Contract Incompleteness, Globalization and Vertical Structure: an Empirical Analysis

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Abstract

This paper studies the effects of international openness and contracting institutions on vertical integration. It first derives a number of predictions regarding the interactions between trade barriers, contracting costs, technology intensity, and the extent of vertical integration from a simple model with incomplete contracts. Then it investigates these predictions using a new dataset of over 14000 firms from 45 developing countries. Consistent with theory, the effect of technology intensity of domestic producers on their likelihood to vertically integrate is decreasing in the quality of domestic contracting institutions and in international openness. Contract enforcing costs are particularly high in developing countries and their effects on the vertical structure of technological intensive firms may have significant welfare costs. If improving domestic contracting institutions is not feasible an equivalent solution is to increase openness to international trade. This would discipline domestic suppliers reducing the need for vertical integration.

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1 Introduction

Anecdotal evidence suggests the presence of substantial heterogeneity in the vertical structure of production across countries. Some observers relate this phenomenon to differences in institutional environments and trade openness. Khanna and Palepu (2000), for example, provide evidence that companies in India are larger and more vertically integrated than in the US and suggest that this happens because trading at arm's length is more costly in developing countries where contract enforcement is weaker. The Economist (1991) notes that the Japanese companies are more vertically integrated than the Western ones, although an increase in foreign competition is leading to a "Japanization" of the Western companies as well[1].

Nevertheless, there has never been a systematic analysis of cross-country differences in vertical integration and their causes. Peter Klein (2005) concludes his overview over the empirical studies on vertical integration in the Handbook of New Institutional Economics by saying:

> "While we know much about transaction cost determinants of vertical integration, we know relatively little about the relation of contracting and organization and the wider legal, political and social environments. The progression from single-industry case studies to cross-industry, within-country analyses, to cross-country investigations is a natural one".

The primary aim of this paper is to make a first attempt at such a cross-country analysis and to investigate the relationship between vertical integration and two important institutional characteristics: contract enforcement and trade openness.

Two well-established theories offer predictions on how differences in contracting institutions among countries could affect the vertical organization of firms. They both relate the vertical structure of firms to the "hold up" problem of underinvestment. Consider the common case where aggregate profits depend on each parties' investment and that these investments are relationship-specific, in the sense that they are sunk outside of the business relationship. If these investments are not contractible, once they have been made, a potential opportunism situation arises. This can lead ex-ante to under-investment and ex-post to inefficient economic performances. Transaction costs economics (TCE) theories, pioneered by the Nobel laureate Oliver Williamson (1975, 1985), assume that vertical integration solves the hold-up problem at a fixed cost and therefore should be prevalent when contracts are harder to write. Nevertheless, this prediction is not entirely ambiguous. Property Rights Theories (PRT), developed by Grossman and Hart (1986) and Hart and Moore (1990), emphasize that vertical integration does not solve the under-investment problem since employees need to be given incentives to invest as well, and the fact that they don't own the tangible asset may weaken their incentives. In the PRT, the effect of better contracting institutions on vertical integration is not entirely clear.

[1] Other studies have emphasized the differences between Emilia Romagna, an Italian region, and the rest of Europe (Johnston and Lawrence, 1998) and between South Korea and Taiwan (Levy,1991). Fan e al. (2007) documented differences across Chinese regions.

Some recent contributions offer predictions on how differences in international openness affect vertical integration. Part of this literature argues that trade liberalization is a force toward vertical industrial disintegration. For example, McLaren (2000) and Grossman and Helpman (2002) model the effects of trade openness in a TCE structure. In McLaren (2000) buyer-supplier pairs are located in the same country and simultaneously choose whether to vertically integrate or outsource. The integration of a pair produces a negative externality since it thins the secondary market and reduces the outside options for non-integrated firms. In this world, trade openness partially increases the incentives to outsourcing by thickening the secondary market. Market thickening is also a reason for which trade openness increases the advantages of outsourcing in Grossman and Helpman (2002). In this model, thickened secondary markets imply lower matching costs between producer and supplier[2]. However, other contributions show that by increasing the gains from becoming a multinational corporation with respect to outsourcing domestically, trade openness may actually increase the vertical integration of domestic firms. (Ornelas and Turner, 2008; Fan et al. 2008).

Therefore, the effects of both contracting institutions and trade openness on vertical integration are potentially ambiguous and a better understanding of these relationships requires an empirical investigation.

In the first part of the paper, I present a simple theoretical model that examines how institutional features of the country contribute to shaping the governance structure of the firm. The model uses the canonical TCE "hold-up" model with some adjustments to adapt it to an international context. A final good producer makes some investments that become fully productive depending on whether the domestic supplier decides to collaborate or not; in case it does not, the domestic producer can turn to a foreign supplier.

The purpose of this model is not to provide a comprehensive theory of vertical integration but to derive a number of simple predictions to confront with the data. Different from previous literature, in an attempt to mimic the real world, the specificity of investments, the quality of contracting institutions and the openness to international trade are classified according to continuous measures. In particular, the level of specificity of the investment is modelled as the part of the investment that is unproductive without the collaboration of the supplier; contract enforcement is modelled as the probability that an ex-ante contract between supplier and producer cannot be enforced; trade barriers are modelled as the fixed cost of turning to a foreign supplier.

Comparative statics on these three variables produce a set of predictions that can be tested in the data.

First, contracting institutions per se do not affect the vertical structure of the firm. The intuition of this result can be found in the classical "hold up" theory. The fact that ex-ante contracts are rarely enforced does not distort investment decisions under outsourcing as long as the investor has sufficient ex-post bargaining power. However, when investments become very specific, the investor's

[2] Antras (2003) and Antras and Helpman (2004) embeds a property right approach in a general equilibrium, factor proportion model of international trade with imperfect competition and product differentiation. The model pins down the boundaries of multinational firms as well as the international location of production. A reduction of tariffs increases the propensity to international outsourcing relative to multinational vertical integration.

outside option deteriorates and his bargaining power as well. In conclusion, the combination of greater asset specificity together with lower contract enforcement implies underinvestment under outsourcing and therefore increases the incentive to vertically integrate. In addition, the model predicts another interaction effect of asset specificity and trade barriers. The fact that the investor can find other partners in other countries limits the ability of his domestic partner to hold him up. Therefore lower trade barriers discipline the investor's partner and attenuate the distortions generated by the low quality of domestic institutions.

I test the predictions of the model using detailed data on 13,992 manufacturing firms operating in 45 countries. This dataset comes by aggregating the ICA World Bank Surveys and provides information on several characteristics of the firms in the sample allowing me to associate a measure of vertical integration and asset specificity to each of them. The main dataset is then merged with the Doing Business Database, which provides country data on institutional features, and the TRAIN Database, which provides data on tariffs.

Using cross-country data is particularly appealing for examining the effects of the openness to international trade and the quality of local contracting institutions on vertical integration. In theory, the effects of trade barriers may be studied in a cross-industry analysis since, for example, different industries may face different tariffs on intermediates. However, trade barriers are much more difficult to measure at the industry level (since they are the result of the interaction of trade costs, tariffs and other hidden barriers) than at the country level (where an average can be considered). On the other hand, contracting institutions vary essentially at country level.

The regressions show that vertical integration is less likely when asset specificity is associated with trade openness and high quality contracting institutions, thus confirming the predictions of the theoretical model. In addition, I conduct a number of robustness checks and find that the results are robust to a wide variety of specifications. Finally, to address the potential endogeneity of asset specificity, I run a battery of IV regressions; results are unchanged.

To the best of my knowledge, this is the first paper that tests the effect of trade openness on the vertical integration on a considerable number of countries. On the other side, there are two very recent contributions that use cross country data to estimate the effects of contract institutions on vertical integration. Macchiavello (2009) uses the UNIDO industry-level database to study the effects of contractual institutions and financial development on the vertical integration of firms. Industry data, however, cannot capture the intra-industry trade within vertically disintegrated firms. Acemoglu, Johnson, Mitton (2009) use instead firm level data coming from WorldBase, a database compiled for the primary purpose of providing business contacts that contains information on millions of firms around the world. The problem with this database is that the only information it provides are the firm name, the number of employees, the country where it operates, and the 4-digit SIC code of the primary industries in which the firm operates. No other information is provided. The authors have to impute the level of vertical integration of each firm, using the information coming from the US input-output accounts; asset specificity is imputed as well using US data. Thus, this empirical analysis is based on the strong assumption that technology is common across

countries. Moreover, since vertical integration is imputed looking at US data, the variability in the level of vertical integration across countries will depend only on the variability in countries' industry composition. As in Macchiavello (2008), their empirical analysis can help us in understanding why sectors that have higher propensity to vertically integrate are more prominent in certain countries. However, it cannot be used to study why, within the same sector, the propensity to vertically integrate differs across countries. This is unfortunate since we would expect that the "hold up" problem would have greater effects on the level of vertical integration in a country by influencing the level of vertical integration within each industry than by influencing the industrial composition (the latter being more the result of determinants like the country's history, its natural resources and its stage of economic development).

To conclude, my work provides an empirical analysis of the institutional determinants of vertical integration using a cross-country database. It is the first one that uses a cross-country database to evaluate the role of lower tariffs and it adds further evidence on the role of better contract institutions. From both the theoretical and the empirical analysis of the paper, a policy advice emerges. Poor contract enforcement, when associated with specific assets, can distort firms' vertical structure. This can have significant welfare costs. If improving home institutions is not feasible, an equivalent solution is to reduce the trade barriers to the import of intermediates. This would discipline domestic suppliers and increase producers' incentives to invest in specific assets. In other words, reducing trade barriers is a way of "importing" foreign institutions since domestic firms will relate with each other as if the relevant contracting institutions were those of the countries where alternative suppliers are operating.

