THE JOURNAL OF FINANCE • VOL. LXIV, NO. 3 • JUNE 2009

# Determinants of Vertical Integration: Financial Development and Contracting Costs

DARON ACEMOGLU, SIMON JOHNSON, and TODD MITTON*

**ABSTRACT**

We study the determinants of vertical integration in a new data set of over 750,000 firms from 93 countries. We present a number of theoretical predictions on the interactions between financial development, contracting costs, and the extent of vertical integration. Consistent with these predictions, contracting costs and financial development by themselves appear to have no effect on vertical integration. However, we find greater vertical integration in countries that have both greater contracting costs *and* greater financial development. We also show that countries with greater contracting costs are more vertically integrated in more capital-intensive industries.

CASUAL EMPIRICISM SUGGESTS THE PRESENCE OF SIGNIFICANT differences in the organization of production across countries. For example, firms are often thought to be larger and more vertically integrated in less developed countries. Khanna and Palepu (1997, 2000) provide evidence consistent with this view and suggest that this is because market and contractual relationships are more costly in less developed countries. Nevertheless, there has not been a systematic analysis of cross-country differences in vertical integration and their causes. Our primary aim in this paper is to make a first attempt at such a systematic analysis and to investigate the relationship between important institutional characteristics and vertical integration across countries.

Two well-established theories offer predictions on how differences in (specific) institutional characteristics of countries should affect the internal organization of the firm in general and vertical integration in particular. First, according to the highly influential Transaction Cost Economics (TCE) theory pioneered by Williamson (1975, 1985), the internal organization of a firm is designed to improve incentives and limit agency costs. Vertical integration is perhaps the best known application of this theory. Vertical integration encourages specific investments and reduces holdup problems when markets are imperfect. According to TCE, vertical integration should therefore be more prevalent when it is harder to write long-term contracts between upstream and downstream firms. This prediction is not entirely unambiguous, however. The more sophisticated

*Acemoglu and Johnson are at MIT, and Mitton is at Brigham Young University. We acknowledge the helpful comments of John McMillan, Rob Stambaugh, and an anonymous referee. We thank David Autor, Joseph Fan, and Nathan Nunn for providing data. We are particularly grateful to Jacques Crémer and Jianye Yan for pointing out an error in an earlier version of the paper. Acemoglu gratefully acknowledges financial support from the National Science Foundation.

approach to vertical integration developed by the Property Rights Theories (PRT) of Grossman and Hart (1986) and Hart and Moore (1990) emphasizes that vertical integration will also create "transaction costs" since employees, like outside suppliers, need to be given incentives to invest, and the fact that they do not have the property rights to tangible assets may weaken their incentives. In the PRT it is not entirely clear whether better contracting institutions should induce more or less vertical integration.[1]

A second body of work emphasizes the importance of contracts and other relationships between firms and financial intermediaries. According to this view, credit market imperfections affect the organization of the firm. Monitoring and contract enforcement are costly, so entrepreneurs need collateral in order to obtain financing (Banerjee and Newman (1993), Legros and Newman (1996)), and they may need to rely on bank financing (Diamond and Rajan (2005), Diamond (2004)). When credit markets have greater imperfections and when a lack of financial development limits the pool of potential entrepreneurs, there should be less entry and, most likely, larger firms in a country (Rajan and Zingales (1998), Kumar, Rajan, and Zingales (1999)). Because larger firms are more likely to produce some of their own inputs or market some of their own outputs, the financial view suggests that better financial institutions and credit markets may be associated with less vertical integration. Nevertheless, the effect of financial development on vertical integration is not unambiguous either. In particular, it may be the case that a lack of financial development prevents firms that would otherwise like to vertically integrate from doing so (see, for example, McMillan and Woodruff (1999)). Therefore, both the effects of financial institutions and contracting institutions on vertical integration are potentially ambiguous and a better understanding of these relationships requires an empirical investigation of the links between the quality of contracting institutions, financial development, and vertical integration.

While the relationship between the effect of financial and contracting institutions on vertical integration is potentially ambiguous, we argue that there are more robust predictions regarding the interaction between the quality of contracts and financial development. In particular, we present a simple model highlighting that it is higher contracting costs *in combination* with greater financial development that should lead to greater vertical integration. The intuition for this prediction is simple: Higher contracting costs in a country may create a demand for vertical integration in certain sectors, but without sufficient financial development, firms may not have the required credit to make the necessary acquisitions (McMillan and Woodruff (1999)). In addition, our model predicts another interaction effect of contracting costs and industry characteristics. Specifically, we predict a disproportionate effect of contracting costs

[1] See the surveys by Holmstrom and Tirole (1989), Joskow (2005), and Whinston (2001). Other important theoretical contributions in the area of vertical integration include Klein, Crawford, and Alchian (1978), Bolton and Whinston (1993), Aghion and Tirole (1997), Baker, Gibbons, and Murphy (2002), and Legros and Newman (2003). See Acemoglu et al. (2004) for a more detailed discussion of the empirical predictions of the PRT approach and an empirical test using U.K. data.

on the vertical integration decision in industries that are more susceptible to holdup problems.

We investigate the cross-country determinants of vertical integration using a new data set of over 750,000 firms from 93 countries. Our methodology follows the finance literature in taking the United States as a benchmark (Rajan and Zingales (1998)), and we combine our firm-level data with the U.S. input–output (IO) tables (which are assumed to accurately describe the technological possibilities in other parts of the world). While there are some limitations to our data, they nonetheless provide a new opportunity to understand how the organization of production differs across countries.

First, we look for the main effects of financial development and contracting costs on the degree of vertical integration across countries. Although cross-country differences in both financial development and contracting institutions are correlated with vertical integration, it turns out that these correlations are largely spurious. These cross-country differences in vertical integration are entirely accounted for by differences in industrial composition across countries. Once we control for differences in industrial composition, contracting costs and credit market development have little explanatory power for differences in vertical integration. Thus, it is not the case that countries with greater contracting costs or credit market imperfections tend to be more vertically integrated in a given sector. Rather, such countries tend to be concentrated in sectors that are naturally vertically integrated wherever they are in the world—that is, in sectors that have greater "propensity for vertical integration." We also investigate whether differences in financial development and contracting costs may be the reason for the differences in industrial composition and find no compelling evidence to support this hypothesis.

Our primary results, on the other hand, focus on the interactions between financial development and contracting costs. Consistent with our simple model, we find that financial development and contracting costs together have a robust interaction effect on the level of a country's vertical integration. Vertical integration is more likely when both contracting costs and financial development are high. This result is significant even when we control for industrial composition. In addition, we conduct a number of robustness checks and find that the result is robust to a wide variety of specifications. The strong interaction effect of contracting costs and financial development suggest that both factors in combination may be important for the equilibrium organization of production.

Finally, our third set of results focuses on the effects of contracting costs across different industries. Our model predicts that contracting costs should have a greater effect in industries that are more subject to holdup problems. Employing capital intensity as a proxy for the degree of holdup problems, we find that higher contracting costs are associated with greater vertical integration in industries that are capital intensive. We also find this result to be robust to a series of alternative specifications. These results suggest that a lack of efficient contract enforcement mechanisms may lead to greater vertical integration, especially in relatively capital-intense industries.

Despite the congruence between our theoretical predictions and the empirical results, it should be emphasized that the interaction results reported in this paper cannot be interpreted as causal relationships. Instead, it is possible that some other (omitted) characteristics lead to the relationship between vertical integration and the interaction of industry characteristics and contracting costs. A more detailed investigation of potential causal effects requires either a more structural approach or an instrumental variables strategy, which we view as an important area for future work.

Our paper relates to the existing literature in a number of ways. The comparative finance literature finds that industries requiring greater external finance tend to not develop in countries with less financial development (Rajan and Zingales (1998)), but has not investigated cross-country differences in vertical integration or in the internal organization of firms.[2]

Also related to our paper are cross-country comparative studies, including Bain (1966), Pryor (1972), Scherer (1973), Nugent and Nabli (1992), Kumar, Rajan and Zingales (1999), Desai, Gompers, and Lerner (2003), Fisman and Sarria-Allende (2004), and Klapper, Laeven, and Rajan (2006).[3] These papers typically focus on concentration, firm size, and entry. Earlier papers use OECD data, while more recent papers use data from the Amadeus database for Western and Eastern Europe or from the Worldscope database, which contains information only for relatively large publicly traded firms. Our data set is, to the best of our knowledge, unique in allowing us to look at a relatively broad cross-section of countries and a large sample of firms, including both private and public companies and medium-size as well as large firms. In addition, none of these studies focuses on the internal organization of the firm or vertical integration.

The paper proceeds as follows. Section I presents our model. Section II describes the data used for the study. Section III presents results on the main effects of financial development and contracting costs on vertical integration. Section IV presents our primary results, which focus on the predictions of our simple model concerning the interaction effects. Section V concludes.

[2] There is a large literature on vertical integration in specific industries in the United States, including Joskow's (1987) seminal paper on ownership arrangements in electricity generating plants, Stuckey's (1983) study of integration between aluminium refineries and bauxite mines, Monteverde and Teece's (1982) investigation of integration in the automobile industry, Masten's (1984) work on the aerospace industry, Ohanian's (1994) work on the pulp and paper industry, Klein's (1988) work on the Fisher Body and General Motors relationship, Baker and Hubbard's (2001, 2003) study of the trucking industry, Lerner and Merges's (1998) work on the biotech sector, and Chipty's (2001) paper on market foreclosure in the cable television industry. Woodruff's (2002) work on the Mexican footwear industry is the only paper we are aware of that provides a systematic study of vertical integration in a developing economy. Finally, Antràs (2003) studies the relationship between capital intensity and outsourcing using 23 U.S. industries.

[3] Another well-known approach, the market foreclosure theory, views vertical integration as a method of increasing monopoly power by downstream firms (e.g., Perry (1978), Aghion and Bolton (1987), Hart and Tirole (1990), Ordover, Salop, and Saloner (1990), and Chipty (2001)). We show that our results are robust to controlling for measures of antitrust regulations (as in Dutz and Hayri (1999)). However, because the available data on cross-country differences in antitrust regulation are more limited, we do not focus on antitrust issues in this paper.

## I. Motivating Theory

In this section, we present a simple model of vertical integration in the presence of contract enforcement problems and imperfect capital markets. Our purpose is to derive a number of simple predictions in the most transparent manner and then confront them with data. For this reason, the model will incorporate a number of simplifying assumptions. Section I.E discusses how some of these assumptions can be relaxed.

### *A. Environment*

Consider the following simple game between a supplier and a producer. Both parties are risk neutral and maximize expected profits net of effort costs. The supplier can produce an input of quality $q$ at effort (nonpecuniary) cost $c(q)$. We assume that $c(\cdot)$ is strictly increasing, convex, and differentiable with $c(0) = 0$, and that it satisfies the Inada conditions $c'(0) = 0$ and $\lim_{q\to\infty} c'(q) = \infty$. Using this input, the producer can manufacture and sell output worth $q$. The skills necessary for the production of the input are specific to the supplier and the skills necessary for manufacturing are specific to the producer. Hence, the production of the final good is not possible without the participation of either of these two parties. The outside options of both the supplier and the producer are normalized to zero.

We consider two possible organizational forms:

- Nonintegration.
- Vertical integration, with the supplier buying the producer.

Under nonintegration, the game form is as follows:

1. The supplier makes an offer to the producer, $(q_c, p_c)$, which implies that the supplier will deliver an input of quality $q_c$ and receive a price of $p_c$.
2. The producer decides whether to accept the contract.
3. Following acceptance of the contract, with probability $\gamma$, the contract is upheld. With probability $1 - \gamma$, the contract is not upheld, and there will be bargaining between the producer and the supplier.
4. After this uncertainty is revealed, the supplier chooses quality $q$.
5. If the contract is upheld, the producer receives the input and if the input is of the specified quality $q_c$, the supplier receives the specified price. Otherwise, the supplier receives zero payments (and the producer still acquires the input).
6. If the contract is not upheld, the supplier and the producer bargain over a price that the producer has to pay for the input of quality $q$ that the supplier has produced. At this point, they both have zero outside options and we assume that they engage in asymmetric Nash/Rubinstein bargaining with the bargaining power of the supplier equal to $\beta$.[4]

[4] The Nash bargaining solution generally differs from the subgame perfect equilibrium of Rubinstein's (1982) bargaining game when there are outside options. However, with zero outside options,

7. Transactions take place and the producer manufactures and sells the final good.

Note that this game form introduces a form of incomplete contracts, since it is not possible to perfectly contract on quality and payments. In particular, when $\gamma = 0$, the contracts are fully incomplete as in the TCE approach of Williamson (1975, 1985) or as in the PRT approach of Grossman and Hart (1986) and Hart and Moore (1990). However, our interest here is not on incompleteness owing to technological reasons, but on contractual incompleteness resulting from enforcement and institutional problems, for example, because of the failure of courts to enforce contracts. Thus, we interpret $\gamma$ as a measure of the quality of courts and the extent of contract enforcement. The higher this parameter is, the more likely contracts are enforced in the society under consideration.[5] Notice also that we have assumed the contract offer is made by the supplier. This is to ensure symmetry with the vertical integration offer below, which will also be made by the supplier.

