiguity	0.197***	
	(0.00984)	
Common language	0.378***	
	(0.00894)	
Colonial link	-0.0265**	
	(0.0116)	
Subsidiary country characteristics		
Rule of law	-0.219***	
	(0.00660)	
ln GDP	0.288***	
	(0.00259)	
ln GDP per capita	-0.141***	
	(0.00747)	
ln (K_ℓ/L_ℓ)	0.127***	
	(0.00696)	
ln years of schooling	0.132***	
	(0.00404)	
Financial development	0.00265	
	(0.00329)	
Labor market flexibility	-0.0375***	
	(0.00347)	
IPR protection	-0.0602***	
	(0.00495)	
State contracting risk	0.0562***	
	(0.00295)	
Expropriation risk	-0.0517***	
	(0.00277)	
Observations	10,196,615	186,400
R^2		0.278
F-statistic (IMR interaction terms)		39.07
P-value of F-test		0.0000

Note: The table reports estimates of the two-stage Heckman selection model. Column 1 reports the first-stage estimation results with the subsidiary dummy $O_{H\ell}$ as the dependent variable. Column 2 reports the second-stage results with the ownership share S_{HM} as the dependent variable, augmenting equation (17) by interaction terms of the IMR predicted in the first stage and subsidiary industry dummies, and including all control variables and FE from column 6 of Table 3. Standard errors, clustered by HQ in column 1 and two-way clustered by subsidiary country-industry and by HQ in column 2, are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

C.4 Propensity Score Matching

In Section 4.3.3, we use legal origins to instrument for the rue of law index and briefly discuss a Propensity Score Matching (PSM) approach to address a potential violation of the exclusion restriction. Here we provide details on the PSM approach and the results.

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:

$$P_{HM} = \Pr(L_{HM} = 1|\mathbf{W}_{HM}) = \Phi(\boldsymbol{\upsilon} \cdot \mathbf{W}_{HM} + \omega_{HM}), \tag{C.2}$$

where we match observations on the variables summarized in the vector $\mathbf{W}_{HM}$ (with associated coefficients $\boldsymbol{\upsilon}$), and ω_{HM} is an error term.

In all variants of our PSM approach, $\mathbf{W}_{HM}$ includes the following baseline set of variables: capital intensity of the HQ's industry, the log of bilateral distance, dummy variables indicating domestic ownership, common language, and colonial link, and log of GDP per capita in the subsidiary's country. Capital intensity is defined as the logarithm of total capital over total employment, measured in the HQ's industry in 2013. It serves as a proxy for headquarter intensity. To better control for country-level confounding factors, we then vary the set of matching variables $\mathbf{W}_{HM}$ by adding alternatively the following characteristics of the subsidiary's country: the log capital-to-labor endowment ratio $\ln(K_\ell/L_\ell)$, average years of schooling, financial development, labor market flexibility, and state contracting risk. These variables are chosen because they have been revealed to significantly predict ownership shares (see Table 1). Finally, we add (instead of country characteristics) the subsidiary firm covariates that are available for many firms, i.e., firm age and the ownership dummy (as in Section 4.3.1).

Based on the propensity score $\widehat{P}_{HM}$ predicted from equation (C.2), 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.[44]

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:

$$\ln\left(S_{HMB}/S_{HMF}\right) = \kappa_1 + \kappa_2 \cdot R_j + \zeta_{HMBF}, \tag{C.3}$$

with coefficients κ_1 and κ_2, and an error term ζ_{HMBF}. Standard errors are clustered at the level of the subsidiary's industry j. Since contracting institutions in British legal origin countries are more favorable for investors, Proposition 2 predicts disproportionately higher ownership shares for subsidiaries in these countries that produce more relationship-specific goods, translating into an estimate $\widehat{\kappa}_2 > 0$.

Table C.3 reports our results from estimating equation (C.3). For all variants of $\mathbf{W}_{HM}$, we find estimates $\widehat{\kappa}_2$ that are positive and significant, confirming our model prediction.

Table C.3: Propensity score matching

Dep. var.: $\ln\left(S_{hmB}/S_{hmF}\right)$	(1)	(2)	(3)	(4)	(5)	(6)
	K/L	Years of schooling	Financial development	Labor market flexibility	State contract. risk	Age, Shareholder
Relationship specificity	0.549***	0.848***	1.085**	0.919***	0.836**	0.449**
	(0.163)	(0.322)	(0.422)	(0.332)	(0.325)	(0.185)
Observations	48,691	46,178	40,341	21,823	46,760	47,048
R^2	0.003	0.005	0.006	0.010	0.005	0.001

The table reports estimates of equation (C.3). The dependent variable is the log ratio of ownership shares across two subsidiaries. The sample includes (nearest neighbor) pairs of observations involving one subsidiary in a British and one in a French legal origin country, matched based on the propensity score predicted by variants of equation (C.2). Standard errors clustered by subsidiary industry are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01.