This paper is organized as follows. Section 1 details the theoretical framework and derives some testable implications. Section 2 presents the main empirical results and several robustness checks. Some concluding remarks close the paper.

2 The model

2.1 Basic structure

In this section, I present a simple model that examines how contract enforcement institutions, trade barriers and asset specificity interact to define the governance structure of a firm. The purpose of this model is not to provide a comprehensive theory of vertical integration but to derive a number of simple predictions to take to the data.

A final good producer (P) in Home (H) wants to buy an input which enhances the productivity of his investments. There is a specific supplier (HS) whose characteristics are most suitable to provide the input to firm P and is located in H as well. P could either outsource to HS or vertically integrate with her.

Under outsourcing, the two parties write a contract on the price of the intermediate good before the specific investment is realized. However, due to contract incompleteness, there is some probability that this agreement is broken after the specific investment has been realized. At this

point, a new agreement has to be reached. However, the bargaining power of HS is much higher than before, because the producer specific investment is sunk without the intermediate good. The amount HS can hold-up P depends on the possible alternatives that the latter has to buy an analogous intermediate. I assume that P can purchase the same intermediate from a foreign supplier FS located in a competitive market. Ex-ante (e.g. before the specific investment has been taken), the price of the foreign intermediate, p_F, is a random variable with randomness reflecting both shocks to the productivity of FS and shocks to the exchange rates. Moreover, when importing an intermediate, the producer has to pay a trade cost t. Ex-ante, the probability of finding an alternative intermediate depends on the trade costs. If this probability is very low, for example because trade barriers are too high and buying in another country is not feasible, then the producer knows that most of the revenues coming from his investment can be expropriated by HS. Then the producer would have lower incentives to invest and this would imply a suboptimal level of investments and ex-post inefficient economic performances.

Under vertical integration, the two parties merge into a single firm. As in Hart and Tirole (1990), this "permits profit-sharing between upstream and downstream units so all conflicts of interest about prices and trading policies are removed". The advantage of this option is that an efficient level of specific investments is realized; the disadvantage is that it requires a fixed cost. The presence of a fixed cost related to the vertical integration choice is a common feature in this literature (see Hart and Tirole, 1990; McLaren, 2000; Ornelas and Turner, 2008) and it can be interpreted as a way to capture all the legal, financial and organizational costs involved when merging two firms.

In sum, the choice between vertical integration and outsourcing solves the trade off between the fixed cost which arises under vertical integration and an inefficient level of specific investments that arises under outsourcing. Better contract enforcement and lower trade barriers attenuate the relevance of the hold up problem and the related investment distortions and therefore increase the incentives to outsource.

The timing of the events in the model is summarized in Figure 1. At period 1, the supplier and the domestic producer decide whether to integrate; if they do not they sign an ex ante contract defining the price of the intermediate input[3]. At period 2, the producer makes its relationship-specific investments I. At the beginning of period 3, the state of nature is revealed: the price of the foreign intermediate (p_F) becomes public and parties are informed on whether the initial contract will be enforced or not. If outsourcing was chosen, with probability $(1-\gamma)$ the initial contract is not enforced and the two parties have to bargain again over a new price[4]. At period 4, the producer can decide whether to buy the intermediate input from the foreign supplier.

The producer's production technology has the following form:

[3]Notice tha I have ruled out the possibility that the producer could outsource to FS in the first stage of the game. There is no loss of generality in doing this since this alternative would be strictly dominated by the alternative to outsource to DS (because outsourcing to FS has a fixed trade cost).

[4]A similar way of modelling contract incompleteness as a determinant of vertical integration has been used by Acemoglu, Johnson and Mitton (2007).

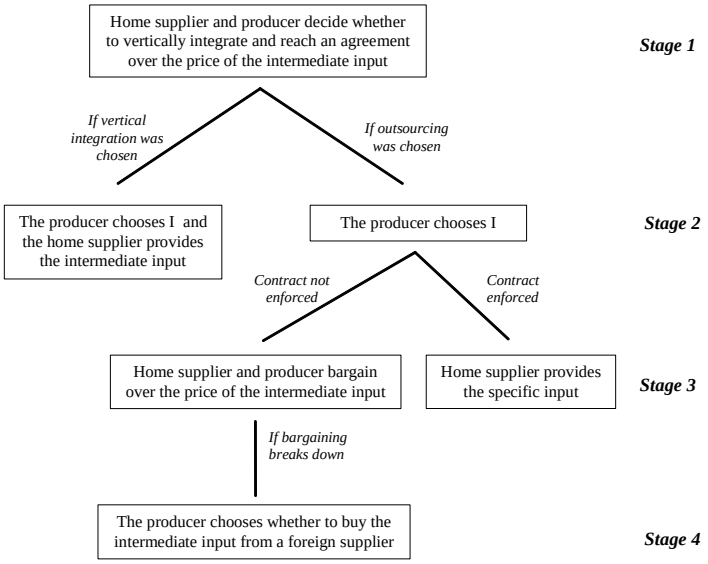

Figure 1: The sequence of events

$$f(\phi, I, x) = (1 - \phi)g(I) + \phi g(I)x \tag{HP1}$$

where I is the producer's investment and x is an indicator variable that is equal to one if the home supplier provides the intermediate good that increases productivity and zero otherwise. $\phi \epsilon (0, 1)$ corresponds to the share of the investment which is unproductive without the intermediate good and it captures the specificity of P's investment. The first term of the production function is the output that the producer can eventually generate without any intermediate good. The second term is the additional output generated by the producer conditional on the supplier providing the intermediate good. Assume that:

$$g''(I) < 0 \tag{HP2}$$

Normalize the cost of one unit of specific investment to 1 and assume that the supplier can provide the intermediate at no cost.[5]

The game is solved by backward induction. In stage 4, if the producer still doesn't have the intermediate input he will buy it from the foreign supplier if:

$$p_F < \psi g(I) - t$$

where ψ is a proxy for how appropriate the foreign intermediate input is to the specific investment made by the producer. Let's consider the case where $\psi \leq \phi$ (e.g. the home intermediate is

[5] A similar production structure (while somehow simplified) can be find in Acemoglu, Aghion, Griffith, Zilibotti (2005).

at least as effective as the foreign one).

2.2 Stage 3: Expected profits under outsourcing

In the third stage of the game, the producer has already made the investments and is outsourcing the production of the intermediate good to the home supplier. Suppose that the initial contract cannot be enforced and the two parties need to bargain over the price of the input. In the event of disagreement, the two parties receive their outside option. The home supplier would make zero profits while the producer could still find it profitable to use the intermediate input produced by the foreign supplier. Denote the outside option of party i under outsourcing by O_i^O. Then:

$$O_p^O(I_p) = (1-\phi)\, g(I) + [Max\{0; \psi g(I) - t - p_F\}] - I \tag{1}$$

$$O_s^O = 0 \tag{2}$$

Call p the new price of the intermediate when bargaining is successful and u_i^0 the ex post payoffs of party i:

$$\begin{cases} u_p^0(I) = g(I) - I - p \\ u_s^0 = p \end{cases}$$

According to the Nash bargaining solution, the price p satisfies:

$$p = Arg \max_p p^{0.5} \left[\phi g(I) - Max\{0; \psi g(I) - t - p_F\} - p\right]^{0.5} \tag{3}$$

which implies:

$$p = \frac{1}{2}\phi g(I) - \frac{1}{2} Max\{0; \psi g(I) - t - p_F\} \tag{4}$$

Hence, under the symmetric Nash equilibrium, the surplus accruing to the producer under outsourcing conditional on the fact that the initial contract has not been enforced is:

$$u_p^0(I) = \left(1 - \frac{\phi}{2}\right) g(I) + Max\{0; \psi g(I) - t - p_F\} - I \tag{5}$$

2.2.1 Stage 2: Choosing the optimal investments

In the second stage of the game the producer chooses the optimal investments. If the producer and the home supplier are vertically integrated, then the producer will decide the level of investments I in order to maximize the joint variable profits π^{VI} :

$$\pi^{VI} = g(I) - I \tag{6}$$

The optimal level of investments under vertical integration I^{VI} is defined by the first order condition $g'(I^{VI}) = 1$. If the producer is outsourcing to the home supplier, then the producer will

decide the level of investments I^O in order to maximize the expected profits $E\pi_p^O$:

$$E\pi_p^O = \gamma[g(I) - P - 1] + (1-\gamma)\left(1 - \frac{\phi}{2}\right) g(I) + (1-\gamma) Max\{0; \frac{1}{2} \int_0^{\psi g(I)-t} (\psi g(I) - t - p_F) dF(p_F)\} - I \tag{7}$$

where P is the price of the intermediate good as in the initial contract. Intuitively, the first term represents the revenues if the initial contract is enforced; the second term represents the revenues that the producer would have under autarky if the initial contract is not enforced; the third term represents the additional revenues that the producer would have in the presence of international trade if the initial contract is not enforced (due to the improvement in his outside option in the bargaining game with the domestic supplier); the last term represents the investment costs. The optimal level of investments under outsourcing, $I^o(\phi, \gamma, t)$, is the level of investment that maximizes $E\pi_p^O$. In general this function has more than one local maxima. The following hypothesis limits the number of local maxima to two.

$$\frac{g''(I)}{g'(I)^2} < -\frac{(1-\gamma)\frac{1}{2}\psi^2 f(\phi g(I) - t)}{1 - (1-\gamma)\frac{1}{2}(\phi - \psi F(\phi g(I) - t))} \tag{HP3}$$

Intuitively $g(I)$ needs to be enough convex (e.g. the marginal productivity of investments needs to fall quickly compared to the hazard rate of the price of foreign supplier).[6] To discuss the local maxima of the function $E\pi_P^O$ is convenient to rewrite it as: $E\pi_P^O = Q(\phi, \gamma, I) + (1-\gamma)\zeta(I, T)$ where $Q(\phi, \gamma, I) \equiv \gamma[g(I) - P - C] + (1-\gamma)\left[\left(1 - \frac{\phi}{2}\right) g(I)\right] - I$ and $\zeta(I, t) \equiv Max\{0; \frac{1}{2} \int_0^{\psi g(I)-t} (\psi g(I) - t - p_F) dFp_F\}$. Define $\overline{I}(t)$ the maximum investment for which: $\zeta(\overline{I}(t), t) \equiv 0$ and $I^*(\phi, \gamma)$ the investment that maximizes $Q(\phi, \gamma, I)$. In other words, $\overline{I}(t)$ is the minimum investment necessary to make credible the threat of buying the intermediate from a foreign supplier and $I^*(\phi, \gamma)$ the optimal investment under autarky.