Under vertical integration, the supplier owns the producer.[6] The game form in this case is simple: The supplier makes an offer of a wage $w$ to the producer for his services. Whether these services have been rendered or not is observable at some effort (nonpecuniary) cost $\eta(\gamma)$, which may potentially depend on the contracting institutions in the society, that is, $\eta(\gamma)$ could be increasing in $\gamma$. The producer receives the wage only if it provides the services. The supplier also chooses its own investment in quality, $q$. The fact that the cost of vertical integration is taken as given (as equal to $\eta(\gamma)$) makes the approach to vertical integration here more similar to the TCE approach of Williamson than to the PRT approach of Grossman–Hart–Moore.

We now proceed to characterizing the subgame perfect equilibria of this game under vertical integration and nonintegration. We will then look at the decision to integrate and at that point also describe potential credit market imperfections facing the firms.

### *B. Equilibrium under Vertical Integration*

Let us write the objective function of the supplier as

$$\pi_s(q, w, a^p) = (q - c(q) - w - \eta(\gamma))a^p,$$

where $w$ is the supplier's wage offer to the producer, $\eta(\gamma)$ is the cost of ensuring compliance by the producer under vertical integration, which the supplier will

Rubinstein's game with a specific ordering of moves and discount factors gives the same solution as the asymmetric Nash bargaining solution, which we use below.

[5] This formulation is similar to that in Acemoglu, Antràs, and Helpman (2007), where the quality of contracting institutions is proxied by the fraction of tasks that are contractible.

[6] For brevity, we only consider vertical integration with the supplier buying the producer. See Section I.E and Acemoglu et al. (2004) for a discussion of backward and forward vertical integration in a related model.

have to incur, and $a^p \in \{0, 1\}$ denotes whether the producer accepts the offer.[7] Since the producer's outside option is equal to zero, he will accept the offer, that is, $a^p = 1$, as long as $w \geq 0$. This implies that the optimal contract for the supplier is

$$w^{VI} = 0 \quad \text{and} \quad q^{VI} = q^*,$$

where $q^*$ is the first-best quality level uniquely determined by

$$c'(q^*) = 1. \tag{1}$$

The uniqueness of $q^*$ is an immediate consequence of the strict convexity of $c$ (which implies that $c'$ is everywhere strictly decreasing). The existence of an interior solution is guaranteed by the Inada conditions.

Therefore, vertical integration achieves the first-best quality. This conclusion is in line with Williamson's (1975, 1985) theory of vertical integration, which emphasizes the contractual distortions in arm's-length relationships, but not those that arise within vertically integrated organizations.

The profits of the supplier and the producer under vertical integration, $\pi_s^{VI}$ and $\pi_p^{VI}$, are therefore

$$\pi_s^{VI} = q^* - c\,(q^*) - \eta\,(\gamma)\,,$$
$$\pi_p^{VI} = 0.$$

The strict convexity of $c$, together with (1), implies that $q^* - c(q^*) > 0$. However, whether $\pi_s^{VI} > 0$ will depend on the size of the transaction cost associated with vertical integration, $\eta(\gamma)$. Naturally, if $\pi_s^{VI} < 0$, vertical integration will never take place in equilibrium.

### *C. Equilibrium under Nonintegration*

To characterize the subgame perfect equilibrium in this case, let us start by backward induction. First consider the subgame in which contracts are upheld. According to the timing of events specified above, the supplier makes the offer and the producer has the option not to accept this offer and receive zero. This implies that the contract $(q_c, p_c)$ must be such that

$$p_c = q_c,$$

since if $p_c > q_c$, the producer would turn down the offer, and if $p_c < q_c$, the supplier could increase the price for given quality $q_c$ and make more profits. Moreover, since $c(\cdot)$ satisfies the Inada conditions, there will exist a contract with $p_c = q_c$ that is profitable for the supplier.[8] Given that the contracts are

[7] Below we will assume that at the beginning of the game, the supplier is potentially credit constrained. This does not affect its wage payment, $w$, since this is paid when (or after) revenues from production, $q$, are realized.

[8] In particular, $q_c - c(q_c)$ is strictly positive for $q_c$ sufficiently small.

being upheld, the supplier will indeed choose $q = q_c$ and receive $p_c$.[9] Consequently, in the subgame in which contracts are enforced, we must have $p_c = q_c$ and the supplier will choose quality $q_c$. This will lead to zero profits for the producer and to a profit of $q_c - c(q_c)$ for the supplier.

Now consider the subgame in which contracts are not upheld and the supplier chooses some quality $q$. Recall that there is now asymmetric Nash bargaining, with weights $\beta$ and $1 - \beta$ and with zero outside options, where $\beta \in (0, 1)$. This implies that in this case, the producer and the supplier will agree to exchange the input of quality $q$ at the price

$$p = \beta q.$$

Therefore, after learning that the contracts will not be upheld, the supplier maximizes

$$\beta q - c\,(q)\,,$$

which has a unique solution given by $\hat{q}_\beta > 0$ such that

$$c'(\hat{q}_\beta) = \beta. \tag{2}$$

Again, uniqueness follows from the strict convexity of $c$. The fact that the solution is an interior solution, that is, $\hat{q}_\beta > 0$, is guaranteed by the Inada conditions. Moreover, the strict convexity of $c(\cdot)$ ensures that $\hat{q}_\beta$ is increasing in $\beta$, and as long as $\beta < 1$ we have

$$\hat{q}_\beta < q^*,$$

so that when contracts are not upheld, there will be *underinvestment* in quality.[10]

This analysis implies that before the uncertainty about whether contracts will be upheld is resolved, the expected payoffs of the two firms are

$$\pi_s^{NI}(q_c) = \gamma(q_c - c(q_c)) + (1 - \gamma)(\beta\hat{q}_\beta - c(\hat{q}_\beta))$$
$$\pi_p^{NI}(q_c) = (1 - \gamma)(1 - \beta)\hat{q}_\beta,$$

where we have incorporated the result, obtained above, that $p_c = q_c$ so that the producer makes zero profits when contracts are upheld and the supplier receives $q_c - c(q_c)$ (probability $\gamma$). We have also substituted in for the optimal investment $\hat{q}_\beta$ of the supplier and the resulting profits when contracts are not upheld (probability $1 - \gamma$).

[9] If, after the signing of the contract, it supplied an input of quality lower than $q_c$, the supplier would receive zero payment. In particular, choosing any $q < q_c$ will necessarily give lower profits to the supplier, since it would not receive the payment $p_c$. Moreover, under contract enforcement it does not have an option to withhold the input.

[10] Here a lower $\beta$ reduces investments, since $\beta$ is the share of the supplier, which is the party that is undertaking the investment. In view of this, we identify "lower $\beta$" with "more severe holdup problems."

The only choice variable for the supplier is then $q_c$. Maximizing $\pi_s^{NI}$ with respect to this implies that the contractually specified quality $q_c$ must equal the efficient quality $q^*$ as given by (1) and

$$p_c = q_c = q^*.$$

Consequently, the ex ante payoffs can be written as

$$\begin{aligned} \pi_s^{NI} &= \gamma(q^* - c(q^*)) + (1-\gamma)(\beta\hat{q}_\beta - c(\hat{q}_\beta)) > 0 \\ \pi_p^{NI} &= (1-\gamma)(1-\beta)\hat{q}_\beta > 0, \end{aligned} \tag{3}$$

where the fact that both expressions are strictly positive again follows from the convexity of $c(\cdot)$ and the fact that $\hat{q}_\beta > 0$. The social gain from vertical integration can now be obtained as

$$\begin{aligned} \Delta\pi^{VI} &\equiv \left(\pi_s^{VI} + \pi_p^{VI}\right) - \left(\pi_s^{NI} + \pi_p^{NI}\right) \\ &= (1-\gamma)[(q^* - \hat{q}_\beta) - (c(q^*) - c(\hat{q}_\beta))] - \eta(\gamma). \end{aligned}$$

This expression implies that if the transaction costs of implementing the vertically integrated organizational structure, $\eta(\gamma)$, are not very large, vertical integration will produce strictly more surplus than nonintegration.

### *D. Vertical Integration Decision*

We now consider the vertical integration decision. The producer and the supplier start out as separate firms, and before stage 1 in the above timing of events, the supplier makes an offer to buy the producer by paying an amount $t$. If the producer accepts this offer, it receives $t$ and there is vertical integration. If it rejects the offer, there are no transfers and the producer and the supplier play the nonintegration game above.[11]

The only additional complication is that the supplier is potentially credit constrained. Thus, every dollar paid at the beginning of the game costs the supplier $(1+\delta)$ dollars, where $\delta \geq 0$ is a measure of credit market frictions facing the supplier at the time the organizational form decisions are taken.

The payoffs of the two parties at this stage of the game can then be written as

$$\begin{aligned} \Pi_s(A_p, t) &= (1-A_p)\pi_s^{NI} + A_p\left(\pi_s^{VI} - (1+\delta)t\right) \\ \Pi_p(A_p, t) &= (1-A_p)\pi_p^{NI} + A_p\left(\pi_p^{VI} + t\right), \end{aligned}$$

where we use capital letters to distinguish them from the payoffs after the organizational form has been determined, and we also condition the payoffs on the strategies at this stage $A_p \in \{0, 1\}$, which denotes the producer's decision of

[11] We could allow $t$ to be negative, so that it would be the producer making a transfer to the supplier. However, such an offer would never be accepted by the producer, since its return from turning down the offer is $\pi_p^{NI} > 0$.

whether to accept the vertical integration offer of the supplier, and on $t$, which denotes the offer from the supplier ($t = 0$ here corresponds to a "no offer" from the supplier, since it will necessarily be rejected in view of the fact that $\pi_p^{NI} > 0$ from (3)).

Clearly, the producer will accept, $A_p = 1$, only if

$$\pi_p^{VI} + t \geq \pi_p^{NI}.$$

Given the above expressions, this happens only if

$$t \geq \hat{t} \equiv (1 - \gamma)(1 - \beta)\hat{q}_\beta.$$

Therefore, the supplier, if she wishes to go ahead with vertical integration, will offer $\hat{t}$.

Is vertical integration profitable for the supplier? This depends on whether

$$\pi_s^{VI} - (1 + \delta)\hat{t} \geq \pi_s^{NI}.$$

Using the expressions derived above, this is equivalent to

$$q^* - c(q^*) - \eta(\gamma) - (1 + \delta)(1 - \gamma)(1 - \beta)\hat{q}_\beta \geq \gamma(q^* - c(q^*)) + (1 - \gamma)(\beta\hat{q}_\beta - c(\hat{q}_\beta)).$$

Rearranging this expression, we obtain that there will be vertical integration in equilibrium if

$$(1 - \gamma)[(q^* - c(q^*)) - (\hat{q}_\beta - c(\hat{q}_\beta))] - \delta(1 - \gamma)(1 - \beta)\hat{q}_\beta - \eta(\gamma) \geq 0. \quad (4)$$

Intuitively, this condition states that there will be vertical integration if the efficiency gains from integration, $(1 - \gamma)[(q^* - c(q^*)) - (\hat{q}_\beta - c(\hat{q}_\beta))]$, are greater than the costs, which consist of costs due to credit market imperfections, $\delta(1 - \gamma)(1 - \beta)\hat{q}_\beta$, and the organizational costs, $\eta(\gamma)$. Inspection of (4) shows that if $\delta = 0$ and $\eta(\gamma) = 0$, that is, if credit markets are perfect and there are no transaction costs associated with vertical integration, there will necessarily be vertical integration. This is natural in view of the observation in the previous subsection that vertical integration reaches the efficient level of input quality, while nonintegration leads to underinvestment. However, with imperfect credit markets or transaction costs of vertical integration, nonintegration can arise in equilibrium.