[44] 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 j 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.

C.5 Measurement

Table C.4: Regressions exploring alternative measurement of key variables

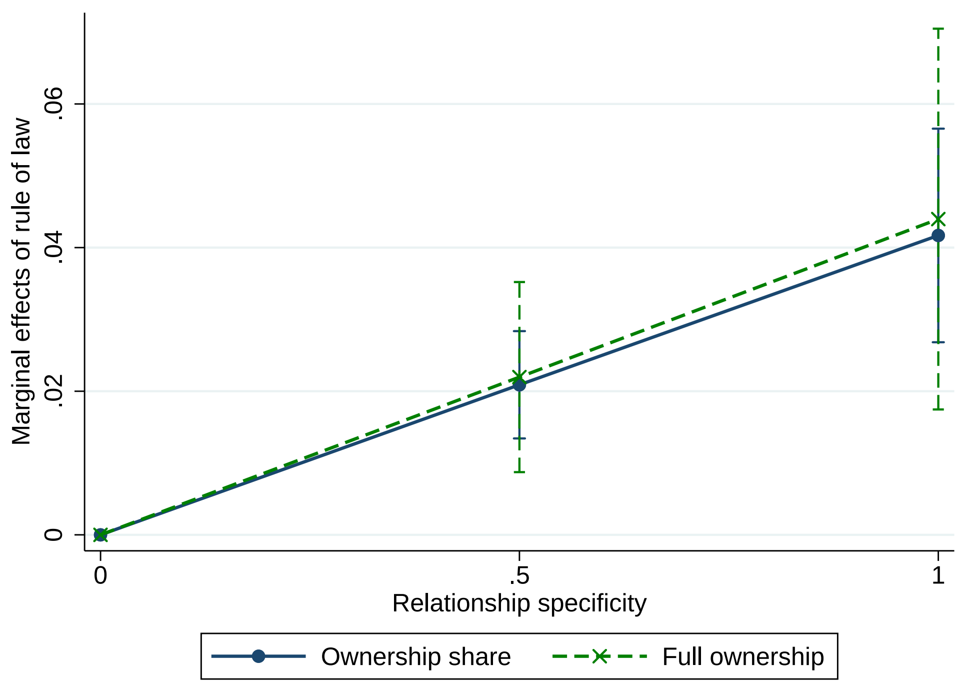
	(1)	(2)	(3)	(4)	(5)	(6)
A. Alternative measures of firm integration						
	Full ownership	Majority ownership	Full (direct shares)	Majority (direct shares)	Direct shares	Numeric shares
Rule of law × specificity	0.0363***	0.0456***	0.0432***	0.0432***	3.544***	3.842***
	(0.0106)	(0.00903)	(0.0107)	(0.0107)	(0.700)	(0.762)
Observations	222,458	222,458	195,253	195,253	195,253	192,779
R^2	0.292	0.231	0.299	0.299	0.279	0.270
B. Alternative measures of the quality of contracting institutions						
Dep. var.: ownership share	IHS Markit	PRS Group	WBDB	Djankov	Heritage	BERI
Contracting institutions	2.925***	2.189***	1.493**	1.341**	3.365***	1.665**
× specificity	(0.688)	(0.578)	(0.634)	(0.540)	(0.719)	(0.793)
Observations	221,607	221,926	222,458	219,562	222,443	185,279
R^2	0.277	0.277	0.278	0.277	0.278	0.288
C. Alternative measures of relationship specificity						
Dep. var.: ownership share	Alternative Rauch measures			Alternative specificity proxies		
	liberal, differentiated	conservative, differentiated	conservative, diff. + ref-priced	BEC share of 'specified' goods	Harvard product complexity index	
Rule of law × specificity	1.994***	2.159***	2.499***	0.775	0.524***	
	(0.456)	(0.487)	(0.946)	(0.553)	(0.180)	
Observations	222,458	222,458	222,458	218,771	188,610	
R^2	0.278	0.278	0.278	0.278	0.298	