Lemma 1 *If $I^*(\phi, \gamma) > \overline{I}(t)$, the profit function has a single local maximum in $I^{**}(\phi, \gamma, t)$ identified by the following equation:*

$$\left[1 - (1-\gamma)\frac{1}{2}(\phi - \psi F(\psi g(I) - t))\right] g'(I^{**}(\phi, \gamma, t)) - 1 \equiv 0 \tag{8}$$

If $I^*(\phi, \gamma) \leq \overline{I}(t)$, the profit function can have an additional single local maximum in $I^*(\phi, \gamma)$ identified by the following equation:

$$\left[1 - (1-\gamma)\frac{\phi}{2}\right] g'(I^*(\phi, \gamma)) - 1 \equiv 0 \tag{9}$$

and such that: $I^*(\phi, \gamma) < I^{**}(\phi, \gamma, t)$

[6] Note that a similar hypothesis is used by Ornelas and Turner (2008)

Thus, the profit function has at most two local maxima $I^*(\phi,\gamma)$ and $I^{**}(\phi,\gamma,t)$. Given the convexity of $g(.)$ it is easy to verify that both $I^*(\phi,\gamma)$ and $I^{**}(\phi,\gamma,t)$ are lower than I^{VI} (e.g. investments are always lower under outsourcing rather than under vertical integration). The entity of underinvestment under outsourcing is proportional to $\left[1-(1-\gamma)\frac{\phi}{2}\right]$ if trade barriers are prohibitive (e.g. if $I^o(\phi,\gamma,t)=I^*(\phi,\gamma)$) and to $\left[(1-\gamma)\frac{1}{2}\phi-(1-\gamma)\frac{1}{2}\psi F(\psi g(I)-t)\right]$ if they are not (e.g. $I^o(\phi,\gamma,t)=I^{**}(\phi,\gamma,t)$). The last expression is very intuitive. The first term represents the classical "hold up" distortion that we find in the transaction cost literature. The interaction between contract incompleteness and asset specificity distorts the incentives to invest of the producer since a part of the surplus generated by the investments can be appropriated by the supplier and this produces a suboptimal investments. The second term represents the effect of opening up the intermediate market and it's the main novelty of the model. The fact that the producer can buy the same intermediate input, with some probability, from a foreign supplier limits the possibility of holding him up and de facto attenuates the distortions created by low quality home institutions. In the limit, if trade barriers and foreign prices are sufficiently low (e.g. $\frac{\psi}{2}F(\psi g(I^O)-t)=1$), the hold up problem disappears. In this sense, opening up a country with bad contracting institutions to trade is a way of "importing" good institutions. This leads to our first proposition (see the Appendix for the complete proof).

Proposition 2 *Under outsourcing, the producer's optimal investment is non increasing in t.*

Notice that, by applying the implicit function theorem on equations 8 and 9, it is possible to prove that both $I^*(\phi,\gamma)$ and $I^{**}(\phi,\gamma,t)$ are increasing in contract enforcement, γ, and decreasing in the specificity of the asset, ϕ. This gives an intuition for the following propositions (see Appendix for complete proof):

Proposition 3 *Under outsourcing, the producer's optimal investment is increasing in γ.*

Proposition 4 *Under outsourcing the producer"s optimal investment is decreasing in ϕ.*

2.2.2 Stage 1: Choosing the governance system

Since both parties have access to ex ante transfers, the subgame perfect equilibrium will always pick the organizational form that maximizes their joint surplus. In line with the transaction cost approach make the hypothesis that vertical integration has a fixed cost η. Call $S^{VI}(\eta)\equiv g(I^{VI})-I^{VI}-\eta$ the joint surplus under vertical integration and $S^O(\gamma,\phi,t)\equiv g(I^O(\gamma,\phi,t))-I^O(\gamma,\phi,t)$ the joint surplus under outsourcing. The comparison of these values gives the following proposition.

Proposition 5 *Vertical integration is more likely when assets are specific (ϕ high), contracts are incomplete (γ low) and trade barriers are high (t high).*
Proof. *The two parties will vertically integrate as long as $\Delta=S^{VI}(\eta)-S^O(\gamma,\phi,t)$ is positive. To obtain an expression for the impact of higher asset specificity on the governance of the firms consider the derivative of the latter with respect to ϕ.*

$$\frac{d\Delta}{d\phi} = \frac{dI^O(\gamma,\phi,t)}{d\phi}[1 - g'(I^O(\gamma,\phi,t))] \tag{10}$$

Notice that $\frac{dI^O(\gamma,\phi,t)}{d\phi}$ *is not positive by proposition 4 and* $[1 - g'(I^O(\gamma,\phi,t))]$ *is also not positive since* $1 - g'(I^{VI}) = 0$ *and* $I^O(\gamma,\phi,t)) < I^{VI}$ *(together with the convexity of g). Thus* $\frac{d\Delta}{d\phi} \geq 0$. *Analogously it can be proven that* $\frac{d\Delta}{dt} \geq 0$ *and* $\frac{d\Delta}{d\gamma} \leq 0$. ■

The intuition behind the last proposition is very straightforward. Higher level of asset specificity, contract incompleteness and trade barriers tend to distort investments under outsourcing making vertical integration more efficient.

The next proposition examines in detail the effect of asset specificity on the governance of the two parties.

Proposition 6 *If the following hypothesis*[7] *is true:*

$$\left[g''(I)\right]^2 - g'g''' \geq 0 \tag{HP4}$$

the effects of asset specificity on the vertical structure of a firm are magnified by domestic incomplete contracts and dampen by low trade barriers.

To obtain the first result, notice that:

$$\frac{d^2\Delta}{d\phi d\gamma} = \frac{dI^O(\gamma,\phi,t)}{d\phi}[-g''(I^O(\gamma,\phi,t))]\frac{dI^O(\gamma,\phi,t)}{d\gamma} + \frac{d^2I^O(\gamma,\phi,t)}{d\phi d\gamma}[1 - g'(I^O(\gamma,\phi,t))] \tag{11}$$

The first term is negative from propositions 3 and 4 (together with the convexity of g). Appendix A reports the proof that HP4 is sufficient for the cross derivative $\frac{d^2I^O(\gamma,\phi,t)}{d\phi d\gamma}$ being positive which is the final step to show that $\frac{d^2\Delta}{d\phi d\gamma} \leq 0$. Analogously, it can be proved that HP4 is a sufficient condition so that $\frac{d^2\Delta}{d\phi dt} \geq 0$.

The traditional IO literature has emphasized the fact that asset specificity has distorting effects on the governance system of a firm only when it interacts with an institutional environment characterized by incomplete contracts. Thus, it should not come as a surprise that a difficult contract enforcement amplifies the distortive effects of asset specificity.

The contribution that the last proposition offers to this literature is that it proposes an escape clause. In fact, the distortive effects that asset specificity has on the vertical structure of a firm given bad domestic contracting institutions can be dampened if the producer has access to foreign markets for intermediates. Notice that in this model there is no international trade: in equilibrium the producer will always buy the widget from the domestic supplier. However, the threat of being replaced by a foreign supplier helps to discipline the domestic supplier. As the latter cannot hold

[7] All the most used production functions (Kobb Douglas, CES, Quadratic) do not violate this assumption.

up the producer anymore, outsourcing does not produce distorted investments and the two parties are less likely to vertically integrate.

In the next sections, the last proposition will be tested empirically.

3 Empirical analysis

3.1 Data and measurement

My firm level data come from The Investment Climate Assessments Survey (ICA). This is an unbalanced firm level panel of annual data covering 95,320 firms in 105 countries. New additional country surveys are implemented each year so that the data cover different periods for different countries starting from 1999 until 2006. Each survey contains questions on the characteristics of the firm (e.g. four-digits SIC, organizational type, business age), measures of economic performances (e.g. sales, capital, labor, payroll, intermediates, inventories) and measures of the business climate (e.g. questions about trade costs, bribery, corruption, lobbying activity, bureaucratic delays, infrastructure, product and labor market regulations). The sample size varies considerably across countries so that the observations in Cape Verde(2006) are 47 while the observations in China (2004) are 2500. Limited information is provided about how the sample is selected in each country. The survey is often contracted out to a survey firm that has access to some business list. Both by design and given the limitations of maintaining a business list that is fully representative, the typical ICA respondent is a large, mature business relative to the country representative (Haltiwanger and Schweiger, 2004).