Further inspection of this condition establishes the following results:

PROPOSITION 1 (Main Effects): *Vertical integration is more likely when credit market imperfections are limited, that is, when $\delta$ is lower.*

*The effects of the extent of contract enforcement and holdup problems, $\gamma$ and $\beta$, on vertical integration are ambiguous.*

*Proof:* These results follow from (4). Higher $\delta$ reduces the left-hand side and has no effect on the right-hand side, thus making (4) less likely to hold. To obtain an expression for the impact of higher $\beta$ (which we will utilize below), consider the derivative of the left-hand side of (4), denoted by *LHS*, with respect to $\beta$:

$$\frac{\partial LHS}{\partial \beta} = \delta(1-\gamma)\hat{q}_\beta - (1+\delta)(1-\gamma)(1-\beta)\frac{\partial \hat{q}_\beta}{\partial \beta}, \tag{5}$$

where we have used the fact that $c'(\hat{q}_\beta) = \beta$ from (2). This condition shows that the impact of $\beta$ on the vertical integration decision is ambiguous. Finally, to see that the impact of $\gamma$ is also ambiguous note that its effect on the left-hand side of (4) is ambiguous and depends on $\delta$ and the gap between $q^*$ and $\hat{q}_\beta$, and that the right-hand side of (4) also depends on $\gamma$. Q.E.D.

This proposition shows that there is no immediate relationship between the extent of contract enforcement, $\gamma$, and the vertical integration outcome. This is because the extent of contract enforcement affects the price that the supplier has to pay the producer to ensure vertical integration and also because the quality of contracts might also affect the efficiency of vertically integrated organizations. On the other hand, credit market imperfections make vertical integration less likely. Nevertheless, as discussed in the introduction, there are reasons for being cautious in interpreting this result since other mechanisms that would lead to a positive relationship between credit market imperfections and vertical integration are absent in our model (recall the effects emphasized by Rajan and Zingales (1998) and Kumar, Rajan, and Zingales (1999)). We therefore interpret the results in Proposition 1 as suggesting that there are no robust predictions regarding the (main) effects of contracting institutions and financial development on vertical integration.

The next proposition, in contrast, shows that there are clear predictions regarding the interaction effects between certain variables.

PROPOSITION 2 (Interaction Effects): *Vertical integration is more likely when there are both more developed credit markets and more severe contract enforcement problems, that is, when both $\delta$ and $\gamma$ are lower.*

*Moreover, if more severe holdup problems (low $\beta$) encourage vertical integration, then this effect becomes stronger when there are also severe contract enforcement problems, that is, when both $\beta$ and $\gamma$ are lower.*

*Proof:* The results again follow from (4). To obtain the first result, note that

$$\frac{\partial LHS^2}{\partial \delta \partial \gamma} = (1-\beta)\hat{q}_\beta > 0,$$

so that the left-hand side of (4) will be greater when both $\delta$ and $\gamma$ are lower, while the right-hand side does not depend on $\delta$. This establishes the first claim.

Next, the cross-partial of the left-hand side with respect to $\beta$ and $\gamma$ is

$$\frac{\partial LHS^2}{\partial \beta \partial \gamma} = -\delta\hat{q}_\beta + (1+\delta)(1-\beta)\frac{\partial \hat{q}_\beta}{\partial \beta}. \tag{6}$$

This expression is positive if and only if (5) is negative. Recall that (5) being negative implies that more severe holdup problems, that is, lower $\beta$, makes vertical integration more likely. Since the right-hand side of (4) does not depend on $\beta$, the cross-partial in (6) then implies that when this is the case, (4) is more likely to hold when both $\beta$ and $\gamma$ are lower, that is, when there are both more severe holdup problems and worse contracting problems. This establishes the second claim. Q.E.D.

Intuitively, severe contract enforcement problems make vertical integration more likely, but suppliers will only be able to acquire producers *if they can raise enough finance*. Thus, some degree of financial development combined with weak contracting institutions is conducive to greater vertical integration.[12] In addition, the effect of contracting institutions should be more pronounced when we look at situations in which potential holdup problems are more important (that is, situations in which holdup problems in arm's-length relationships already favor vertical integration).

In the empirical work below, we start by looking at the main effects, but our focus will be the two interaction predictions in Proposition 2. Before confronting these implications with data, we discuss how the various simplifying assumptions imposed so far can be relaxed without affecting the main implications we are focusing on.

### *E. Generalizations and Discussion*

The theoretical model presented so far makes a number of simplifying assumptions to derive our key empirical predictions in the most transparent manner. We now discuss how some of the simplifying assumptions we have imposed can be relaxed.

First, we have only allowed vertical integration involving a takeover of the producer by the supplier. A natural question is how other forms of vertical integration would affect our primary results. Recall that in our model only the supplier makes noncontractible quality investments. Vertical integration is potentially valuable because it transfers property and control rights to the supplier, preventing potential holdup problems resulting from imperfect enforcement of contracts. In this light, it is straightforward to see that allowing the producer to buy the supplier would have no effect on the results. If the producer acquired the supplier, this would only make the potential holdup problem worse.[13]

Second, one can also consider the option of a "stock-for-stock" merger between the supplier and the producer, whereby both the supplier and the producer become shareholders in the newly formed vertically integrated company. The implications of this type of merger for investment incentives would depend on

[12] The next subsection discusses how this result generalizes to richer environments.

[13] This would not be the case when the producer also makes potentially noncontractible investments. See the discussion below and also Acemoglu et al. (2004) for a related model in which both suppliers and producers undertake noncontractible investments and both types of vertical integration can arise in equilibrium. The innovation of the current model relative to that work is to consider the implications of credit market frictions and the interaction between credit market frictions and contracting institutions, which is also the focus of our empirical work.

exactly how control rights will be distributed between the two parties. Nevertheless, it is clear that since the supplier would not be the full residual claimant of the profits of the vertically integrated company (because some of its stock would belong to the producer), its investment incentives would be weaker than under the current vertical integration arrangement. Therefore, in the context of our model this type of merger is an inferior arrangement relative to the acquisition of the producer by the supplier. However, depending on the exact details of how such a merger would work, it may arise in equilibrium when credit market problems are so severe that the acquisition of the producer by the supplier is not possible.

Most importantly, as already pointed out above, we have simplified the model by assuming that only the supplier makes noncontractible investments. In the more general PRT approach of Grossman and Hart (1986) and Hart and Moore (1990), both the supplier and the producer make noncontractible investments. In this case, vertical integration resulting from the acquisition of the producer by the supplier will also create distortions, this time by increasing the risk of holdup of the producer by the supplier. If the underinvestment problem faced by the producer is more severe than that of the supplier, then the producer acquiring the supplier and having greater control rights in the vertically integrated company may be a preferred organizational form. Grossman and Hart (1986) and Hart and Moore (1990) discuss the general conditions under which different types of vertical integration can take place and Acemoglu et al. (2004) provide a characterization of the conditions under which different types of vertical integration will emerge as a function of the technology and R&D possibilities, though without incorporating credit market constraints. It can be shown that if the optimal organizational form involves the producer acquiring the supplier and the producer is also credit constrained, then similar results to those reported here would apply, but this time credit market problems would prevent the producer from acquiring the supplier.

## II. Data and Descriptive Statistics

Our firm-level data come from WorldBase. This database, compiled by Dun & Bradstreet for the primary purpose of providing business contacts, contains information on millions of public and private firms around the world. For each firm, WorldBase reports the four-digit SIC code of the primary industry in which the firm operates and the SIC codes of up to five secondary industries, listed in descending order of importance.[14] WorldBase includes data for 213 different countries. We exclude 19 of these because they are not defined as countries in the World Bank's World Development Indicators database.[15] In

[14] In the entire sample, approximately 64% of firms report one SIC code, 24% report two codes, 8% report three codes, 2% report four codes, 1% report five codes, and less than 1% report six codes. Note that we do not have the breakdown of sales by SIC for firms active in multiple industries.

[15] This excludes 15 nonindependent territories, 3 independent countries below the World Bank size threshold, and 1 disputed territory. Taiwan is retained and treated as though it were a separate country despite not being in the World Bank database.

addition, because not all of the countries in WorldBase include reporting of secondary industries, our analysis is restricted to the 93 countries for which this information is available.

Our sample consists of all firms in these countries in the September 2002 WorldBase file, with a maximum of 30,000 per country (a limit imposed due to cost constraints). For those countries with more than 30,000 firms, the 30,000 largest are selected, ranked by annual sales. We include firms from all industries except those operating only in "wholesale trade" and "retail trade" (we explain this omission below). After these adjustments to the data, we have a base sample of 769,199 firms from 93 countries.

We use the benchmark input–output accounts published by the Bureau of Economic Analysis (BEA) to calculate the degree of vertical integration for each firm in our sample (see Lawson (1997) for a discussion of the accounts). Our methodology follows the approach of Fan and Lang (2000). The input–output accounts report the dollar value of each input used to produce the output of 498 different industries in the U.S. economy. We use the 1992 input–output accounts because these are the most recently published at the six-digit input–output (IO) code level. Input–output tables from the U.S. should be informative about input flows across industries, to the extent these are determined by technology. For example, in all countries, car makers need to obtain tires, steel, and plastic from plants specialized in the manufacture of those goods.[16]

We begin by matching the four-digit SIC codes from each firm in our sample with the appropriate six-digit IO code using the BEA's concordance guide (see Lawson (1997)). Following Fan and Lang (2000), we exclude IO codes 69.01 and 69.02 (wholesale and retail trade) from our analysis because the input–output classification system does not define these categories finely enough to allow meaningful vertical integration calculations—almost all four-digit SIC codes between 5000 and 5999 map into just these two IO codes.

For every pair of industries, $\text{IO}_i$ and $\text{IO}_j$, the input–output accounts allow us to calculate the dollar value of $\text{IO}_i$ required to produce a dollar's worth of $\text{IO}_j$ in the United States. This amount, which we call the vertical integration coefficient, $\text{VI}_{ij}$, represents the opportunity for vertical integration between $\text{IO}_i$ and $\text{IO}_j$, that is, when it is higher, there is more use of input $i$ in the production of output $j$.

Using the full set of vertical integration coefficients (i.e., $\text{VI}_{ij}$ for every $\text{IO}_i$ and $\text{IO}_j$), we calculate a vertical integration index for each firm in our data set. The index is denoted by $v_{cif}$ for firm $f$ in industry $i$ in country $c$, and is defined as

$$v_{cif} = \frac{1}{|N_f|} \sum_{j \in N_f} VI_{ij}, \tag{7}$$

[16] The use of the same input–output table across countries is justified when all countries share the same technology frontier and when either all production functions are Leontief or there is factor price equalization. However, even when these stringent assumptions are not satisfied, we expect there to be a correlation in the input use patterns across countries.

where $N_f$ is the set of industries in which firm $f$ is active and $|N_f|$ denotes the number of these industries. In words, we first sum the $\text{VI}_{ij}$ coefficients between the firm's primary industry and all industries in which the firm operates. This sum represents the dollar value of inputs from industries in which the firm operates that is required to produce one dollar's worth of the firm's primary output. We then create a similar index $v_{cif}$ for secondary industries in which a firm operates. The vertical integration index is then the average of these sums for each firm, and as such represents the average opportunity for vertical integration in all lines of a business in which the firm is active.

Across all 769,199 firms in our data set, this index ranges from 0 (i.e., no vertical integration) to 53.5 (i.e., an average of 53.5 cents worth of the inputs required to produce one dollar's worth of output are produced by industries in which the firm operates). The index represents the "opportunity" for vertical integration within the firm, though firms may use this opportunity to differing degrees. For example, a firm that owns (lists) a secondary industry supplying inputs necessary for its primary industry may still purchase part or all of these inputs from other suppliers. This is a common limitation of most studies of vertical integration, which, like us, use input–output tables to measure vertical integration (e.g., Acemoglu et al. (2004) or Fan and Lang (2000)). There is no obvious reason to expect that this measurement problem will introduce systematic bias in the relationship between vertical integration and contracting costs or financial development.