Note: The table reports estimates of equation (17), including all control variables and FE from column 6 of Table 3. In Panel A, we consider alternative measures of firm integration: The dependent variable is a full ownership dummy ($S_{HM} = 100\%$) in columns 1 and 3, a majority ownership dummy ($S_{HM} \geq 50\%$) in columns 2 and 4, of which columns 3 and 4 are based only on direct ownership shares. The continuous direct ownership share is the dependent variable in column 5. Column 6 returns to the baseline measure of the ownership share, but includes only those shares that are reported as precise numeric values (see Appendix B for an explanation). In panels B and C, the dependent variable is the ownership share as defined in the main analysis. In Panel B, we consider six alternative measures of the quality of contracting institutions, as listed in the column header and described in Table C.5 in this Appendix. In Panel C, we consider alternative measures of relationship specificity: In column 1, we use the liberal variant of the Rauch (1999) classification and compute the share of differentiated goods (instead of referenced-priced plus differentiated). In columns 2-3, we use the conservative variant of the Rauch (1999) classification and compute, respectively, the share of differentiated goods (column 2) and the share of referenced-priced plus differentiated goods (column 3). In column 4, we use the share of 'specified' goods according to the Broad Economic Categories Rev. 5 (BEC 5) classification, and in column 5 we use the Harvard product complexity index as alternative measures of specificity. 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.

Table C.5: Alternative measures of 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 Group)	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)	Measures the time and cost for resolving a commercial dispute through a local first-instance court, and the quality of judicial processes index.
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" ([sic.] Knack and Keefer, 1995).

Figure C.1: Fractional logit and logit regression results on interaction effect



Note: The figure depicts estimated marginal effects of rule of law by relationship specificity from a fractional logit model with the ownership share as the dependent variable (blue, solid line) and from a logit model with the full ownership dummy as the dependent variable (green, dashed line), alongside 95% confidence intervals. The regression includes the same covariates and fixed effects as in column 2 of Table 3. All other covariates are evaluated at the sample means. Standard errors are clustered at the subsidiary country-industry level. The number of observations is 228,232 in the fractional logit model and 228,002 in the logit model.

C.6 Subsamples

Table C.6: Subsamples

Dep. var.: ownership share	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OECD	Non-OECD	No OFCs	All OFCs	FDI	Vertical	All industries	S$\geq$ 25%
Rule of law $\times$ specificity	2.869**	5.384***	3.212***	3.282***	3.398**	3.559***	2.710***	1.589***
	(1.189)	(1.913)	(0.703)	(0.690)	(1.416)	(0.794)	(0.713)	(0.542)
Observations	161,114	56,973	217,234	222,639	50,624	166,617	327,144	201,669
R^2	0.280	0.314	0.276	0.278	0.348	0.295	0.261	0.294

Note: The table reports estimates of equation (17), including all control variables and FE from column 6 of Table 3. The dependent variable is the ownership share. Column 1 considers the subsample of subsidiaries in OECD countries and column 2 considers the subsample of subsidiaries in non-OECD countries. Column 3 excludes all subsidiaries in any potential tax haven (so-called 'offshore financial centers', OFCs), and column 4 includes all subsidiaries in OFCs. Column 5 restricts the sample to international (cross-border) ownership links (FDI). Column 6 restricts the sample to HQ and subsidiaries in different industries ('vertical' ownership links). Column 7 includes subsidiaries active in all industries, including services. Column 8 includes only ownership shares of at least 25%. 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.

References

Acemoglu, D., Antràs, P., and Helpman, E. (2007). Contracts and Technology Adoption. *American Economic Review*, 97(3):916–943.

Acemoglu, D., Johnson, S., and Mitton, T. (2009). Determinants of Vertical Integration: Financial Development and Contracting Costs. *Journal of Finance*, 64(3):1251–1290.

Ai, C. and Norton, E. C. (2003). Interaction Terms in Logit and Probit Models. *Economics Letters*, 80(1):123–129.

Alfaro, L., Antràs, P., Chor, D., and Conconi, P. (2019). Internalizing Global Value Chains: A Firm-Level Analysis. *Journal of Political Economy*, 27(2):509–559.

Alfaro, L. and Charlton, A. (2009). Intra-industry Foreign Direct Investment. *American Economic Review*, 99(5):2096–2119.

Alfaro, L., Conconi, P., Fadinger, H., and Neman, A. (2016). Do Prices Determine Vertical Integration? *Review of Economic Studies*, 83(1-35).

Altomonte, C. and Rungi, A. (2013). Business Groups as Hierarchies of Firms: Determinants of Vertical Integration and Performance. Working Paper Series 1554, European Central Bank.