I have used a limited subset of the information provided in these large surveys. In particular, I have used data on output value and intermediate costs to measure the degree of vertical integration of the firms in the sample, information on net book value of machinery and equipment, land, buildings and leasehold improvements to measure their asset specificity, information on the number of workers to measure their size.

The Doing Business database (World Bank) provides objective measures of business regulations and their enforcement in 175 countries. It was originally developed to study the regulatory costs of business and to analyze specific regulations that enhance or constrain investments, productivity, and growth; it covers four years (2003-2006). In my empirical analysis, I have used the available information on the trade barriers to imports, the justice system's ability to enforce contracts and the quality of financial institutions.

Regarding the trade barriers to imports, three variables are recorded: the number of documents necessary to import a good, the time necessary to end the import procedures and the cost of importing a 20 foot container. I have used the last measure which includes costs for documents, administrative fees for customs clearance and inland transport but it does not include tariffs or trade taxes.

Regarding the efficiency of the judicial system in resolving a commercial dispute, the database reports the time necessary to enforce a contract when disputing in courts, the cost to do it and

the average number of documents needed. In particular, the cost is reported as a percentage of a claim assumed to be equivalent to 200 per cent of the average income per capita. The data are collected through studies of the codes of civil procedure and other court regulations as well as surveys completed by local litigation lawyers (and, in a quarter of the countries, by judges as well). I have used the last two measures to proxy the quality of national contracting institutions.

Finally the Doing Business database reports a legal right index and a credit information index that I have used to infer the quality of financial institutions.

Accurate data on the tariffs are taken from the UNCTAD TRAINS database. As a proxy of trade barriers, I have considered the average of the tariffs on imports of machinery and transport equipment both unweighted and weighted by their corresponding trade value.

Table 1 sums up the determinants of the firm vertical structure according to the theoretical model and the variables used to proxy them.

Table 1: Measures used in the empirical analysis

Variable	Proxy
Vertical integration	Value added / Total sales (ICA)
Asset specificity	Machinery,equipment/Machinery,equipment,land,buildings (ICA)
Contract incompleteness	Contract enforcement costs (DB) Contract enforcement procedures (DB)
Financial development	Legal right index (DB) Credit information index (DB)
Trade barriers	Average tariffs on machinery imports (TRAINS) Weighted average tariff on machinery imports (TRAINS) Average costs to import (DB) Longest time to clear customs (ICA)

Data sources in parentheses

Table 1 summarizes the distribution of observations across countries. As you can see all the countries considered have low and medium-low per capita income (lower than 9100$). Most of observations are concentrated in Bangladesh, China, Egypt, India, Morocco, Pakistan and Vietnam.

Table 1 provides some descriptive statistics for the variables used in the empirical analysis.

The first four rows consider firm level variables coming from the ICA database. The firms considered in the regressions are 13926 distributed in 45 countries and 16 manufacturing industries. Row 1 reports descriptive statistics for the vertical integration index at the firm level. Observations are fairly distributed around 0.5 (mean and median have the same value) starting from values very close to zero to values very close to one. Row 2 reports the average number of permanent workers at the firm level. Both the mean and the median are very high (respectively: 216 and

44). This confirms the fact that the typical ICA respondent is a large, mature business relative to a representative business for a country. Row 3 reports the proxy for asset specificity which is computed by taking the ratio of net book value of machinery and equipment over the same value plus the net book value of lands, buildings and leasehold improvements.

Row 4 reports firm's share of national market of the main product line. Again both mean and median look pretty high (respectively 19% and 5%) confirming the fact that the database concentrates on large mature businesses. Moreover, notice that this information is available for around half of the firms analyzed.

Rows 5 and 6 consider two different measures of contract incompleteness reported in the Doing Business Database: number of procedures and cost for enforcing a commercial contract. In both cases the mean (respectively 32 and 22) is very high compared to US (17 and 7.7). As expected, low income countries are associated with worse contracting institutions.

Row 7 reports a measure of the quality of the financial system which is obtained by running a principal component on a legal right index and a credit information index reported in the Doing Business Database.

The next four rows report the different measures of trade barriers used in my empirical analysis: row 8 and 9 report the average (simple and weighted) tariff to machinery and transport equipment as in the UNCTAD TRAINS database; row 10 reports the cost to import a good as in the Doing Business Database; rows 11 reports the longest time to clear customs as in the ICA surveys averaged at the country level.

Finally, rows 12 and 13 are the countries' 2006 per capita GNI and total population as reported by the Doing Business Database. As can be seen most of the observations are concentrated in countries with low income per capita (the 75th percentile is 2630$).

3.2 Main effects

In this section, I study the main effects of asset specificity, contract enforcement costs and trade barriers to intermediates on the vertical structure of firms. Propositions 2, 3 and 4 predict a positive association between asset specificity, contract enforcement costs and trade barriers with the level of firms' vertical integration. In order to test these predictions, I have estimated the following equation:

$$VI_{fsc} = \beta_0 + \beta_1 CI_c + \beta_2 TB_c + \beta_3 AS_f + \varepsilon_{fsc} \tag{12}$$

where VI_{fsc} is vertical integration of firm f in country c in sector s, CI_c is the cost to enforce a contract in country c (contract incompleteness), TB_c is the cost to import intermediates in country c (trade barriers), AS_f is the proxy for the specificity of assets of firm f.

Column 1 of Table 4 reports a non significant positive correlation of trade barriers with vertical integration and a non significant negative correlation of contract incompleteness and asset specificity with vertical integration. The data do not seem to support our initial claim. In the second column, I have included a full set of industry dummies. This implies that all cross-country comparisons

are relative to the "mean propensity to aggregate" in a particular industry. In other words, this regression looks at, for example, whether firms in a country with high trade barrier are more vertically integrated relative to firms in a country with low trade barrier in the same industry. The results do not change significantly.

In column 3, I include financial development as additional explanatory variable. Macchiavello (2008) and Acemoglu et al (2008) show that financial development tends to be associated with more vertically integrated firms. Since, a large literature documents that good financial institutions are strongly correlated with good contracting institutions and lower trade barriers, I don't want that omitting this variable could lead to spurious correlations in our analysis. The regression confirms the presence of a positive correlation between financial development and vertical integration. Moreover, the negative coefficient on contract incompleteness becomes five times smaller while the positive coefficient on trade barriers doubles.

In column 4, I add country's population and GNP per capita to the regressors. The coefficient on contract incompleteness turns to positive (though still not significant). The negative signs on the coefficients of population and GNP per capita can be explained by the fact that bigger economies have thicker intermediate goods markets and therefore smaller hold-up distortions (and less scope for vertical integration).

In sum, when controlling for financial development and market size, there seem to be some evidence of a positive correlation of vertical integration with both contract incompleteness and trade barriers. However, this evidence is not strong (coefficients are not significant). Moreover, there seem to be a negative correlation between asset specificity and vertical integration, which is at odd with the theory.

There are several reasons that can explain these results. First, the lack of significance is probably due to the fact that contract incompleteness and trade barriers are capturing the effects of many other country level variables that can affect vertical integration and that are missing in my specification. This is a common problem in cross-country analysis where main effects can be very hard to test. The negative sign of asset specificity is difficult to justify. Notice however that the theory predicts asset specificity to have a positive effect on vertical integration only when associated with incomplete contracts.

3.3 Interaction effects

The results in the previous section may suggest that there are no robust regularities in cross-country vertical integration patterns. In this section, I turn to interaction effect and show that this is not true.

The problem of unobservables is attenuated when examining interaction effects since eventual omitted variables at country level can be captured by country fixed effects. In this section, I study how the effect of asset specificity on firms' vertical structure varies as contractual institutions and trade barriers vary.

Since I don't want to impose a particular function that define the vertical integration of firms,

I take a second order approximation of a general function: $VI = f(AS, CI, TB, FD)$ and add country and industry fixed effects. The following equation is estimated by ols:

$$VI_{fsc} = \beta_1 AS_f + \beta_2 AS_f^2 + \beta_3 CI_c \cdot AS_f + \beta_4 TB_c \cdot AS_f + \beta_5 FD_c \cdot AS_f + S_c + S_s + \varepsilon_{fsc} \quad (13)$$

where S_c and S_s are respectively the country and the industry fixed effects. The results are reported in column 1 of Table 5. Notice that the signs are all in line with the theoretical predictions. As predicted by Proposition 6, the effects of asset specificity on the vertical structure of the firm are magnified by domestic incomplete contracts and dampen by low trade barriers. Figure A.4 depicts $\frac{dVI_{fsc}}{dAS_f}$ as a function of trade barriers, contract enforcement costs and financial development. The first graph shows how the marginal effect of asset specificity on vertical integration changes as importing costs change (with contract enforcement costs and financial development fixed at their mean level). Notice that, for low trade barriers (importing costs below 1000 $ for a 20-foot container, 35th percentile) I cannot reject the hypothesis that asset specificity has no significant effect on vertical integration. However, as trade barriers become higher, the effect of asset specificity becomes positive and significant. The second graph depicts the marginal effect of asset specificity as the cost of enforcing a contract vary. When contract enforcing costs are low (court and attorney fees below 35% of the value of the claim, 49th percentile) asset specificity has no significant effect on vertical integration. However, the effect becomes positive and substantial as contract enforcement costs raise. Finally, the third graph depicts the marginal effect of asset specificity on vertical integration as the level of financial development of the country raises. The effect becomes positive and significant, when financial development is above the 82th percentile of the distribution.