For an example of how the vertical integration index is created, consider a Japanese auto maker in our data (primary code 59.0301) that also has two secondary sectors in the WorldBase data: automotive stampings (41.0201) and miscellaneous plastic products (32.0400). The $\text{VI}_{ij}$ coefficients between these industries are as shown in the following table:

| | | *Output (j)* | | |
|---|---|---|---|---|
| | | Autos | Stampings | Plastics |
| *Input (i)* | Autos | 0.0043 | 0.0000 | 0.0000 |
| | Stampings | 0.0780 | 0.0017 | 0.0000 |
| | Plastics | 0.0405 | 0.0024 | 0.0560 |
| | SUM | 0.1228 | 0.0041 | 0.0560 |

The table shows that, for example, the $\text{VI}_{ij}$ coefficient for stampings to autos is 0.078, indicating that 7.8 cents worth of automotive stampings are required to produce a dollar's output of autos, and this automaker has the internal capability to produce those stampings. (Notice that industries have $\text{VI}_{ij}$ coefficients with themselves; for example, miscellaneous plastic products are required to produce miscellaneous plastic products.) The bottom row shows the sum of the $\text{VI}_{ij}$ for each industry, for example, 12.3 cents worth of the inputs required to

**Table I**

**Descriptive Statistics**

The table presents descriptive statistics of data used in subsequent tables. Firm-level data and the vertical integration propensity measure come from the Sept. 2002 WorldBase database. Other country-level variables come from the World Bank's World Development Indicators and Doing Business data set. Industry-level variables are calculated from U.S. data from the sources noted, with industries based on 77 BEA-defined categories.

| | Mean | 25th Pctile | Median | 75th Pctile | St. Dev. | *N* |
|---|---|---|---|---|---|---|
| *Firm-level variables* | | | | | | |
| (1) Vertical integration index | 4.87 | 0.46 | 3.34 | 6.79 | 5.58 | 769,199 |
| (2) Number of employees, log | 3.86 | 2.56 | 3.74 | 5.00 | 1.87 | 676,046 |
| *Country-level variables* | | | | | | |
| (3) Vertical integration index, average | 4.98 | 4.38 | 4.93 | 5.50 | 1.00 | 93 |
| (4) Vertical integration propensity | −11.81 | −12.33 | −11.84 | −11.30 | 0.96 | 93 |
| (5) Financial development (Domestic credit/GDP) | 0.54 | 0.29 | 0.54 | 0.87 | 0.43 | 73 |
| (6) Procedural complexity index | 5.83 | 4.58 | 5.56 | 7.03 | 1.56 | 56 |
| (7) Contract enforcement procedures, 50% debt (/10) | 2.47 | 1.70 | 2.20 | 3.10 | 0.97 | 56 |
| (8) Contract enforcement procedures, 200% debt (/10) | 2.80 | 2.20 | 2.70 | 3.50 | 0.94 | 61 |
| (9) Legal formalism | 3.66 | 2.75 | 3.47 | 4.57 | 1.18 | 62 |
| (10) Population, log | 14.95 | 12.39 | 15.52 | 16.96 | 2.75 | 93 |
| (11) GDP per capita, log | 9.03 | 8.21 | 9.17 | 9.98 | 1.00 | 93 |
| *Industry-level variables (from U.S.)* | | | | | | |
| (12) Fixed assets/sales, log (Compustat) | −0.63 | −1.11 | −0.81 | −0.17 | 0.80 | 74 |
| (13) Fixed assets/total assets, log (Compustat) | −0.74 | −1.05 | −0.69 | −0.32 | 0.32 | 74 |
| (14) Fixed assets/employees, log (Compustat) | 4.35 | 3.78 | 4.04 | 4.75 | 1.00 | 74 |
| (15) Capital stock/employment, log (NBER) | 3.60 | 3.33 | 3.59 | 3.92 | 0.55 | 52 |
| (16) Capital stock/value added, log (NBER) | 0.28 | 0.08 | −0.86 | −0.58 | 0.55 | 52 |
| (17) Capital/output, log (Autor et al.) | −0.72 | −1.00 | −0.86 | −0.58 | 0.55 | 67 |
| (18) External dependence on finance (Compustat) | 0.23 | −0.25 | 0.20 | 0.69 | 1.26 | 74 |

make autos can be produced within this firm. The vertical integration index for this firm, $v_{cif}$, is then the average of the sums in the bottom row.[17]

Table I reports descriptive statistics for data used in the paper. The first row gives the vertical integration index at the firm level, and the third row reports statistics for countries' average level of vertical integration. Table I also provides descriptive statistics for the other country-level measures we use as

[17] The index could also be constructed putting greater weight on the more important industries. While it seems natural to emphasize the primary industries in the index, WorldBase does not report sales breakdowns by industry, so the weightings would be somewhat arbitrary. We have constructed the index using different weighting schemes and find little difference in the results.

independent variables. In row (5) we report our measure of financial development. This is the value of domestic credit provided to the private sector (as a percent of GDP), taken from World Bank data for the year 2000. This measure has been used frequently in other work (see, for example, Rajan and Zingales (1998)). Rows (6) through (9) report our different measures of contracting institutions. Row (6) reports the procedural complexity index, which is an index of the complexity in collecting a commercial debt valued at 50% of GDP per capita. This variable comes from the World Bank (2004). Row (7) reports the number of procedures required to collect the same contract, again from the World Bank (2004). Row (8) is a similar measure of the number of procedures required to enforce a contract, but it reflects procedures for collecting a debt valued at 200% of GDP per capita, a variable also reported by the World Bank. Row (9) reports legal formalism, which is an index of formality in legal procedures for collecting a bounced check. This variable comes from Djankov et al. (2003).[18] For all measures of contracting costs, a higher value reflects greater costs or greater complexity in enforcing contracts in that country.

Other variables reported in Table I include the log of country population (row (10)), which is taken from World Bank data for the year 2000. Row (11) is the log of GDP per capita in 2000. Our GDP estimates are PPP adjusted and are taken from the World Factbook.[19] Appendix A reports correlation coefficients of the country-level variables. The other rows of Table I report summary statistics on the number of employees per firm (row (2)) and the vertical integration propensity by country (row (4), discussed in the next section). Rows (12) through (18) report characteristics of relevant industries from U.S. data (discussed in Section IV).

## III. Main Effects of Financial Development and Contracting Costs

In this section we study the main effects of financial development and contracting costs on the level of vertical integration across countries. Proposition 1 of our model predicts a positive association between credit market development and vertical integration, although other theories based on the effect of credit market constraints on entry would suggest a negative association. With respect to contracting costs, our model's prediction for the effect of contracting costs on vertical integration is ambiguous. However, theories emphasizing the role of contracting institutions in the internal organization of the firm, such as Williamson (1975, 1985), suggest a negative correlation between vertical integration and the quality of contracting institutions. We turn to our firm-level

[18] As an additional check on our results, we also use a country's legal origin as an explanatory variable. Countries with legal systems based on French civil law have been shown to have higher contracting costs (Djankov et al. (2003), Acemoglu and Johnson (2005)), so legal origin may be considered an indirect measure of contracting institutions. The results with legal origin are similar to those with the four direct measures of contracting institutions and are not reported to save space (details available upon request).

[19] On the web at: http://www.cia.gov/cia/publications/factbook/. This covers a larger sample than the World Bank GDP estimates, and the two estimates are very similar for the countries for which they overlap.

data set to investigate whether any main effects of financial development or contracting costs are apparent in the data.

### A. Vertical Integration

In the odd-numbered columns of Table II we estimate the equation

$$v_{cf} = \mathbf{x}_c'\beta + \mathbf{z}_f'\phi + \varepsilon_{cf}, \tag{8}$$

where $v_{cf}$ is vertical integration in firm $f$ in country $c$, $\mathbf{x}_c$ is the set of country-level covariates, specifically, our measures of financial development or contracting costs, and $\mathbf{z}_f$ is a set of firm-level covariates, in particular, firm size, as measure by the log of the number of employees.

Note, however, that equation (8) does not account for cross-country differences in industrial composition. The extent of vertical integration varies markedly across sectors. Not controlling for industrial composition may lead to a spurious relationship between country characteristics and vertical integration. Consequently, our preferred specifications are presented in the even-numbered columns of Table II and include a full set of industry fixed effects:

$$v_{cif} = \mathbf{x}_c'\beta + \mathbf{z}_f'\phi + \delta_i + \varepsilon_{cif}, \tag{9}$$

where $v_{cif}$ is vertical integration of firm $f$ in industry $i$ of country $c$, $\mathbf{x}_c$ and $\mathbf{z}_f$ are country-level and firm-level covariates as before, and the $\delta_i$'s are a full set of industry fixed effects (dummies). These fixed effects enable us to capture cross-industry differences in the technological or other determinants of vertical integration. The industry dummies are defined at the two-digit IO level, which results in a set of 76 dummy variables.[20] The inclusion of a full set of industry dummies implies that in equation (9), all cross-country comparisons are relative to the "mean propensity to integrate" in a particular industry. In other words, this regression looks at, for example, whether firms in a country with worse contracting institutions are more vertically integrated relative to firms in a country with better contracting institutions in the *same* industry. In the regressions in Table II, because the variables of interest (financial development and contracting costs) vary only at the country level, the standard errors are corrected for clustering at the country level.

The inclusion of firm size as a control variable in both (8) and (9) is important because a potential concern with the results in this paper is sample selection. Our data set contains different numbers of firms from different countries, and this variation in the selection of sample firms could be a source of variation in vertical integration. The main source of the problem would be potential correlation between vertical integration and firm size (combined with differential selection on firm size across countries). For example, it may be the case that we only observe relatively larger companies in countries with weaker institutions

[20] We use the primary industry of each firm, that is, the IO code matched to the SIC code that comes first in WorldBase.

**Table II**

## Main Effects of Financial Development and Contracting Costs

The table presents coefficient estimates from regressions of a firm-level vertical integration index on measures of contracting costs and financial development. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Even-numbered columns include a full set of industry dummies based on 77 BEA-defined industries. Robust standard errors, adjusted for clustering within countries, are in parentheses.

| | | | Procedural Complexity | | Contract Enforcement Procedures (50% Debt) | | Contract Enforcement Procedures (200% Debt) | | Legal Formalism | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Financial development | −0.34 | 0.02 | | | | | | | | |
| | (0.15) | (0.13) | | | | | | | | |
| Contracting costs | | | 0.10 | 0.03 | 0.24 | 0.01 | 0.28 | 0.02 | 0.13 | 0.00 |
| | | | (0.06) | (0.04) | (0.09) | (0.07) | (0.10) | (0.07) | (0.07) | (0.06) |
| Log number of employees | 0.27 | 0.04 | 0.27 | 0.05 | 0.27 | 0.05 | 0.27 | 0.05 | 0.28 | 0.04 |
| | (0.05) | (0.03) | (0.05) | (0.03) | (0.05) | (0.03) | (0.05) | (0.03) | (0.05) | (0.03) |
| Industry dummies | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| $R^2$ | 0.01 | 0.40 | 0.01 | 0.40 | 0.01 | 0.40 | 0.01 | 0.40 | 0.01 | 0.41 |
| Number of countries | 73 | 73 | 56 | 56 | 56 | 56 | 61 | 61 | 62 | 62 |
| Number of observations | 648,157 | 648,157 | 661,580 | 661,580 | 661,580 | 661,580 | 661,747 | 661,747 | 642,253 | 642,253 |

and larger companies are more likely to be vertically integrated. Estimating the relationship between vertical integration and contracting or financial institutions at the firm level, while also controlling for firm size, partially alleviates this sample selection concern.[21]

Column (1) of Table II reports a statistically significant correlation between credit market development and vertical integration. The coefficient on domestic credit to the private sector is −0.34 with a standard error of 0.15. The finding that greater financial development is associated with less vertical integration is contrary to Proposition 1, although it is consistent with theories emphasizing the effect of financial development on entry. Column (2), however, shows that once we control for industrial composition, the significant effect of financial development on vertical integration disappears. The correlation between financial development and vertical integration (when not controlling for industry composition) appears to be spurious, and is almost entirely accounted for by differences in industry composition across countries.

Columns (3) through (10) investigate the effect of contracting costs on vertical integration using our four different measures of contracting costs. The odd-numbered columns show a positive correlation between our measures of contracting costs and vertical integration, as would be predicted by Williamson's TCE approach. For two of the four measures of contracting costs this positive correlation is statistically significant. However, the even-numbered columns show that after we control for industry composition, the significant effects of contracting costs disappear. Therefore, as with the results for financial development, the raw correlation between contracting institutions and vertical integration appears to be spurious and accounted for by cross-country differences in industry composition.

We conduct a series of robustness checks to ensure that this general pattern persists in alternative specifications. In additional tests (not reported) we find similar results when we limit the data set to manufacturing industries, when we exclude the most and least vertically integrated industries, and when we limit the analysis to industries that appear in 90% or more of the countries in the data set. In all cases, there is a correlation between financial development or contracting institutions and vertical integration without industry controls, but this correlation disappears once we control for industry composition by including a full set of industry dummies.