Antràs, P. (2003). Firms, Contracts, and Trade Structure. *Quarterly Journal of Economics*, 118(4):1375–1418.

Antràs, P. (2014). Grossman–Hart (1986) Goes Global: Incomplete Contracts, Property Rights, and the International Organization of Production. *Journal of Law, Economics, and Organization*, 30(1):118–175.

Antràs, P. (2015). *Global Production: Firms, Contracts, and Trade Structure*. Princeton University Press.

Antràs, P. and Chor, D. (2013). Organizing the Global Value Chain. *Econometrica*, 81(6):2127–2204.

Antràs, P. and Helpman, E. (2004). Global Sourcing. *Journal of Political Economy*, 112(3):552–580.

Antràs, P. and Helpman, E. (2008). Contractual Frictions and Global Sourcing. In Helpman, E., Marin, D., and Verdier, T., editors, *The Organization of Firms in a Global Economy*, chapter 1, pages 9–54. Harvard University Press: Cambridge, MA.

Asiedu, E. and Esfahani, H. (2001). Ownership Structure In Foreign Direct Investment Projects. *The Review of Economics and Statistics*, 83(4):647–662.

Atalay, E., Hortaçsu, A., and Syverson, C. (2014). Vertical Integration and Input Flows. *American Economic Review*, 104(4):1120–48.

Barro, R. J. and Lee, J. W. (1996). International Measures of Schooling Years and Schooling Quality. *American Economic Review*, 86(2):218–23.

Berkowitz, D., Moenius, J., and Pistor, K. (2006). Trade, law, and product complexity. *The Review of Economics and Statistics*, 88(2):363–373.

Berlingieri, G., Pisch, F., and Steinwender, C. (2018). Organizing Global Supply Chains: Input Cost Shares and Vertical Integration. NBER Working Papers 25286, National Bureau of Economic Research, Inc.

Bernard, A., Jensen, J., Redding, S., and Schott, P. (2010). Intrafirm Trade and Product Contractibility. *American Economic Review*, 100(2):444–48.

Bircan, Ç. (2013). Optimal Degree of Foreign Ownership under Uncertainty. Working Papers 617, Research Seminar in International Economics, University of Michigan.

Boehm, J. (2020). The Impact of Contract Enforcement Costs on Value Chains and Aggregate Productivity. *The Review of Economics and Statistics*, pages 1–45.

Bolatto, S., Naghavi, A., Ottaviano, G., and Kejzar, K. (2019). Intellectual property and the organization of the global value chain. CEPR Discussion Paper 14256, Centre for Economic Policy Research.

Botero, J. C., Djankov, S., Porta, R. L., Lopez-de Silanes, F., and Shleifer, A. (2004). The Regulation of Labor. *The Quarterly Journal of Economics*, 119(4):1339.

Broda, C. and Weinstein, D. E. (2006). Globalization and the Gains from Variety. *The Quarterly Journal of Economics*, 121(2):541.

Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2011). Robust Inference With Multiway Clustering. *Journal of Business & Economic Statistics*, 29(2):238–249.

Carluccio, J. and Bas, M. (2015). The Impact of Worker Bargaining Power on the Organization of Global Firms. *Journal of International Economics*, 96(1):162–181.

Carluccio, J. and Fally, T. (2012). Global Sourcing under Imperfect Capital Markets. *The Review of Economics and Statistics*, 94(3):740–763.

Chari, A., Ouimet, P. P., and Tesar, L. L. (2010). The Value of Control in Emerging Markets. *Review of Financial Studies*, 23(4):1741–1770.

Chor, D. (2010). Unpacking Sources of Comparative Advantage: A Quantitative Approach. *Journal of International Economics*, 82(152-167).

Coase, R. H. (1937). The Nature of the Firm. *Economica*, 4(16):386–405.

Corcos, G., Irac, D. M., Mion, G., and Verdier, T. (2013). The Determinants of Intrafirm Trade: Evidence from French Firms. *Review of Economics and Statistics*, 95(3):825–838.

Correia, S. (2014). REGHDFE: Stata Module to Perform Linear or Instrumental-variable Regression Absorbing any Number of High-dimensional Fixed Effects. Statistical Software Components, Boston College Department of Economics.

Costinot, A. (2009). On the Origins of Comparative Advantage. *Journal of International Economics*, 77(2):255–264.

Cravino, J. and Levchenko, A. (2017). Multinational Firms and International Business Cycle Transmission. *Quarterly Journal of Economics*, 132(2):921–962.