In column 2, I add the variable "number of workers" in the regression. The inclusion of firm size as a control variable is due to the fact that a potential concern with the result of this paper is sample selection. As we have seen, the typical ICA respondent is larger than the representative business of the country. It could be that relatively larger companies are more vertically integrated and from country with worst institutions we could only observe larger companies. Controlling for firms size could partially alleviates this sample selection concern.[8] The results are unchanged.

In column 3, I add the interaction between GNI per capita and asset specificity among the regressors. Existing works demonstrate that contract enforcement is correlated with the stage of economic development. I would like to be sure that the interactions $CI_c \cdot AS_f$ and $TB_c \cdot AS_f$ are not just proxying for other factors associated with the stage of development. This new regressors has a very low significance and do not alter substantially our previous results.

Another possible concern is that the ratio between value added and shipments is sensible not only to the firm's vertical integration but also to the firm's market power. This would bias the results if for example, trade barriers provide protection for monopolists or weak contract enforcement is likely associated with weak antitrust policies. In column 6, I have added a variable that could

[8] Following Acemoglu, Johnson and Mitton (2005), I have also experimented with regressions controlling for second, third and fourth order polinomial in firm size and found very similar results.

eventually capture firm's market power (market share for main product line). The main results are not affected. Some coefficients change slightly but this is probably due to the fact that I have to limit the analysis for the firms for which I have information on the market power which are less than half of the original sample.

As further robustness checks, I have replicated the analysis above using a different proxy for contract incompleteness: the number of procedures to enforce a commercial contract (instead of the cost). The results are shown in Table 6 and are not qualitatively too different from the previous ones.

In Table 7, I have repeated the analysis using three different proxies for trade barriers (trade costs to import, average tariffs and longest time to clear customs) and the two different proxies for contract incompleteness. Again qualitatively, the results are similar.

Finally in Table 8, I have replicated the analysis using an alternative measure of financial development. Instead of looking only at the credit information index provided by the Doing Business Database, I use a principal component of this variable together with other two variables provided in the same database: the legal right index and the private bureau coverage of credit information. The signs are unchanged. However, both the magnitude and the significance of the coefficient on the interaction between asset specificity and contract incompleteness is lower. This is probably related with the high correlation between this new measure of financial development and the usual measure of contract incompleteness that makes it difficult to disentangle the effects of these two variables (interacted with asset specificity) on the vertical integration of firms.

In order to take into account the multilevel dimension of the data, I have redone the analysis using a hierarchical linear model. I estimated the following system of equations by mle:

$$VI_{fsc} = \alpha_0 + \alpha_{4c} AS_f + S_c + S_s + \varepsilon_{fsc} \tag{14}$$

$$\beta_{4c} = \delta_0 + \delta_1 CI_c + \delta_2 TB_c + \delta_3 FD_c + \upsilon_{0c} \tag{15}$$

The results are reported in Table 9. Both the coefficients and their standard errors do not vary significantly compared to the ols case.

3.4 IV regression

Two potential concerns apply to the OLS and HLM estimates that we have seen so far. First, it may be that some omitted firm-level variables are driving both the asset specificity and the vertical integration of the firms in my sample. Second, the estimates may suffer of a potential reverse causality problem. For example, it may be that firms that are more vertically integrate are more likely to perform primary activities that are less technologically intensive and require less specific assets. In both cases, the error term is going to be correlated with the regressors, biasing the estimates.

A more satisfactory approach would be to use an instrumental variable strategy, with instru-

ments that affect asset specificity, without influencing vertical integration through other channels (i.e., they should be orthogonal to the error term, ε_{fsc}, in equation 13). In this paragraph, I instrument the firm asset specificity using a measure of intensity in physical investments in the same industry in US[9].

The first-stage equations for the model in equation 13 are:

$$AS_f = X'\pi_{11} + Z'\pi_{12} + Z'CI_c\pi_{13} + Z'TB_c\pi_{14} + Z'FD_c\pi_{15} + u_{1f} \tag{16}$$

$$AS_f^2 = X'\pi_{21} + Z'\pi_{22} + Z'CI_c\pi_{23} + Z'TB_c\pi_{24} + Z'FD_c\pi_{25} + u_{2f} \tag{17}$$

$$AS_f * CI_c = X'\pi_{31} + Z'\pi_{32} + Z'CI_c\pi_{33} + Z'TB_c\pi_{34} + Z'FD_c\pi_{35} + u_{3f} \tag{18}$$

$$AS_f * TB_c = X'\pi_{41} + Z'\pi_{42} + Z'CI_c\pi_{43} + Z'TB_c\pi_{44} + Z'FD_c\pi_{45} + u_{4f} \tag{19}$$

where Z is the vector of instruments for asset specificity (in other words, investment intensity in the U.S.), and X' is a vector of all the covariates that appear in the second stage as well. In table 10, I report the IV estimates of equation 13. The instrumental variable strategy confirms the validity of the previous results. Most of the previous estimates are unchanged; only the effect of financial development combined with asset specificity on vertical integration decreases slightly. The last table reports the first-stage coefficients. The first-stage relationship are highly significant and show a very appealing pattern: physical investment intensity in a particular industry in the US is highly correlated with the asset specificity of the firms in the sample in the same industry. The F-test of the exclusion restriction is 0.66, so my analysis do not suffer from a weak instrument problem.

In conclusion, IV regressions confirms the pattern of previous results. The effects of asset specificity on vertical integration increases in the presence of low quality contracting institutions and high trade barriers.

4 Conclusion

This paper investigates the cross-country determinants of vertical integration using a new dataset of over 14,000 manufacturing firms operating in 45 developing countries. In particular, it revisits the effects of the interaction between technology intensity and some specific institutional features on the vertical integration decisions of firms. This focus is motivated by both theory and anecdotal evidence.

A large body of theoretical contributions has highlighted the effects of both international openness and contractual institutions on the vertical structure of firms. Moreover, some empirical works

[9] Acemoglu, Aghion, Griffith and Zilibotti (2005) were the first to propose this instrument for asset specificity in a firm-level analysis limited to UK manufacturing plants.

have documented the presence of significant heterogeneity in the propensity of firms to vertically integrate across countries. Nevertheless, there has never been a systematic empirical analysis of the cross-country differences in vertical integration and their causes. First, I develop a simple model that sums up previous theories and allows for some intuitive comparative statics exercise. In particular, it suggests that technology intensity should have greater effects on the vertical structure of firms when combined with low quality contracting institutions and high trade barriers. The empirical results are consistent with these predictions and are robust to different econometric specifications and techniques.

I conclude that poor contract enforcement can distort firms' vertical structure in the presence of specific assets. This can have significant welfare costs especially in developing economies. If improving home institutions is not feasible an equivalent solution is to open to international trade. This would reduce the hold-up problem by disciplining domestic suppliers, thus reducing the need for vertically integrated organizations.

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Proof of Lemma 1. We can rewrite the profit function as $E\pi_1^O = Q(\phi, \gamma, I)$ for $I < \overline{I}(t)$ and $E\pi_2^O = Q(\phi, \gamma, I) + (1-\gamma)\zeta(I, t)$ for $I \geq \overline{I}(t)$.

The producer chooses investment in order to maximize this profit function. For $I < \overline{I}(t)$, the profit function is $E\pi_1^O = Q(\phi, \gamma, I)$ and, by HP2, it is locally convex. Thus, if a local maximum exists in this range, then it is defined by the FOC $\frac{dQ(\phi,\gamma,I)}{dI} = 0$, which can be rewritten as:

$$\left[1 - (1-\gamma)\frac{\phi}{2}\right] g'(I^*(\phi, \gamma)) - 1 \equiv 0$$

.

For $I \geq \overline{I}(t)$, the profit function becomes $E\pi_2^O = Q(\phi, \gamma, I) + (1-\gamma)\zeta(I, t)$ and, by the HP2 and HP3 is locally convex. Thus, if a local maximum exists in this range, then it is defined by the FOC $\frac{dQ(\phi,\gamma,I)}{dI} + (1-\gamma)\frac{d\zeta(I,t)}{dI} = 0$, which can be rewritten as:

$$\left[1 - (1-\gamma)\frac{1}{2}(\phi - \psi F(\psi g(I) - t))\right] g'(I^{**}(\phi, \gamma, t)) - 1 \equiv 0$$

Notice that if $I^*(\phi, \gamma) > \overline{I}(t)$, there cannot be a local maximum for $I < \overline{I}(t)$ .In fact, the function $Q(\phi, \gamma, I)$ is strictly increasing in I for $I < \overline{I}(t)$. Therefore, the profit function will have a single local maximum in $I = I^{**}(\phi, \gamma, t)$.

In sum: If $I^*(\phi, \gamma) > \overline{I}(t)$, the profit function has a unique local maximum in $I = I^{**}(\phi, \gamma, t)$. If $I^*(\phi, \gamma) < \overline{I}(t)$, the profit function can have at most two local maxima respectively in $I^*(\phi, \gamma)$ and $I^{**}(\phi, \gamma, t)$. ■

Proof of Proposition 2. The producer will choose the level of investment that maximizes the profit function defined by equation 7. Given Lemma 1, the profit function has at most two local maxima: $E\pi_1^O(\phi, \gamma) = Q(\phi, \gamma, I^*(\phi, \gamma))$ and $E\pi_2^O(\phi, \gamma, t) = Q(\phi, \gamma, I^{**}(\phi, \gamma, t)) + (1-\gamma)\zeta(I^{**}(\phi, \gamma, t), t)$. In order to prove that optimal investment under outsourcing is decreasing in trade barriers t, we will consider three different cases:

1. $E\pi_1^O(\phi, \gamma)$ is the global maximum for every t. In this case the optimal investment is $I^*(\phi, \gamma)$ and does not depend on trade barrriers.