The lack of a correlation between our institutional measures and vertical integration after controlling for industrial composition can be interpreted in different ways. One possibility is that our measures of specific institutions do not adequately capture cross-country differences in these factors. Naturally, the various proxies for contracting costs and financial development are imperfect and potentially measured with error. Nevertheless, in addition to the results in Table II that do not control for industry, previous work shows that these indices do have significant information content, and are correlated with

[21] We also experiment with regressions controlling for second-, third-, and fourth-order polynomials in firm size, and find very similar results.

economic outcomes (see, for example, Djankov et al. (2003)). Moreover, we show below significant and robust results consistent with the predictions of Proposition 2 using the same measures. Thus, the lack of correlation between these measures and vertical integration is unlikely to be driven by measurement error.

Another possibility is simply that these specific institutions have no impact on average vertical integration across countries. Such an interpretation would be a challenge to many of the theories discussed in the introduction, which (implicitly or explicitly) suggest that differences in contracting costs or credit market development should have a major effect on cross-country patterns of the internal organization of the firm and vertical integration. However, as shown in Section I, somewhat more refined theories make more robust predictions about interactions rather than main effects. In Section IV we show that the data provide considerable support for these interaction effects.

Before turning to the interaction effects, one other potential interpretation also needs to be discussed. It may be that the lack of significance of financial development and contracting costs after controlling for industrial composition reflects a more subtle effect of these specific institutions on the internal organization of firms. Perhaps these institutional factors influence industrial composition as a way of preventing the transaction costs and the underinvestment problems that are more prevalent in certain sectors. For example, countries with worse contracting institutions or more limited financial development may be more concentrated in industries that typically have higher vertical integration, such as mining (ferrous and nonferrous), petroleum and gas, leather, fabrics, chemicals, apparel, and electronic components, precisely as a way of preventing the costs of weaker contracts and less developed financial markets. We investigate this possibility in the next subsection and show that this mechanism does not seem to be responsible for the lack of a relationship between contracting and financial institutions and vertical integration.

### *B. Vertical Integration Propensity*

To study why the significant correlation between vertical integration and our measures of specific institutions disappears when industry dummies are included in the regressions, we calculate, for each country, the propensity to vertically integrate according to industrial composition:

$$\hat{V}_c = \sum_i \hat{\delta}_i \frac{S_{ci}}{S_c}, \tag{10}$$

where $\hat{\delta}_i$'s are the estimates of the industry dummies (reported in Appendix B) from a firm-level regression of vertical integration on industry dummies using U.S. data, $S_{ci}$ is total sales in industry $i$ in country $c$, and $S_c$ is total sales in country $c$. The dummies $\hat{\delta}_i$ measure the average level of vertical integration in industry $i$ in the U.S., so $\hat{V}_c$ measures the average tendency for vertical integration in the country due to its industrial composition. In other words, $\hat{V}_c$

measures the extent of vertical integration in a country if the country had the average level of vertical integration in the United States corresponding to each industry.[22] Consequently, the source of variation in $\hat{V}_c$ arises purely from the industrial composition of the country.

We estimate the following simple model:

$$\hat{V}_c = \mathbf{x}_c'\beta + \varepsilon_c, \tag{11}$$

where $\hat{V}_c$ is the vertical integration propensity for country $c$, $\mathbf{x}_c$ is a vector of country-level variables including either financial development or contracting costs as well as the log of population (to control for country size) and the log of GDP per capita, and $\varepsilon_c$ is an error term capturing all omitted factors.

In Table III, we report results from regressions estimating equation (11). In the odd-numbered columns of Table III, we report results without per-capita GDP as an explanatory variable. Column (1) of Table III shows a significant negative correlation between financial development and vertical integration propensity. The remaining odd-numbered columns demonstrate a significant positive correlation between all four measures of contracting costs and vertical integration propensity. The magnitude of the coefficients in the odd-numbered columns implies that a one-standard deviation increase in financial development is associated with about a 1/3-standard deviation decrease in a country's vertical integration propensity, and that a one-standard deviation increase in contracting costs is associated with about a 1/4- to 1/3-standard deviation increase in vertical integration propensity.

These results illustrate why the correlations between vertical integration and contracting and financial institutions disappear when we control for industrial composition (industry dummies). Countries with weaker institutions, as measured by contracting costs or credit market development, tend to be concentrated in industries with higher (technological) propensity for vertical integration. This pattern is therefore consistent with a major effect of contracting institutions or financial development on industry composition.

However, the even-numbered columns of Table III strongly weigh against this interpretation. These columns show that the relationship between contracting and financial institutions and the vertical integration propensity disappears once we control for (log) GDP per capita. There appears to be a strong negative correlation between per-capita GDP and vertical integration propensity. In each of the even-numbered columns, the inclusion of GDP per capita entirely eliminates the significant effect of financial development and contracting costs. This evidence therefore suggests that differences in industry composition and the resulting differences in vertical integration propensity across countries are more likely to be due to differences in the stage of development rather than a direct consequence of weaker contracting institutions or lower levels of financial development.

[22] In alternative tests we also calculate the industry dummy coefficients using data from all G7 nations and using data from all 93 countries in our data set. The results are very similar to our baseline results and are available upon request.

**Table III**

**Financial Development, Contracting Costs, and the Propensity for Vertical Integration**

The table presents coefficient estimates from regressions of a country's vertical integration propensity on measures of contracting costs and financial development. "Vertical integration propensity" is a measure of the average tendency for firms in the country to vertically integrate based on how the country's industrial composition is weighted in industries with a natural propensity for vertical integration. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Robust standard errors are in parentheses.

| | | | Procedural Complexity | | Contract Enforcement Procedures (50% Debt) | | Contract Enforcement Procedures (200% Debt) | | Legal Formalism | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Financial development | −0.80 | 0.12 | | | | | | | | |
| | (0.18) | (0.15) | | | | | | | | |
| Contracting costs | | | 0.18 | −0.03 | 0.27 | −0.04 | 0.35 | −0.02 | 0.14 | −0.07 |
| | | | (0.05) | (0.05) | (0.10) | (0.09) | (0.08) | (0.10) | (0.07) | (0.06) |
| Log population | 0.07 | 0.06 | 0.27 | 0.16 | 0.27 | 0.17 | 0.15 | 0.18 | 0.09 | 0.06 |
| | (0.04) | (0.03) | (0.07) | (0.04) | (0.07) | (0.03) | (0.05) | (0.04) | (0.05) | (0.04) |
| Log GDP per capita | | −0.63 | | −0.72 | | −0.71 | | −0.68 | | −0.66 |
| | | (0.10) | | (0.10) | | (0.10) | | (0.11) | | (0.10) |
| $R^2$ | 0.20 | 0.51 | 0.26 | 0.72 | 0.25 | 0.72 | 0.24 | 0.67 | 0.12 | 0.58 |
| Number of countries | 73 | 73 | 56 | 56 | 56 | 56 | 61 | 61 | 62 | 62 |

## IV. Interaction Effects

The results in the previous section may suggest that there are no robust regularities in cross-country vertical integration patterns once we control for industrial composition. In this section, we turn to interaction effects to show that this is not true. Here we focus on the interaction effects predicted by our model in Proposition 2. We first study the interaction effect of financial development combined with contracting costs, and then focus on the differential effects of contracting costs across industries.

### *A. The Interaction of Financial Development and Contracting Costs*

The first implication of Proposition 2 is that vertical integration should be more prevalent in countries that have both higher contracting costs and greater financial development. To test this implication we conduct additional regressions of the type shown in equation (9), with some modifications. As an additional country-level regressor ($\mathbf{x}_c$) we include our variable of interest, the interaction of financial development and contracting costs. In addition, as control variables for size and development we include among $\mathbf{x}_c$ log population and the log of per-capita GDP. Industry dummies are included in all specifications.

Table IV presents the results on the interaction of financial development and contracting costs. The four columns in the table correspond to the four different measures of contracting costs. The first two rows of Table IV report the main effects of financial development and contracting costs. The third row reports the coefficients for our variable of interest, the interaction of financial development and contracting costs. Table IV shows that for all four measures of contracting costs, the coefficient on our interaction term is positive and statistically significant. The magnitude of the coefficients suggests, for example, that in countries with the weakest financial development, a one-standard deviation increase in contracting costs is associated with only a small increase in a country's average vertical integration index, but that in the countries with the strongest financial development, a one-standard deviation increase in contracting costs is associated with roughly a 3/4-standard deviation increase in a country's average vertical integration index (depending on the contracting measure). The coefficients on per-capita GDP and population are positive and generally significant; the inclusion of these variables demonstrates that financial development and contracting costs are not picking up other effects associated with the size or development of countries. It is also worth noting in Table IV that the main effects of contracting costs are now positive and usually significant, even though industry dummies are included in the regression. The main effects of financial development, on the other hand, are not significant.[23] Table IV shows that financial development and contracting costs do have a significant correlation with a country's level of vertical integration, but

[23] The main effects are evaluated at their sample mean values.

**Table IV**

**The Interaction of Financial Development and Contracting Costs**

The table presents coefficient estimates from regressions of a firm-level vertical integration index on measures of contracting costs and financial development. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Also included but not reported are a full set of industry dummies based on 77 BEA-defined industries. Robust standard errors, adjusted for clustering within countries, are in parentheses. Interaction terms are created using demeaned variables.

| | Procedural Complexity (1) | Contract Enforcement Procedures (50% Debt) (2) | Contract Enforcement Procedures (200% Debt) (3) | Legal Formalism (4) |
|---|---|---|---|---|
| Financial development | −0.01 | −0.12 | −0.08 | −0.09 |
| | (0.16) | (0.14) | (0.18) | (0.17) |
| Contracting costs | 0.10 | 0.38 | 0.28 | 0.13 |
| | (0.05) | (0.12) | (0.12) | (0.08) |
| Financial development × | 0.24 | 0.74 | 0.45 | 0.39 |
| Contracting costs | (0.08) | (0.16) | (0.16) | (0.13) |
| Log GDP per capita | 0.17 | 0.27 | 0.34 | 0.19 |
| | (0.07) | (0.09) | (0.11) | (0.07) |
| Log population | 0.05 | 0.12 | 0.10 | 0.06 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| Log number of employees | 0.05 | 0.04 | 0.04 | 0.05 |
| | (0.03) | (0.02) | (0.03) | (0.03) |
| Industry dummies | Yes | Yes | Yes | Yes |
| $R^2$ | 0.40 | 0.40 | 0.40 | 0.40 |
| Number of countries | 54 | 54 | 57 | 57 |
| Number of observations | 638,217 | 638,217 | 638,348 | 618,362 |

that it is the interaction of these two institutional factors that has the greatest importance.

In Tables V and VI we report additional tests to assess the robustness of the results presented in Table IV. In Table V we repeat the regressions of Table IV, but also include the interaction of GDP per capita with contracting costs and with financial development as additional explanatory variables. The motivation for including these terms is that existing work demonstrates that financial development is correlated with the stage of economic development, and moreover, the results in Table III show that controlling for GDP per capita could significantly change the relationship between contracting and financial institutions and vertical integration propensity. Consequently, we would like to make sure that the interaction of financial development and contracting costs is not just proxying for other factors associated with the stage of development interacted with contracting costs or financial development. Table V is reassuring in this respect. It shows that the results are robust to inclusion of these additional interaction terms. In columns (1) through (4) we include the interaction of log GDP per capita and contracting costs. In all four columns, the coefficient on the

**Table V**

**The Interaction of Financial Development and Contracting Costs, Per-capita GDP Interactions Included**

The table presents coefficient estimates from regressions of a firm-level vertical integration index on measures of contracting costs and financial development. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Also included but not reported are a full set of industry dummies based on 77 BEA-defined industries. Robust standard errors, adjusted for clustering within countries, are in parentheses. Interaction terms are created using demeaned variables.

| | Procedural Complexity (1) | Contract Enforcement Procedures (50% Debt) (2) | Contract Enforcement Procedures (200% Debt) (3) | Legal Formalism (4) | Procedural Complexity (5) | Procedural Complexity (6) |
|---|---|---|---|---|---|---|
| Financial development | −0.03 | −0.13 | −0.08 | −0.10 | 0.00 | −0.03 |
| | (0.17) | (0.14) | (0.18) | (0.17) | (0.16) | (0.16) |
| Contracting costs | 0.09 | 0.37 | 0.29 | 0.13 | 0.10 | 0.09 |
| | (0.05) | (0.11) | (0.12) | (0.08) | (0.05) | (0.05) |
| Financial development × | 0.21 | 0.68 | 0.48 | 0.38 | 0.28 | 0.23 |
| Contracting costs | (0.09) | (0.18) | (0.20) | (0.13) | (0.08) | (0.09) |
| Log GDP per capita × | 0.04 | 0.07 | −0.03 | 0.01 | | 0.18 |
| Contracting costs | (0.06) | (0.12) | (0.09) | (0.07) | | (0.17) |
| Log GDP per capita × | | | | | 0.14 | 0.01 |
| Financial development | | | | | (0.15) | (0.01) |
| Log GDP per capita | 0.17 | 0.26 | 0.35 | 0.19 | 0.18 | 0.18 |
| | (0.07) | (0.09) | (0.11) | (0.07) | (0.07) | (0.07) |
| Log population | 0.05 | 0.11 | 0.10 | 0.06 | 0.05 | 0.05 |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Log number of employees | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 |
| | (0.03) | (0.02) | (0.03) | (0.03) | (0.03) | (0.03) |
| Industry dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Number of countries | 54 | 54 | 57 | 57 | 54 | 54 |
| Number of observations | 638,217 | 638,217 | 638,348 | 618,362 | 638,217 | 638,217 |

interaction of financial development and contracting costs is positive, statistically significant, and also of a similar magnitude to the estimates in Table IV. For example, with the procedural complexity measure the coefficient estimate on the interaction term is 0.21 (standard error = 0.09) compared to 0.24 in Table IV. In all cases, the interactions of contracting costs with GDP per capita are always small and insignificant. In column (5) we include the interaction of GDP per capita and financial development. The coefficient on the interaction between financial development and the procedural complexity measure of contracting costs remains positive and significant. Finally, in column (6) we include both the interactions of financial development and GDP per capita and contracting costs and GDP per capita. The coefficient on the interaction between financial development and the procedural complexity index remains very similar to the baseline and is statistically significant (0.23, standard error = 0.09), while the GDP interactions continue to be insignificant.[24]

[24] The results with the other measures of contracting costs are similar and not reported to save space.