Crozet, M. and Koenig, P. (2010). Structural Gravity Equations with Intensive and Extensive Margins. *Canadian Journal of Economics*, 43(1):41–62.

Cui, F. (2011). Incomplete Contracts, Joint Ventures, and Ownership Restrictions. *Oxford Economic Papers*, 63:254–278.

Defever, F. and Toubal, F. (2013). Productivity, Relationship-specific Inputs and the Sourcing Modes of Multinationals. *Journal of Economic Behavior & Organization*, 94:345–357.

Del Prete, D. and Rungi, A. (2017). Organizing the Global Value Chain: A Firm-level Test. *Journal of International Economics*, 109(C):16–30.

Desai, M. A., Foley, F., and Hines, J. (2004). The costs of shared ownership: Evidence from international joint ventures. *Journal of Financial Economics*, 73:323–374.

Dharmapala, D. and Hines, J. R. (2009). Which Countries Become Tax Havens? *Journal of Public Economics*, 93(9):1058–1068.

Djankov, S., Porta, R. L., de Silanes, F. L., and Shleifer, A. (2003). Courts. *The Quarterly Journal of Economics*, 118(2):453–517.

Eppinger, P. and Ma, H. (2020). Optimal Ownership and Firm Performance: Theory and Evidence from China's FDI Liberalization. University of Tübingen, mimeo.

Fajgelbaum, P., Grossman, G. M., and Helpman, E. (2015). A Linder Hypothesis for Foreign Direct Investment. *The Review of Economic Studies*, 82(1):18–121.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The Next Generation of the Penn World Table. *American Economic Review*, 105(10):3150–82.

Gibbons, R. (2005). Four Formal(izable) Theories of the Firm? *Journal of Economic Behavior & Organization*, 58:200–245.

Gorodnichenko, Y., Kukharskyy, B., and Roland, G. (2017). Cultural Distance, Firm Boundaries, and Global Sourcing. City University of New York, mimeo.

Grossman, G. M. and Helpman, E. (2002). Integration versus Outsourcing in Industry Equilibrium. *Quarterly Journal of Economics*, 117(1):85–120.

Grossman, S. J. and Hart, O. D. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, 94(4):691–719.

Halonen, M. (2002). Reputation and the Allocation of Ownership. *Economic Journal*, 112:539–558.

Hart, O. D. and Moore, J. (1990). Property Rights and the Nature of the Firm. *Journal of Political Economy*, 98(6):1119–1158.

Head, K., Mayer, T., and Ries, J. (2010). The Erosion of Colonial Trade Linkages after Independence. *Journal of International Economics*, 81(1):1–14.

Heckman, J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*, 47(1):153–61.

Helpman, E., Melitz, M., and Rubinstein, Y. (2008). Estimating Trade Flows: Trading Partners and Trading Volumes. *The Quarterly Journal of Economics*, 123(2):441–487.

Herkenhoff, P. and Krautheim, S. (2020). The International Organization of Production in the Regulatory Void. CESifo Working Paper 6922, CESifo Group Munich.

Holmstrom, B. (1999). The Firm as a Subeconomy. *Journal of Law, Economics, & Organization*, 15(1):74–102.

Holmstrom, B. and Milgrom, P. (1991). Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design. *Journal of Law, Economics, and Organization*, 7(0):24–52.

Holmstrom, B. and Milgrom, P. (1994). The firm as an incentive system. *The American Economic Review*, 84(4):972–991.

Javorcik, B. (2004). The Composition of Foreign Direct Investment and Protection of Intellectual Property Rights: Evidence from Transition Economies. *European Economic Review*, 48(1):39–62.

Kaufmann, D., Kraay, A., and Mastruzzi, M. (2010). The Worldwide Governance Indicators: Methodology and Analytical Issues. Policy Research Working Paper 5430, World Bank.

Klein, P. G. (2005). The Make-or-Buy Decision: Lessons from Empirical Studies. In Ménard, C. and Shirley, M., editors, *Handbook of New Institutional Economics*. Springer.

Knack, S. and Keefer, P. (1995). Institutions And Economic Performance: Cross-Country Tests Using Alternative Institutional Measures. *Economics and Politics*, 7(3):207–227.

Kohler, W. and Smolka, M. (2014). Global Sourcing and Firm Selection. *Economics Letters*, 124(3):411–415.

Kohler, W. and Smolka, M. (2018). Productivity and Firm Boundaries. CESifo Working Paper 7214, CESifo Group Munich.