2. $E\pi_2^O(\phi, \gamma, t)$ is the global maximum for every t. In this case the optimal investment is $I^{**}(\phi, \gamma, t)$. Applying the implicit theorem function to equation 8, is possible to verify that $I^{**}(\phi, \gamma, t)$ is a strictly decreasing function of t.

3. $E\pi_1^O(\phi, \gamma)$ is the global maximum for some values of t while $E\pi_2^O(\phi, \gamma, t)$ is the global maximum for some others. Notice while the first one is not affected by t, the second one is decreasing and continuos in t. Therefore, in this case it exists a unique $\widehat{t}$ at which the producer is indifferent between $I^*(\phi, \gamma)$ and $I^{**}(\phi, \gamma, t)$. This tariff is implicitly defined by: $E\pi_1^O(\phi, \gamma) \equiv E\pi_2^O\left(\phi, \gamma, \widehat{t}\right)$. Consider an increase in trade costs dt. For $t < \widehat{t}$, the optimal investment is $I^{**}(\phi, \gamma, t)$, which is decreasing in t. For $t > \widehat{t}$, the optimal investment is $I^*(\phi, \gamma)$,

which is not affected by t. Finally, when t increases from $\widehat{t}-dt$ to $\widehat{t}+dt$, the optimal investment drops from $I^{**}(\phi,\gamma,t)$ to $I^{*}(\phi,\gamma)$. Thus, also in this case investment is not decreasing in t.

■

Claim 7 *If the profit function has two local maxima $E\pi_1^O(\phi,\gamma)$ and $E\pi_2^O(\phi,\gamma,t)$, then it should be that:*

$$\frac{dE\pi_1^O(\phi,\gamma)}{d\gamma} < \frac{dE\pi_2^O(\phi,\gamma,t)}{d\gamma}$$

Proof. *Given Lemma 1, the profit function can have two local maxima as long as $I^{*}(\phi,\gamma) < \overline{I}(t)$. Using the envelope theorem:*

$$\frac{dE\pi_1^O(\phi,\gamma)}{d\gamma} = \frac{\partial E\pi_1^O(\phi,\gamma)}{\partial\gamma} = -P + \frac{\phi}{2}g(I^{*}(\phi,\gamma))$$

$$\frac{dE\pi_2^O(\phi,\gamma,t)}{d\gamma} = \frac{\partial E\pi_2^O(\phi,\gamma,t)}{\partial\gamma} = -P+\frac{\phi}{2}g(I^{**}(\phi,\gamma,t))-\frac{1}{2}\int_0^{\psi g(I^{*}(t,\gamma))-t}(\psi g(I^{**}(\phi,\gamma,t))-t-p_F)\,dFp_F$$

$$Call\,\Sigma \equiv \frac{dE\pi_2^O(\phi,\gamma,t)}{d\gamma}-\frac{dE\pi_1^O(\phi,\gamma)}{d\gamma} = \frac{\phi}{2}(g(I^{**}(\phi,\gamma,t))-g(I^{*}(\phi,\gamma))-\frac{1}{2}\int_0^{\psi g(I^{*}(t,\gamma))-t}(\psi g(I^{**}(\phi,\gamma,t))-t-p_F)\,dFp_F$$

Given Lemma 1, if the profit function has two local maxima then $I^{*}(\phi,\gamma) < \overline{I}(t)$ and $I^{**}(\phi,\gamma,t) > \overline{I}(t)$. Thus:

$$\Sigma > \frac{\phi}{2}(g(I^{**}(\phi,\gamma,t)) - g(\overline{I}(t)) - \frac{1}{2}\int_0^{\psi g(\overline{I}(t))-t}\left(\psi g\left(\overline{I}(t)\right)-t-p_F\right)dFp_F$$

On RHS of the inequality, the first term is positive while the second one is zero by definition of $\overline{I}(t)$. Hence $\Sigma > 0$ (e.g. $\frac{dE\pi_1^O(\phi,\gamma)}{d\gamma} < \frac{dE\pi_2^O(\phi,\gamma,t)}{d\gamma}$). ■

Proof of Proposition 3. Given Lemma 1, the profit function has at most two local maxima: $E\pi_1^O(\phi,\gamma) = Q(\phi,\gamma,I^{*}(\phi,\gamma))$ and $E\pi_2^O(\phi,\gamma,t) = Q(\phi,\gamma,I^{**}(\phi,\gamma,t)) + (1-\gamma)\,\zeta(I^{**}(\phi,\gamma,t),t)$. In order to prove that optimal investment is increasing in contract enforcement, we can divide our analysis in three cases:

1. $E\pi_1^O(\phi,\gamma)$ is the global maximum for every γ. In this case the optimal investment is $I^{*}(\phi,\gamma)$ for every γ. Applying the implicit theorem function to equation 9, is possible to verify that $I^{*}(\phi,\gamma)$ is a strictly increasing function of γ.

2. $E\pi_2^O(\phi,\gamma,t)$ is the global maximum for every γ. In this case the optimal investment is $I^{**}(\phi,\gamma,t)$ for every γ. Applying the implicit theorem function to equation 8, is possible to verify that $I^{**}(\phi,\gamma,t)$ is a strictly increasing function of γ.

3. $E\pi_1^O(\phi,\gamma)$ is the global maximum for some values of γ while $E\pi_2^O(\phi,\gamma,t)$ is the global maximum for some others.

   Define $\Omega(\phi,\gamma,t) \equiv E\pi_1^O(\phi,\gamma) - E\pi_2^O(\phi,\gamma,t)$. In this case $\Omega(\phi,\gamma,t)$ takes positive values for some γ and negative values for others. Together with the fact that $\Omega(\phi,\gamma,t)$ is continuous in γ (because sum of continuous function) and strictly decreasing in γ (by claim 7), this observation implies that there exists a unique $\widehat{\gamma}$ such that if $\gamma < \widehat{\gamma}$ then $\Omega(\phi,\gamma,t) > 0$, if $\gamma > \widehat{\gamma}$ then $\Omega(\phi,\gamma,t) < 0$ and for $\gamma = \widehat{\gamma}$ we have $\Omega(\phi,\widehat{\gamma},t) = 0$. In other words, if $\gamma < \widehat{\gamma}$ the global maximum is $E\pi_1^O(\phi,\gamma)$, if $\gamma > \widehat{\gamma}$ global maximum is $E\pi_2^O(\phi,\gamma,t)$ and if $\gamma = \widehat{\gamma}$, the profit function has two global maxima $E\pi_1^O(\phi,\widehat{\gamma}) = E\pi_2^O(\phi,\widehat{\gamma},t)$. Consider an increase in γ. For $\gamma < \widehat{\gamma}$, the optimal investment is $I^*(\phi,\gamma)$ and hence is increasing in γ; for $\gamma > \widehat{\gamma}$, the optimal investment is $I^{**}(\phi,\gamma,t)$ and hence is increasing in γ. Finally when γ increases from $\widehat{\gamma} - d\gamma$ to $\widehat{\gamma} + d\gamma$, the optimal investment jumps up from $I^*(\phi,\gamma)$ to $I^{**}(\phi,\gamma,t)$: thus also in this case the optimal investment in increasing in γ.

■

Proof of Proposition 4. Given Lemma 1 the profit function has at most two local maxima: $E\pi_1^O(\phi,\gamma)$ and $E\pi_2^O(\phi,\gamma,t)$ for every ϕ. Three subcases are possible:

1. $E\pi_1^O(\phi,\gamma)$ is the global maximum for every ϕ. In this case the optimal investment is $I^*(\phi,\gamma)$ for every ϕ. Applying the implicit theorem function to equation 9, is possible to verify that $I^*(\phi,\gamma)$ is a continuous and strictly decreasing function of ϕ.

2. $E\pi_2^O(\phi,\gamma,t)$ is the global maximum for every ϕ. In this case the optimal investment is $I^*(\phi,\gamma,t)$ for every ϕ. Applying the implicit theorem function to equation 8, is possible to verify that $I^{**}(\phi,\gamma,t)$ is a continuous and strictly decreasing function of ϕ.

3. $E\pi_1^O(\phi,\gamma)$ is the global maximum for some values of γ while $E\pi_2^O(\phi,\gamma,t)$ is the global maximum for some others.