**Table VI**

## The Interaction of Financial Development and Contracting Costs, Squared Country-Level Measures Included

The table presents coefficient estimates from regressions of a firm-level vertical integration index on measures of contracting costs and financial development. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Also included but not reported are a full set of industry dummies based on 77 BEA-defined industries. Robust standard errors, adjusted for clustering within countries, are in parentheses. Interaction terms are created using demeaned variables.

| | Procedural Complexity (1) | Contract Enforcement Procedures (50% Debt) (2) | Contract Enforcement Procedures (200% Debt) (3) | Legal Formalism (4) |
|---|---|---|---|---|
| Financial development | −0.29 | −0.32 | −0.09 | 0.10 |
| | (0.30) | (0.38) | (0.64) | (0.56) |
| Contracting costs | 0.64 | 0.31 | 0.49 | 0.81 |
| | (0.26) | (0.37) | (0.48) | (0.31) |
| Financial development$^2$ | 0.12 | 0.11 | −0.01 | −0.12 |
| | (0.35) | (0.21) | (0.38) | (0.32) |
| Contracting costs$^2$ | −0.05 | 0.02 | −0.05 | −0.09 |
| | (0.02) | (0.08) | (0.10) | (0.04) |
| Financial development × | 0.200 | 0.81 | 0.37 | 0.21 |
| Contracting costs | (0.096) | (0.26) | (0.37) | (0.15) |
| Log GDP per capita | 0.21 | 0.27 | 0.33 | 0.22 |
| | (0.07) | (0.09) | (0.11) | (0.07) |
| Log population | 0.06 | 0.12 | 0.10 | 0.06 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| Log number of employees | 0.05 | 0.03 | 0.04 | 0.05 |
| | (0.03) | (0.02) | (0.03) | (0.03) |
| Industry dummies | Yes | Yes | Yes | Yes |
| $R^2$ | 0.40 | 0.40 | 0.40 | 0.40 |
| Number of countries | 54 | 54 | 57 | 57 |
| Number of observations | 638,217 | 638,217 | 638,348 | 618,362 |

In Table VI we again repeat the regressions of Table IV, but we now include squared terms for financial development and contracting costs. Our motivation is to assess whether the interaction of financial development and contracting costs proxies for nonlinear effects of the institutional factors. Table VI shows that the results are generally robust to inclusion of the squared terms, but that the coefficients on the interaction of financial development and contracting costs are somewhat smaller. In all four columns the coefficient on the interaction term remains positive. In two cases, the coefficient continues to be statistically significant, but it loses significance in the other two.

We also check the robustness of our results with alternative measures of financial development. Although measures of overall credit market development are most relevant for our theoretical predictions, it is instructive to look at how the results vary with other measures of financial development. For this reason, we repeat the regressions in Table IV using stock market capitalization over GDP (from World Bank data), a measure of accounting standards (from Rajan and Zingales (1998)), an index of creditor rights (from Djankov, McLiesh, and Shleifer (2007)), the number of domestic listed firms and the number of IPOs (both scaled by population and from La Porta et al. (1997)). Our results are generally robust using the first four measures, but become statistically insignificant with the number of IPOs used as the index of financial development. Since the number of IPOs appears least relevant as a measure of credit market constraints in the context of vertical integration decisions, we interpret these results as broadly consistent with and supportive of the main implications of our theory.

Overall, the results in Tables IV through VI demonstrate a relatively robust effect of the interaction of financial development and contracting costs on vertical integration. The results are consistent with the theoretical results in Proposition 2, and suggest that contracting costs do affect the incentives for vertical integration, but that a certain degree of financial development is necessary to permit firms to vertically integrate in response to their country's contracting environment.

### B. Country-Industry Interactions

The regression equations so far impose a "constant effect" of specific institutional characteristics on vertical integration. Another possibility is that these characteristics have differential effects across industries. This is the second implication of Proposition 2. In particular, our model predicts that contracting costs will have a larger impact on the vertical integration decision in industries that are more susceptible to supplier holdup problems. As a proxy for the extent of holdup problems in a particular industry, we use the industry's capital intensity. We estimate regressions of the form

$$v_{cif} = \alpha y_c m_i + \beta x_c m_i + \mathbf{z}'_f \phi + \delta_i + \eta_c + \varepsilon_{ci}, \tag{12}$$

where $y_c$ represents (log) income per capita, $x_c$ represents one of our measures of contracting costs, and $m_i$ represents industry-level characteristics that proxy for severity of holdup problems (and thus measure the sensitivity of the industry to the quality of contracting institutions). The main effect for $m_i$ is already taken out by the full set of industry dummies, $\delta_i$. The main coefficient of interest in this specification is $\beta$, and for this reason, we also include in this equation a full set of country dummies, $\eta_c$. The term $y_c m_i$ is included to investigate whether the interaction is between the specific institutional features and industry characteristics as opposed to some other factor related to income per capita (for example, a broader notion of institutional differences). We also include firm-level characteristics, specifically, the log of the number of employees as a measure of firm size ($\mathbf{z}_f$).

Following the methodology in Rajan and Zingales (1998), all of the industry-level measures are based on U.S. data. In doing so we are assuming that

**Table VII**

**The Interaction of Contracting Costs and Capital Intensity**

The table presents coefficient estimates from regressions of a firm-level vertical integration index on the interaction of contracting costs and capital intensity. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Capital intensity (the log of the ratio of fixed assets to sales) comes from the Compustat database. Also included but not reported are a full set of industry dummies (based on 77 BEA-defined industries) and a full set of country dummies. Robust standard errors, adjusted for clustering within country-industry pairs, are in parentheses.

| | Procedural Complexity (1) | Contract Enforcement Procedures (50% Debt) (2) | Contract Enforcement Procedures (200% Debt) (3) | Legal Formalism (4) |
|---|---|---|---|---|
| Contracting costs × | 0.10 | 0.18 | 0.05 | 0.13 |
| Capital intensity | (0.04) | (0.06) | (0.08) | (0.05) |
| Log GDP per capita × | 0.12 | 0.12 | 0.05 | 0.13 |
| Capital intensity | (0.08) | (0.08) | (0.10) | (0.08) |
| Log number of employees | 0.03 | 0.03 | 0.03 | 0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| Industry dummies | Yes | Yes | Yes | Yes |
| Country dummies | Yes | Yes | Yes | Yes |
| $R^2$ | 0.41 | 0.41 | 0.41 | 0.41 |
| Number of countries | 56 | 56 | 61 | 62 |
| Number of observations | 661,082 | 661,082 | 661,249 | 642,043 |

characteristics of industries in the U.S. economy are representative of (or at the very least correlated with) the characteristics of the same industries in other countries. In Table VII our industry characteristic is capital intensity, which we measure as the log of the ratio of fixed assets to sales for firms in the particular industry in the U.S. Although capital intensity is clearly not a perfect proxy for the severity of holdup problems, it has a number of advantages in the context of our theoretical and empirical investigation. First, this measure has been widely used in the analysis of the relationship between capital intensity and vertical integration (e.g., Chandler (1976), MacDonald (1985), Lieberman (1991), and Antràs (2003)). Second, the capital intensities of industries do not seem to vary much across countries, so that this measure can be used as a "fixed" industry characteristic. Finally, and most importantly, holdup problems related to capital intensity may be precisely those for which vertical integration is a good remedy. In contrast, the problems arising from more intangible characteristics of sectors or firms might lead to the countervailing incentive problems within firms as emphasized by the PRT approach of Grossman and Hart (1986) and Hart and Moore (1990) and discussed in Section I above.

In all of the results reported below, we calculate capital intensity using the Compustat database. We aggregate the data by first taking the average ratio of fixed assets to sales across all years 1990 to 1999 for each firm in Compustat, and then by taking the median of this ratio across all firms in each industry. In later tables, we employ alternative measures of capital intensity. Descriptive statistics for all industry-level measures are found in rows (12) through (18) of Table I.

Estimates from equation (12) are reported in Table VII. The four columns correspond to the four different measures of contracting costs, as noted in the table. Each of the columns in the table reports a positive coefficient on the interaction of contracting costs and capital intensity. In three out of the four regressions, the positive coefficient on the interaction term is statistically significant. The magnitude of the significant coefficients suggests, for example, that in the least capital-intensive industries, an increase in contracting costs is associated with only a small increase in vertical integration, but that in the most capital-intensive industries, a one-standard deviation increase in contracting costs implies approximately a 3/4-standard deviation increase in the country's average vertical integration index. The coefficient on per-capita GDP interacted with capital intensity is also positive but not significant; the inclusion of this interaction ensures that the interaction of contracting costs and capital intensity is not just proxying for other institutional factors related to development. Overall, the results in Table VII suggest that a country's level of contracting costs does have a significant correlation with average vertical integration in the country, and that this effect is more pronounced in industries that are more capital intensive.

In Tables VIII through X we report additional tests to assess the robustness of the significant interaction effect of contracting costs and capital intensity on vertical integration. In Table VIII we repeat the regressions of Table VII but add additional interaction terms to assess whether the significance of contracting costs and capital intensity is subsumed by other potential interaction effects. In column (1) of Table VIII, we add the interaction of financial development and an industry's dependence on external finance. Our model, and existing theory, suggests that financial development matters for the organization of production, and, as Rajan and Zingales (1998) argue, the effect of financial development may be more pronounced in industries with greater dependence on external finance. As with our capital intensity measure, external dependence is calculated from the Compustat database, and it is defined as in Rajan and Zingales (1998). Column (1) of Table VIII reports a significant effect on vertical integration from the interaction of financial development and external dependence, but this effect does not subsume the effect of contracting costs interacted with capital intensity, which retains a significant positive effect.