Kukharskyy, B. (2016). Relational Contracts and Global Sourcing. *Journal of International Economics*, 101(C):123–147.

Kukharskyy, B. (2020). A Tale of Two Property Rights: Knowledge, Physical Assets, and Multinational Firm Boundaries. *Journal of International Economics*, 122:103262.

La Porta, R., de Silanes, F. L., Shleifer, A., and Vishny, R. (1998). Law and Finance. *Journal of Political Economy*, 106(6):1113–1155.

La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2008). The Economic Consequences of Legal Origins. *Journal of Economic Literature*, 46(2):285–332.

Leuven, E. and Sianesi, B. (2015). PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing.

Levchenko, A. A. (2007). Institutional Quality and International Trade. *Review of Economic Studies*, 74(3):791–819.

Ma, Y., Qu, B., and Zhang, Y. (2010). Judicial Quality, Contract Intensity and Trade: Firm-level Evidence from Developing and Transition Countries. *Journal of Comparative Economics*, 38(2):146–159.

Nunn, N. (2007). Relationship-specificity, Incomplete Contracts, and the Pattern of Trade. *Quarterly Journal of Economics*, 122(2):569–600.

Nunn, N. and Trefler, D. (2008). The Boundaries of the Multinational Firm: An Empirical Analysis. In Elhanan Helpman, Dalia Marin, and Thierry Verdier, editor, *The Organization of Firms in a Global Economy*, pages 55–83. Harvard University Press.

Nunn, N. and Trefler, D. (2013). Incomplete Contracts and the Boundaries of the Multinational Firm. *Journal of Economic Behavior & Organization*, 94:330–344.

Nunn, N. and Trefler, D. (2014). Domestic Institutions as a Source of Comparative Advantage. In Helpman, E., Rogoff, K., and Gopinath, G., editors, *Handbook of International Economics*, volume 4, chapter 5. Elsevier.

Park, W. G. (2008). International Patent Protection: 1960–2005. *Research policy*, 37(4):761–766.

Raff, H., Ryan, M., and Stähler, F. (2009). Whole vs. Shared Ownership of Foreign Affiliates. *International Journal of Industrial Organization*, 27:572–581.

Ramondo, N., Rappoport, V., and Ruhl, K. J. (2016). Intrafirm Trade and Vertical Fragmentation in U.S. Multinational Corporations. *Journal of International Economics*, 98(C):51–59.

Rauch, J. E. (1999). Networks versus Markets in International Trade. *Journal of International Economics*, 48(1):7–35.

Rosenbaum, P. and Rubin, D. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*, 70(1):41–55.

Rosenbaum, P. and Rubin, D. (1984). Reducing Bias in Observational Studies Using Subclassification on the Propensity Score. *Journal of the American Statistical Association*, 79(387):516–524.

Schwarz, C. and Suedekum, J. (2014). Global Sourcing of Complex Production Processes. *Journal of International Economics*, 93(1):123–139.

Simon, H. A. (1951). A Formal Theory of the Employment Relationship. *Econometrica*, 19(3):293–305.

Spolaore, E. and Wacziarg, R. (2016). Ancestry, Language and Culture. In Ginsburgh, V. and Weber, S., editors, *The Palgrave Handbook of Economics and Language*, pages 174–211. Palgrave Macmillan UK, London.

Stock, J. and Yogo, M. (2002). Testing for Weak Instruments in Linear IV Regression. NBER Technical Working Papers 0284, National Bureau of Economic Research, Inc.

Tomiura, E. (2007). Foreign Outsourcing, Exporting, and FDI: A Productivity Comparison at the Firm Level. *Journal of International Economics*, 72(1):113–127.

Wang, Y., Wang, Y., and Li, K. (2014). Judicial Quality, Contract Intensity and Exports: Firm-level

Evidence. *China Economic Review*, 31:32 – 42.

Whinston, M. D. (2003). On the Transaction Cost Determinants of Vertical Integration. *Journal of Law, Economics, & Organization*, 19(1):1–23.

Williamson, O. (1971). The Vertical Integration of Production: Market Failure Considerations. *American Economic Review*, 61(2):112–123.

Williamson, O. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. The Free Press, New York.

Williamson, O. (1985). *The Economic Institutions of Capitalism*. The Free Press, New York.

Yeaple, S. R. (2006). Offshoring, Foreign Direct Investment, and the Structure of U.S. Trade. *Journal of the European Economic Association*, 4(2-3):602–611.