   Consider $\Omega(\phi,\gamma,t) \equiv E\pi_1^O(\phi,\gamma) - E\pi_2^O(\phi,\gamma,t)$ and notice that, in this case, it takes positive values for some ϕ and negative for others. Together with the fact that $\Omega(\phi,\gamma,t)$ is continuous in ϕ (because sum of continuous function) and strictly increasing in ϕ ($\frac{d\Omega(\phi,\gamma,t)}{d\phi} = -(1-\gamma)\frac{1}{2}\left[g(I^*(\phi,\gamma)) - g(I^{**}(\phi,\gamma,t)\right]$), this observation implies that there exists a unique $\widehat{\phi}$ such that if $\phi < \widehat{\phi}$ then $\Omega(\phi,\gamma,t) < 0$, if $\phi > \widehat{\phi}$ then $\Omega(\phi,\gamma,t) > 0$ and for $\phi = \widehat{\phi}$, $\Omega\left(\widehat{\phi},\gamma,t\right) = 0$. In other words, if $\phi < \widehat{\phi}$ the global maximum is $E\pi_2^O(\phi,\gamma,t)$, if $\phi > \widehat{\phi}$ global maximum is $E\pi_1^O(\phi,\gamma)$ and if $\phi = \widehat{\phi}$, the profit function has two global maxima $E\pi_1^O\left(\widehat{\phi},\gamma\right) = E\pi_2^O\left(\widehat{\phi},\gamma,t\right)$. Consider an increase in ϕ. For $\phi < \widehat{\phi}$, the optimal investment is $I^{**}(\phi,\gamma,t)$ and hence is decreasing in ϕ; for $\phi > \widehat{\phi}$, the optimal investment is $I^*(\phi,\gamma)$ and hence is decreasing in ϕ. Finally when ϕ increases from $\widehat{\phi} - d\phi$ to $\widehat{\phi} + d\phi$, the optimal investment jumps down from $I^{**}(\phi,\gamma,t)$ to $I^*(\phi,\gamma)$: thus also in this case the optimal investment in decreasing in ϕ.

■

Proof of Proposition 6. I will prove that $\frac{d^2 I^O(\phi,\gamma,t)}{d\phi d\gamma}$ is positive. Consider two cases:

1. Suppose that: $I^O(\phi,\gamma,t) = I^*(\phi,\gamma)$. Call $SOC1 \equiv \left[1-(1-\gamma)\frac{\phi}{2}\right] g''(I)$ and (notice that this quantity is negative by HP2). Applying the implicit function theorem to equation 9, we have:

   $\frac{dI^*(\phi,\gamma)}{d\phi} = \frac{(1-\gamma)\frac{1}{2}g'(I)}{SOC1}$

   $\frac{dI^*(\phi,\gamma)}{d\gamma} = \frac{-\frac{\phi}{2}g'(I)}{SOC1}$

   Notice that $\frac{dI^*(\phi,\gamma)}{d\phi} \leq 0$ while $\frac{dI^*(\phi,\gamma)}{d\gamma} \geq 0$. The cross derivative is then:

   $\frac{d^2 I^*(\phi,\gamma)}{d\phi d\gamma} = \frac{\left[-\frac{1}{2}g'+(1-\gamma)\frac{1}{2}g''\frac{dI}{d\gamma}\right]SOC1-\left[\frac{\phi}{2}g''+\left[1-(1-\gamma)\frac{\phi}{2}\right]g'''\frac{dI}{d\gamma}\right](1-\gamma)\frac{1}{2}g'}{SOC1^2}$

   which after some algebra becomes:

   $\frac{d^2 I^*(\phi,\gamma)}{d\phi d\gamma} = \frac{-\frac{1}{2}g'g''-\frac{\left[(g'')^2-g'g'''\right]}{g''}\frac{\phi}{4}g'}{SOC1^2}$

   which is not negative as long as $(g'')^2 - g'g''' \geq 0$.

2. Suppose that: $I^O(\phi,\gamma,t) = I^{**}(\phi,\gamma,t)$. Define $SOC2 \equiv \left[1-(1-\gamma)\frac{\phi}{2}\right] g''(I)+(1-\gamma)\frac{\psi}{2}F(\psi g(I)-t)g''(I)+(1-\gamma)\frac{1}{2}\psi^2 g'(I)^2 f(\psi g(I)-t)$ and notice that this quantity is negative by HP2 and HP3. Applying the implicit function theorem to equation 8, we have:

   $\frac{dI^{**}(\phi,\gamma,t)}{d\phi} = \frac{(1-\gamma)\frac{1}{2}g'(I)}{SOC2}$

   $\frac{dI^{**}(\phi,\gamma,t)}{d\gamma} = \frac{\left[\frac{\phi}{2}-\frac{\psi}{2}F(\psi g(I)-t)\right]g'(I)}{SOC2}$

   $\frac{dI^{**}(\phi,\gamma,t)}{dt} = \frac{(1-\gamma)\frac{1}{2}\psi g'(I)f(\psi g(I)-t)}{SOC2}$

   Notice that $\frac{dI^*(\phi,\gamma)}{d\phi} \leq 0$ while $\frac{dI^*(\phi,\gamma)}{d\gamma} \geq 0$. The cross derivative is then:

   $\frac{d^2 I^{**}(\phi,\gamma,t)}{d\phi d\gamma} = \frac{\left[-\frac{1}{2}g'+(1-\gamma)\frac{1}{2}g''\frac{dI}{d\gamma}\right]}{SOC2}+$

   $-\frac{\left[(\frac{\phi}{2}-\frac{\psi}{2}F)g''+\left[1-(1-\gamma)(\frac{\phi}{2}-\frac{\psi}{2}F)\right]g'''\frac{dI}{d\gamma}+(1-\gamma)\frac{\psi^2}{2}g'g''f\frac{dI}{d\gamma}-\frac{\psi^2}{2}(g')^2 f+(1-\gamma)\psi^2 g'g''f\frac{dI}{d\gamma}+(1-\gamma)\frac{\psi^2}{2}(g')^2 f'\psi g'\frac{dI}{d\gamma}\right](1-\gamma)\frac{1}{2}g'}{SOC2^2}$

   which can be rewritten as:

   $\frac{d^2 I^{**}(\phi,\gamma,t)}{d\phi d\gamma} = \frac{\left[-\frac{1}{2}g'+(1-\gamma)\frac{1}{2}g''\frac{dI}{d\gamma}\right]}{SOC2}+$

   $-\frac{\left[(\frac{\phi}{2}-\frac{\psi}{2}F)\left[1-(1-\gamma)(\frac{\phi}{2}-\frac{\psi}{2}F)\right]\left((g'')^2-g'g'''\right)-\frac{\psi^2}{2}(g')^2 f+(1-\gamma)\psi^2 g'g''f\frac{dI}{d\gamma}+(1-\gamma)\frac{\psi^2}{2}(g')^2 f'\psi g'\frac{dI}{d\gamma}\right](1-\gamma)\frac{1}{2}g'}{SOC2^2}$

   which is not positive as long as $(g'')^2 - g'g''' \geq 0$.

■

A Data sources and construction

A.1 Value of Output

The ICA survey collects information on "Total market value of the production" (c274c1y) and "Total sales" (c274a1y) but there is a high number of missing values. Therefore I have used the following strategy:

Compute the number of observations about the value of the production and the total sales in each country.

Generate the variable output which, in each country, equals the value of the production when the number of observations about the value of production is at least 110 percent the number of observations about total sales. Otherwise it equals the total sales.

Notice that I could have also adjusted total sales by subtracting the variation in the variable "Inventories and stock" (281k1y). The problem is that inventories data are questionable: too many firms report zero while for Brazil and Ethiopia, when output is computed in this way, it is mostly negative.

A.2 Cost of Intermediate Goods

I consider two different measures of raw material costs: "Raw material costs (excluding fuel)" (c274b1y) and "Total purchase of raw material (excluding fuel)" (c274d1y). I use the former variable when available and the latter otherwise.

The cost of energy is computed by summing up the variables "Consumption of electricity" (c274f1y) and "Consumption of fuel" (c274g1y) when both are available and using the variable "Consumption of energy" (c274e1y) otherwise. For the remaining missing values, I impute the share of energy in each sector over the raw material cost.

Finally I compute the cost of intermediate production goods by summing up the cost of material and the cost of energy.

A.3 Vertical integration

Vertical integration is measured by the ratio of value added to sales (e.g.: (Total Output- Cost of intermediate)/Total output). This measure has been used in many previous studies but, as already discussed above, is susceptible to bias. This bias increases with the amount of value added by downstream firms. For this reason my analysis is limited to firms producing primarily in manufacturing industries. The observations in the first and the last percentile have been dropped in order to correct for outliers.

A.4 Number of workers

The ICA survey collects information on "Average number of permanent workers" (c262a1y) and "Average number of temporary workers" (c263a1y). It is not clear whether missing values for

temporary workers indicate that there are no temporary workers in that firm or that the respondent simply gives the total number of workers under the voice permanent workers. I choose to totally disregard data about temporary workers and consider permanent workers as the only measure of the labor used in the production process. No information on hours per worker are collected. The observations in the first and the last percentile have been dropped.