In columns (2) and (3) of Table VIII we add other combinations of the interactions used in column (1). In column (2) we include contracting costs interacted with external dependence, and in column (3) we include financial development interacted with capital intensity. In both columns, the interaction of contracting costs and capital intensity retains its positive sign and statistical significance, although the coefficient is only marginally significant in column (3). In column (4) we include all three alternative interaction terms as controls. With all three controls included, as well as the interaction of per-capita GDP and capital

**Table VIII**

**The Interaction of Contracting Costs and Capital Intensity, Additional Controls**

The table presents coefficient estimates from regressions of a firm-level vertical integration index on the interaction of contracting costs and capital intensity. Contracting costs are measured alternately as procedural complexity, contract enforcement procedures, or legal formalism, as noted. Capital intensity (the log of the ratio of fixed assets to sales) and external dependence (i.e., dependence on external finance as in Rajan and Zingales (1998)) come from the Compustat database. Also included but not reported are a full set of industry dummies (based on 77 BEA-defined industries) and a full set of country dummies. Robust standard errors, adjusted for clustering within country-industry pairs, are in parentheses.

| | | Procedural Complexity | | | Contract Enforcement Procedures (50% Debt) | Contract Enforcement Procedures (200% Debt) | Legal Formalism |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Contracting costs × Capital intensity | 0.09 | 0.10 | 0.079 | 0.083 | 0.15 | 0.01 | 0.10 |
| | (0.04) | (0.04) | (0.042) | (0.042) | (0.07) | (0.08) | (0.06) |
| Financial development × External dependence | 0.13 | | | 0.09 | 0.15 | 0.14 | 0.11 |
| | (0.06) | | | (0.07) | (0.07) | (0.08) | (0.07) |
| Contracting costs × External dependence | | −0.04 | | −0.03 | 0.02 | 0.01 | −0.01 |
| | | (0.02) | | (0.02) | (0.03) | (0.04) | (0.03) |
| Financial development × Capital intensity | | | −0.07 | −0.08 | −0.09 | −0.16 | −0.13 |
| | | | (0.19) | (0.19) | (0.19) | (0.19) | (0.20) |
| Log GDP per capita × Capital intensity | 0.11 | 0.12 | 0.14 | 0.14 | 0.14 | 0.08 | 0.15 |
| | (0.08) | (0.08) | (0.09) | (0.09) | (0.09) | (0.11) | (0.08) |
| Log number of employees | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Industry dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.40 | 0.41 | 0.40 | 0.40 | 0.40 | 0.40 | 0.41 |
| Number of countries | 54 | 56 | 54 | 54 | 54 | 57 | 57 |
| Number of observations | 637,727 | 661,082 | 637,727 | 637,727 | 637,727 | 637,858 | 617,890 |

**Table IX**

**The Interaction of Contracting Costs and Capital Intensity, Alternative Measures of Capital Intensity**

The table presents coefficient estimates from regressions of a firm-level vertical integration index on contracting costs (measured as procedural complexity) interacted with capital intensity. Capital intensity measures are in logs and come from the Compustat database, NBER productivity database, or Autor, Katz, and Krueger (1998), as noted. Also included but not reported are a full set of industry dummies (based on 77 BEA-defined industries) and a full set of country dummies. Robust standard errors, adjusted for clustering within country-industry pairs, are in parentheses.

| | Fixed Assets/ Total Assets (Compustat) (1) | Fixed Assets/ Employees (Compustat) (2) | Capital Stock/ Employment (NBER) (3) | Capital Stock/ Value Added (NBER) (4) | Capital/ Output (Autor et al.) (5) |
|---|---|---|---|---|---|
| Contracting costs × | 0.12 | 0.09 | 0.11 | 0.14 | 0.05 |
| Capital intensity | (0.04) | (0.03) | (0.05) | (0.07) | (0.04) |
| Log GDP per capita × | 0.15 | 0.14 | −0.04 | −0.07 | 0.29 |
| Capital intensity | (0.07) | (0.08) | (0.13) | (0.17) | (0.08) |
| Log number of employees | 0.03 | 0.03 | 0.17 | 0.17 | 0.04 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Industry dummies | Yes | Yes | Yes | Yes | Yes |
| Country dummies | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.41 | 0.41 | 0.41 | 0.41 | 0.43 |
| Number of countries | 56 | 56 | 56 | 56 | 56 |
| Number of observations | 661,082 | 661,082 | 267,931 | 267,931 | 544,655 |

intensity, this is a stringent test of the robustness of our interaction prediction. Column (4) shows that the coefficient on the interaction of contracting costs and capital intensity retains its positive sign and is significant at the 5% level. In columns (5) through (7) of Table VIII we repeat the test in column (4) using the three other measures of contracting costs. With contract enforcement procedures (50% debt) as the measure of contracting costs, the coefficient on the interaction of contracting and capital intensity is positive and significant. For the other two measures, the coefficients are positive, but the coefficient on the interaction of legal formalism and capital intensity loses significance relative to the results in Table VII.

In Table IX we repeat the regressions of Table VII using alternative measures of capital intensity. The first two measures, the ratio of fixed assets to total assets and the ratio of fixed assets to employees, also come from the Compustat database and are calculated in analogous fashion to the ratio of fixed assets to sales. The next two measures, the ratio of capital stock to employment and the ratio of capital stock to value added, are calculated from the NBER productivity database. Because this measure is available only for manufacturing industries, the number of observations in regressions using this variable is smaller. The final measure, the ratio of capital to output, is taken from Autor, Katz, and

Krueger (1998), who calculate capital intensity from the National Income and Product Accounts (NIPA) for the year 1990. We use the concordance that these authors developed to map the NIPA industries to our IO industries. All capital intensity measures are in logs.

Table IX reports the results of estimating equation (12) with the alternative measures of capital intensity. The five columns in the table correspond to different measures of capital intensity as noted. In each column, the coefficient on the interaction of contracting costs and capital intensity retains its positive sign, and in four out of the five cases, the coefficient is statistically significant. Table IX shows that this significant interaction effect is robust to alternative definitions of capital intensity.[25]

As a final set of tests, in Table X we report additional robustness checks of the significant effect of contracting costs interacted with capital intensity. In Panel A of Table X we limit the sample to manufacturing industries. The coefficient on the interaction of contracting costs and capital intensity retains its positive sign in all columns, and is statistically significant in all but one of the columns. In Panel B of Table X we exclude industries that are naturally the most and least vertically integrated (based on U.S. data). We exclude those industries that fall in the highest and lowest 5% in level of vertical integration. The motivation for this test is to assess whether our results are driven by a small number of industries with extreme levels of vertical integration. The results in Panel B are similar to previous results. All coefficients on our interaction term of interest are positive, and all but one of the coefficients are significant at standard levels. In Panel C of Table X we limit our sample to industries for which there are existing firms in most (90% or more) of the countries in the sample. The motivation for this test is to ensure that our results are not driven by a few relatively uncommon industries. The results in Panel C again show positive coefficients on our interaction term of interest in all cases, with statistical significance in all but two of the columns.

[25] We also experiment with estimates of equation (12) using an alternative measure of holdup problems constructed by Nunn (2007) that is intended to proxy for the degree to which industries rely on relationship-specific investments. Nunn (2007) uses data from Rauch (1999) to identify relationship-specific inputs as those not sold on organized exchanges or reference priced in trade publications. We repeat our regressions using this measure of relationship specificity as the industry characteristic, but the results (not reported) are generally not significant, and when significant they tend to be nonrobust. While we do not know the exact reason why the results are different with capital intensity and the measures of relationship specificity, a number of explanations are possible. First, capital intensity of a sector in the United States, which is a broadly technological characteristic, may be a better predictor of capital intensity in other countries than the measure of relationship specificity, which is the result of market interactions and not a technological characteristic. Second, as noted above, capital intensity might be better suited to assess the view of Williamson (1975, 1985) and Klein, Crawford, and Alchian (1978), in which vertical integration resolves contracting problems, whereas relationship specificity might lead to the types of problems emphasized in the PRT approach of Grossman and Hart (1986) and Hart and Moore (1990) and discussed in Section I above, whereby the effects of vertical integration are more complex. Put differently, it may be that high capital intensity leads to contracting problems that vertical integration resolves in a relatively straightforward manner, while other forms of contracting problems are more difficult to resolve with vertical integration.

**Table X**

## The Interaction of Contracting Costs and Capital Intensity, Other Robustness Checks

The table presents coefficient estimates from regressions of a firm-level vertical integration index on contracting costs (measured as procedural complexity) interacted with capital intensity. Capital intensity measures are in logs and come from the Compustat database, NBER productivity database, or Autor, Katz, and Krueger (1998), as noted. Also included but not reported are a full set of industry dummies (based on 77 BEA-defined industries) and a full set of country dummies. "Most and least vertically integrated industries" refers to the 5% most and 5% least vertically integrated industries. Robust standard errors, adjusted for clustering within country-industry pairs, are in parentheses.

| | Fixed Assets/ Total Assets (Compustat) (1) | Fixed Assets/ Employees (Compustat) (2) | Capital Stock/ Employment (NBER) (3) | Capital Stock/ Value Added (NBER) (4) | Capital/ Output (Autor et al.) (5) |
|---|---|---|---|---|---|
| Panel A: Manufacturing Industries Only | | | | | |
| Contracting costs × | 0.20 | 0.06 | 0.11 | 0.15 | 0.203 |
| Capital intensity | (0.06) | (0.04) | (0.05) | (0.07) | (0.101) |
| Log GDP per capita × | 0.06 | 0.01 | −0.04 | −0.09 | 0.26 |
| Capital intensity | (0.15) | (0.11) | (0.13) | (0.18) | (0.27) |
| Log number of employees | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| $R^2$ | 0.41 | 0.41 | 0.41 | 0.41 | 0.41 |
| Number of countries | 56 | 56 | 56 | 56 | 56 |
| Number of observations | 253,222 | 253,222 | 253,577 | 253,577 | 253,577 |
| Panel B: Most and Least Vertically Integrated Industries Excluded | | | | | |
| Contracting costs × | 0.13 | 0.10 | 0.12 | 0.139 | 0.07 |
| Capital intensity | (0.04) | (0.04) | (0.05) | (0.069) | (0.06) |
| Log GDP per capita × | 0.16 | 0.14 | −0.04 | −0.08 | 0.35 |
| Capital intensity | (0.07) | (0.08) | (0.13) | (0.17) | (0.14) |
| Log number of employees | 0.04 | 0.04 | 0.17 | 0.17 | 0.05 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| $R^2$ | 0.33 | 0.32 | 0.38 | 0.38 | 0.34 |
| Number of countries | 56 | 56 | 56 | 56 | 56 |
| Number of observations | 543,427 | 543,427 | 258,577 | 258,577 | 433,264 |
| Panel C: Industries Appearing in at Least 90% of Countries Only | | | | | |
| Contracting costs × | 0.13 | 0.11 | 0.11 | 0.13 | 0.04 |
| Capital intensity | (0.04) | (0.04) | (0.05) | (0.08) | (0.05) |
| Log GDP per capita × | 0.14 | 0.13 | −0.10 | −0.18 | 0.31 |
| Capital intensity | (0.08) | (0.09) | (0.13) | (0.18) | (0.09) |
| Log number of employees | 0.02 | 0.02 | 0.20 | 0.20 | 0.03 |
| | (0.02) | (0.02) | (0.03) | (0.03) | (0.02) |
| $R^2$ | 0.39 | 0.39 | 0.38 | 0.38 | 0.42 |
| Number of countries | 56 | 56 | 56 | 56 | 56 |
| Number of observations | 567,027 | 567,027 | 184,647 | 184,647 | 458,928 |

Overall, the results in Tables VII through X show that there is a relatively robust association between vertical integration and the interaction of contracting costs with capital intensity. These results are again consistent with Proposition 2, which suggests that contracting costs should have a differential effect on the organization of production in capital-intensive industries.

## V. Conclusion

In this paper, we study the cross-country determinants of vertical integration in a new data set of over 750,000 firms from 93 countries. Our focus is on the effect of specific institutional features on the vertical integration decisions of firms. This focus is motivated by both empirics and theory. Casual empiricism and existing work suggest that there are large differences in the organization of production and firms across countries and that this may be related to contracting problems. Relatedly, a body of influential theories suggest that contracting costs and credit market development should be important determinants of vertical integration. We present a model that builds on these existing results. While our model suggests that the main effects of institutional features may be important for vertical integration, the more compelling aspects of our model are the predictions for interaction effects of these institutional factors. In particular, our model suggests an important interaction effect of contracting costs combined with financial development. In addition, it predicts that contracting costs will have a greater effect in industries with the potential for more severe holdup problems.

Our empirical results do not confirm the importance of the main effects of financial development and contracting costs. Although vertical integration is correlated with contracting institutions and financial development, we find that these correlations are spurious and entirely driven by cross-country differences in industrial composition. In particular, countries with higher contracting costs or more limited financial development are concentrated in industries with a high propensity for vertical integration. Once we control for differences in industrial composition, none of these factors seem to affect vertical integration.

In contrast, the predictions of our simple model concerning interactions receive substantial empirical support. We find a robust differential effect of contracting costs across industries: Countries with higher contracting costs are significantly more integrated in industries that are more capital intensive. We also find that the interaction of contracting costs and financial development has a significant relationship with cross-country differences in vertical integration. In short, contracting costs may have a strong impact on vertical integration, but the effect is more pronounced in relatively capital-intensive industries, and stronger financial development may be a prerequisite for firms to efficiently integrate in response to high contracting costs.

We view our study as a first step in understanding the cross-country patterns of firm organization. Despite the importance of the organization of production for productivity and the existence of various influential theories, we know very little about these patterns. The data set and the approach in this paper can be useful in investigating other dimensions of differences in the organization of firms across countries.

## Appendix A
## Correlation Coefficients of Country-Level Variables

| | Vertical Integration Propensity | Financial Development | Procedural Complexity Index | Contract Enforcement Procedures 50% Debt | Contract Enforcement Procedures, 200% Debt | Legal Formalism | Population, Log | GDP per Capita, Log |
|---|---|---|---|---|---|---|---|---|
| Vertical integration propensity | 1.000 | −0.398 | 0.262 | 0.260 | 0.371 | 0.248 | 0.324 | −0.563 |
| Financial development | | 1.000 | −0.276 | −0.455 | −0.509 | −0.413 | 0.035 | 0.689 |
| Procedural complexity index | | | 1.000 | 0.578 | 0.571 | 0.855 | −0.082 | −0.157 |
| Contract enforcement procedures, 50% debt | | | | 1.000 | 0.829 | 0.712 | −0.093 | −0.420 |
| Contract enforcement procedures, 200% debt | | | | | 1.000 | 0.666 | 0.025 | −0.498 |
| Legal formalism | | | | | | 1.000 | 0.116 | −0.301 |
| Population, log | | | | | | | 1.000 | −0.179 |
| GDP per capita, log | | | | | | | | 1.000 |

## Appendix B
## Estimated Industry Dummies for Vertical Integration

| Industry (Brief Description) | Estimated Dummy Coefficient | Industry (Continued) | Coefficient (Continued) |
|---|---|---|---|
| Health/Education Services | −16.81 | Radio/TV Broadcasting | −12.55 |
| Maintenance Construction | −16.40 | Manufacturing, Misc. | −12.44 |
| Furniture, Household | −16.30 | Machinery, Farm | −12.38 |
| Household Appliances | −16.27 | New Construction | −12.18 |
| Automotive Service | −15.98 | Machinery, Service Industry | −12.15 |
| Wood Containers | −15.58 | Industrial Equipment | −12.06 |
| Eating/Drinking Places | −15.19 | Utilities | −12.03 |
| Furniture, Commercial | −15.15 | Food | −11.78 |
| Lodging/Personal Services | −15.10 | Rubber | −11.72 |
| Ordnance | −14.78 | Paints | −11.66 |
| Machinery, Industrial | −14.60 | Textiles, Fabricated | −11.50 |
| Ag/Forestry/Fishery Services | −14.59 | Finance/Insurance | −11.37 |
| Screw Machine/Stamping | −14.51 | Mining, Chemical | −10.83 |
| Electrical, Misc. | −14.43 | Engines | −10.79 |
| Footwear/Other Leather | −14.35 | Motor Vehicles | −10.50 |
| Electric Lighting | −14.31 | Real Estate | −10.23 |
| Scientific Instruments | −14.19 | Transportation | −9.62 |
| Mining, Nonmetallic | −13.92 | Metal Containers | −9.44 |
| Printing/Publishing | −13.91 | Aircraft | −9.34 |
| Other Transportation Equipment | −13.77 | Iron/Steel Manufacturing | −9.30 |
| Heating/Plumbing Fabrication | −13.75 | Petroleum Refining | −9.09 |
| Optical Equipment | −13.69 | Drugs/Cleansers | −8.50 |
| Machinery, Special | −13.55 | Glass | −8.22 |
| Audio/Video Equipment | −13.52 | Plastics | −7.98 |
| Machinery, Metalworking | −13.44 | Computer/Office Equipment | −7.57 |
| Paperboard Containers | −13.40 | Mining, Coal | −6.17 |
| Stone/Clay | −13.24 | Electronic Components | −5.96 |
| Forestry/Fishery | −13.06 | Nonferrous Metal Manufacturing | −4.97 |
| Lumber and Wood | −13.01 | Apparel | −4.69 |
| Machinery, Mining | −13.00 | Mining, Iron | −4.38 |
| Professional Services | −13.00 | Communications, Not Radio/TV | −3.93 |
| Electrical Equipment | −12.91 | Chemicals | −1.86 |
| Other Agricultural | −12.89 | Fabrics | −1.30 |
| Other Fabricated Metal | −12.89 | Amusement | −0.82 |
| Tobacco | −12.89 | Livestock (omitted in regression) | 0.00 |
| Paper | −12.87 | Leather | 0.82 |
| Textiles, Misc. | −12.84 | Petroleum and Gas | 2.45 |
| Machinery, Misc. | −12.71 | Mining, Nonferrous | 6.20 |

## REFERENCES

Acemoglu, Daron, Philippe Aghion, Rachel Griffith, and Fabrizio Zilibotti, 2004, Vertical integration and technology: Theory and evidence, NBER Working paper #10997.

Acemoglu, Daron, Pol Antràs, and Elhanan Helpman, 2007, Contracts and technology adoption, *American Economic Review* 97, 916–943.

Acemoglu, Daron, and Simon Johnson, 2005, Unbundling institutions, *Journal of Political Economy* 113, 949–995.

Aghion, Philippe, and Patrick Bolton, 1987, Contracts as a barrier to entry, *American Economic Review* 77, 388–401.

Aghion, Philippe, and Jean Tirole, 1997, Formal and real authority in organizations, *Journal of Political Economy* 105, 1–29.

Antràs, Pol, 2003, Firms, contracts, and trade structure, *Quarterly Journal of Economics* 118, 1375–1418.

Autor, David, Lawrence Katz, and Alan Krueger, 1998, Computing inequality: Have computers changed the labor market? *Quarterly Journal of Economics* 113, 1169–1214.

Bain, Joe, 1966, *International Differences in Industrial Structure* (Yale University Press, New Haven).

Baker, George, Robert Gibbons, and Kevin J. Murphy, 2002, Relational contracts and the theory of the firm, *Quarterly Journal of Economics* 117, 39–83.

Baker, George, and Thomas Hubbard, 2001, Empirical strategies in contract economics: Information and the boundary of the firm, *American Economic Review* 91, 189–194.

Baker, George, and Thomas Hubbard, 2003, Make versus buy in trucking: Asset ownership, job design, and information, *American Economic Review* 93, 551–572.

Banerjee, Abhijit, and Andrew Newman, 1993, Occupational choice and the process of development, *Journal of Political Economy* 101, 274–298.

Bolton, Patrick, and Michael Whinston, 1993, Incomplete contracts, vertical integration, and supply assurance, *Review of Economic Studies* 60, 121–148.

Chandler, Alfred D., 1976, *The Visible Hand: The Managerial Revolution in American Business* (Harvard University Press, Cambridge).

Chipty, Tasneem, 2001, Vertical integration, market foreclosure, and consumer welfare in the cable television industry, *American Economic Review* 91, 428–453.

Desai, Mihir, Paul Gompers, and Josh Lerner, 2003, Institutions, capital constraints and entrepreneurial firm dynamics: Evidence from Europe, NBER Working paper #10165.

Diamond, Douglas, 2004, Committing to commit: Short-term debt when enforcement is costly, *Journal of Finance* 59, 1447–1479.

Diamond, Douglas, and Raghuram Rajan, 2005, Liquidity shortages and banking crises, *Journal of Finance* 60, 615–647.

Djankov, Simeon, Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer, 2003, Courts, *Quarterly Journal of Economics* 118, 453–517.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer, 2007, Private credit in 129 countries, *Journal of Financial Economics* 84, 299–329.

Dutz, Mark, and Aydin Hayri, 1999, Does more intense competition lead to higher growth? World Bank Policy Research Working Paper #2320.

Fan, Joseph, and Larry Lang, 2000, The measurement of relatedness: An application to corporate diversification, *Journal of Business* 73, 629–660.

Fisman, Raymond, and Virginia Sarria-Allende, 2004, Regulation of entry and the distortion of industrial organization, Working paper, Columbia University.

Grossman, Sanford, and Oliver Hart, 1986, The costs and benefits of ownership: A theory of vertical and lateral Integration, *Journal of Political Economy* 94, 691–719.

Hart, Oliver, and John Moore, 1990, Property rights and the nature of the firm, *Journal of Political Economy* 98, 1119–1158.

Hart, Oliver, and Jean Tirole, 1990, Vertical integration and market foreclosure, *Brookings Papers on Economic Activity* Special Issue, 205–276.

Holmstrom, Bengt, and Jean Tirole, 1989, The theory of the firm, in Richard Schmalensee, and Robert Willig, eds.: *The Handbook of Industrial Organization*, Vol. I (Elsevier, Amsterdam).

Joskow, Paul, 1987, Contract duration and relationship specific investments: Empirical evidence from coal markets, *American Economic Review* 77, 168–185.

Joskow, Paul, 2005, Vertical integration, in Claude Ménard, and Mary Shirley, eds.: *Handbook of New Institutional Economics* (Springer).

Khanna, Tarun, and Krishna Palepu, 1997, Why focused strategies may be wrong for emerging markets, *Harvard Business Review* 75, 41–51.

Khanna, Tarun, and Krishna Palepu, 2000, Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups, *Journal of Finance* 55, 867–891.

Klapper, Leora, Luc Laeven, and Raghuram Rajan, 2006, Entry regulation as a barrier to entrepreneurship, *Journal of Financial Economics* 82, 591–629.

Klein, Benjamin, 1988, Vertical integration as organizational ownership: The Fisher Body–General Motors relationship revisited, *Journal of Law, Economics, and Organization* 4, 199–213.

Klein, Benjamin, Robert Crawford, and Armen Alchian, 1978, Vertical integration, appropriable rents, and the competitive contracting process, *Journal of Law and Economics* 21, 297–326.

Kumar, Krishna, Raghuram Rajan, and Luigi Zingales, 1999, What determines firm size? NBER Working paper #7208.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny, 1997, Legal determinants of external finance, *Journal of Finance* 52, 1131–1150.

Lawson, Ann, 1997, Benchmark input–output accounts for the U.S. economy, 1992, *Survey of Current Business* 77, 36–82.

Legros, Patrick, and Andrew Newman, 1996, Wealth effects, distribution and the theory of organization, *Journal of Economic Theory* 70, 312–341.

Legros, Patrick, and Andrew Newman, 2003, Competing for ownership, CEPR Working paper #2573.

Lerner, Josh, and Robert Merges, 1998, The control of strategic alliances: An empirical analysis of biotechnology collaborations, *Journal of Industrial Economics* 46, 125–156.

Lieberman, Marvin, 1991, Determinants of vertical integration: An empirical test, *Journal of Industrial Economics* 39, 451–466.

MacDonald, James M., 1985, Market exchange or vertical integration: An empirical analysis, *Review of Economics and Statistics* 67, 327–331.

McMillan, John, and Christopher Woodruff, 1999, Dispute prevention without courts in Vietnam, *Journal of Law, Economics, and Organization* 15, 637–658.

Masten, Scott, 1984, The organization of production: Evidence from the aerospace industry, *Journal of Law and Economics* 27, 403–417.

Monteverde, Kirk, and David Teece, 1982, Supplier switching costs and vertical integration in the automobile industry, *Bell Journal of Economics* 13, 206–213.

Nugent, Jeffrey, and Mustapha Nabli, 1992, Development of financial markets and the size distribution of manufacturing establishments: International comparisons, *World Development* 20, 1489–1500.

Nunn, Nathan, 2007, Relationship-specificity, incomplete contracts, and the pattern of trade, *Quarterly Journal of Economics* 122, 569–600.

Ohanian, Nancy, 1994, Vertical integration in the U. S. pulp and paper industry 1900–1940, *Review of Economics and Statistics* 76, 202–207.

Ordover, Janusz, Steven Salop, and Garth Saloner, 1990, Equilibrium vertical foreclosure, *American Economic Review* 80, 127–142.

Perry, Martin, 1978, Price discrimination and vertical integration, *Bell Journal of Economics* 9, 209–217.

Pryor, Frederic, 1972, An international comparison of concentration ratios, *Review of Economics and Statistics* 54, 130–140.

Rajan, Raghuram, and Luigi Zingales, 1998, Financial dependence and growth, *American Economic Review* 88, 559–586.

Rauch, James, 1999, Networks versus markets in international trade, *Journal of International Economics* 48, 7–35.

Rubinstein, Ariel, 1982, Perfect equilibrium in a bargaining model, *Econometrica* 50, 97–110.

Scherer, Frederic, 1973, The determinants of industrial plant sizes in six nations, *Review of Economics and Statistics* 55, 135–145.

Stuckey, John, 1983, *Vertical Integration and Joint Ventures in the Aluminum Industry* (Harvard University Press, Cambridge).

Whinston, Michael, 2001, Assessing the property rights and transaction-cost theories of firm scope, *American Economic Review Papers and Proceedings* 91, 184–188.

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

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

Woodruff, Christopher, 2002, Noncontractible investments and vertical integration in the Mexican footwear industry, *International Journal of Industrial Organization* 20, 1197–1224.

World Bank, 2004, *World Development Report: Making Services Work for Poor People* (The World Bank and Oxford University Press, Washington and New York).