Table 2: Descriptive statistics per country

Country	GNI per capita	Population	Observations
Bangladesh	470	1.42e+08	670
Bolivia	1010	9182015	40
Cambodia	380	1.41e+07	4
Chile	5870	1.63e+07	643
China	1740	1.30e+09	931
Costa Rica	4590	4327228	251
Dominican Republ	2370	8894907	98
Ecuador	2630	1.32e+07	198
Egypt	1250	7.40e+07	1391
El Salvador	2450	6880951	338
Ethiopia	160	7.13e+07	312
Guatemala	2400	1.26e+07	314
Guyana	1010	751218	146
Honduras	1190	7204723	360
India	720	1.09e+09	2088
Kyrgyz Republic	440	5156000	44
Lebanon	6180	3576818	58
Lesotho	960	1794769	14
Madagascar	290	1.86e+07	110
Malawi	160	1.29e+07	127
Mauritius	5260	1248000	81
Moldova	880	4205747	22
Mongolia	690	2554000	135
Morocco	1730	3.02e+07	1090
Nicaragua	910	5486685	354
Oman	9070	2566981	25
Pakistan	690	1.56e+08	850
Philippines	1300	8.31e+07	535
Poland	7110	3.82e+07	41
South Africa	4960	4.52e+07	437
Sri Lanka	1160	1.96e+07	276
Syria	1380	1.90e+07	46
Tajikistan	330	6506980	46
Tanzania	340	3.83e+07	58
Thailand	2750	6.42e+07	609
Uzbekistan	510	2.66e+07	48
Vietnam	620	8.30e+07	1032
Zambia	490	1.17e+07	91
kosovo	3280	9993904	13
Total	1659.367	2.96e+08	912.186

Notes: Data on per capita GNI and Population refer to 2006 (Source: Doing Business Database)

Table 3: Descriptive statistics

	Mean	St.Dev	Min	25th Pctile	50th Pctile	75th Pctile	Max	N
Firm level data								
Value added to sales	.49	.23	.00067	.32	.49	.65	1	13926
Number of workers	216	646	0	15	44	166	19047	13926
Asset specificity	.6	.29	0	.38	.6	.85	1	13926
Mkt share	19	28	0	1	5	25	100	6999
Country level data								
Enforcement contract costs	37	10	20	29	36	42	58	39
Enforcement contract procedure	27	26	10	15	18	28	137	39
Financial development	-.22	1.7	-2.3	-1.6	-.67	.87	4.9	39
Average tariffs	9.5	6	1.4	4.5	9	13	28	39
Weighted average tariffs	10	6.9	.72	5	9	15	28	39
Trade costs to import	1477	928	375	850	1230	1962	3970	39
Max time to clear customs	17	9.6	4.3	10	15	23	40	39
GNI per capita	2044	2178	160	510	1160	2630	9070	39
Population	8.9e+07	2.7e+08	751218	5486685	1.3e+07	4.5e+07	1.3e+09	39

Table 4: Main Effects

	(1) VI	(2) VI	(3) VI	(4 VI
AS	-0.0135	-0.0233*	-0.0191	-0.0116
	(-1.16)	(-2.03)	(-1.47)	(-0.90)
CI	-0.000587	-0.000682	-0.000191	0.00121
	(-0.58)	(-0.69)	(-0.19)	(1.04)
TB	0.0000307	0.0000270	0.0000466	0.0000255
	(1.13)	(1.02)	(1.36)	(0.78)
FD			0.0134	0.0112
			(1.42)	(1.56)
lpop				-0.0246**
				(-3.13)
lgni				-0.00615
				(-0.37)
INDUSTRY DUMMIES	NO	YES	YES	YES
r2_a	0.00673	0.0282	0.0332	0.0516
N	13926	13926	13926	13926

Notes. The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 5: Interaction Effects: Main Results

	(1) VI	(2) VI	(3) VI	(4) VI
AS	-0.239***	-0.239***	-0.258*	-0.231
	(-4.39)	(-4.41)	(-2.59)	(-1.46)
AS·CI	0.00134*	0.00134*	0.00135*	0.00203*
	(2.07)	(2.04)	(2.13)	(2.30)
AS·FD	0.0181***	0.0181***	0.0175**	0.0120
	(3.93)	(3.92)	(3.53)	(1.69)
AS·TB	0.0000327**	0.0000327**	0.0000337**	0.0000285
	(3.29)	(3.29)	(3.51)	(1.71)
AS^2	0.0547	0.0546	0.0542	0.0443
	(1.64)	(1.61)	(1.62)	(0.87)
AS·GNI			0.00284	-0.000774
			(0.25)	(-0.04)
MkT Share				0.0000177
				(0.12)
Workers		-0.000000120	-0.000000115	-0.000000919
		(-0.02)	(-0.02)	(-0.11)
INDUSTRY DUMMIES	NO	YES	YES	YES
COUNTRY DUMMIES	YEs	YES	YES	YES
r2_a	0.126	0.125	0.125	0.123
N	13926	13926	13926	6999

Notes. The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 6: Interaction Effects: Alternative Measure of Contract Enforcement

	(1) VI	(2) VI	(3) VI	(4) VI
AS	-0.184***	-0.184***	-0.240	-0.291
	(-3.73)	(-3.62)	(-2.02)	(-1.54)
AS·CI2	0.000478	0.000478	0.000637*	0.00122*
	(1.53)	(1.53)	(2.06)	(2.21)
AS·FD	0.0153***	0.0153***	0.0139**	0.0113
	(3.72)	(3.72)	(3.40)	(1.80)
AS·TB	0.0000277**	0.0000277**	0.0000309**	0.0000360*
	(2.74)	(2.74)	(3.07)	(2.44)
AS^2	0.0556	0.0557	0.0546	0.0517
	(1.60)	(1.57)	(1.55)	(0.99)
AS·GNI			0.00764	0.0114
			(0.61)	(0.53)
Mkt Share				0.0000130
				(0.09)
Workers		8.70e-08	0.000000119	-0.000000363
		(0.01)	(0.02)	(-0.04)
INDUSTRY DUMMIES	YES	YES	YES	YES
COUNTRY DUMMIES	YES	YES	YES	YES
r2_a	0.839	0.839	0.839	0.850
N	13926	13926	13926	6999

Notes: The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI2 is the average number of procedures for enforcing a contract from the moment the plaintiff files a lawsuit in court until the moment of payment (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 7: Interaction Effect: Alternative Measure of Trade Barriers

	(1) VI	(2) VI	(3) VI	(4) VI	(5) VI	(6) VI
AS	-0.164***	-0.164***	-0.177***	-0.177***	-0.188***	-0.188***
	(-3.72)	(-3.73)	(-3.85)	(-3.84)	(-3.96)	(-3.94)
AS·CI	0.000300	0.000300	0.000861	0.000861	0.000744	0.000744
	(0.38)	(0.38)	(1.45)	(1.44)	(1.32)	(1.31)
AS·FD	0.0129**	0.0129**	0.0109**	0.0109**	0.00987*	0.00987*
	(3.48)	(3.47)	(2.88)	(2.87)	(2.59)	(2.59)
AS· Tariffs	0.00192	0.00192				
	(1.44)	(1.43)				
AS· Ave cust			0.00228	0.00228		
			(1.98)	(1.97)		
AS· Max cust					0.00228*	0.00228*
					(2.39)	(2.39)
AS[1]	0.0520	0.0520	0.0548	0.0548	0.0573	0.0572
	(1.51)	(1.49)	(1.61)	(1.58)	(1.71)	(1.67)
Workers		-0.000000106		-6.43e-08		-3.58e-08
		(-0.02)		(-0.01)		(-0.01)
INDUSTRY DUM	YES	YES	YES	YES	YES	YES
COUNTRY DUM	YES	YES	YES	YES	YES	NO
r2_a	0.839	0.839	0.839	0.839	0.839	0.839
N	13926	13926	13922	13922	13926	13926

Notes: The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). Tariffs in the average tariff on machineries and equipments (source: TRAINS). Ave Cust (Max Cust) is the average (maximum) time to clear customs (source: ICA). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 8: Interaction Effect: Alternative Measure of Financial Development

	(1) VI	(2) VI	(3) VI	(4) VI	(5) VI	(6) VI
AS	-0.157**	-0.157**	-0.173	-0.127**	-0.127**	-0.183
	(-3.50)	(-3.46)	(-1.60)	(-2.90)	(-2.83)	(-1.42)
AS·CI	0.00104	0.00104	0.00105			
	(1.53)	(1.53)	(1.59)			
AS·CI2				0.000503	0.000504	0.000633
				(1.74)	(1.74)	(2.00)
AS·FD2	0.0179*	0.0179*	0.0171	0.0167*	0.0167*	0.0147*
	(2.44)	(2.44)	(1.89)	(2.65)	(2.64)	(2.18)
AS·TB	0.0000252*	0.0000252*	0.0000259**	0.0000232*	0.0000232*	0.0000259*
	(2.59)	(2.59)	(2.76)	(2.33)	(2.33)	(2.50)
AS^2	0.0515	0.0515	0.0513	0.0526	0.0527	0.0519
	(1.49)	(1.46)	(1.47)	(1.49)	(1.46)	(1.45)
AS·GNI			0.00216			0.00705
			(0.16)			(0.51)
Workers		2.55e-08	2.54e-08		0.000000189	0.000000207
		(0.00)	(0.00)		(0.03)	(0.04)
INDUSTRY DUM	YES	YES	YES	YES	YES	YES
COUNTRY DUM	YES	YES	YES	YES	YES	NO
r2_a	0.125	0.125	0.125	0.125	0.125	0.125
N	13926	13926	13926	13926	13926	13926

Notes: The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). CI2 is the average number of procedures for enforcing a contract from the moment the plaintiff files a lawsuit in court until the moment of payment (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD2 is the principal component of a legal right index (which measures the degree to which collateral and bankruptcy laws facilitate lending) and a credit information index (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 9: Interaction Effect: HLM Regressions

	(1) VI	(2) VI	(3) VI
AS	-0.245***	-0.245***	-0.264**
	(-4.47)	(-4.47)	(-2.75)
AS·CI	0.00146*	0.00146*	0.00154*
	(2.11)	(2.11)	(2.09)
AS·FD	0.0181***	0.0181***	0.0175**
	(3.39)	(3.39)	(2.82)
AS·TB	0.0000333*	0.0000333*	0.0000345*
	(2.29)	(2.29)	(2.23)
AS^2	0.0558*	0.0558*	0.0562*
	(2.38)	(2.37)	(2.37)
AS·GNI			0.00237
			(0.21)
Workers		-1.00e-07	0
		(-0.03)	(0.00)
INDUSTRY DUMMIES	YES	YES	YES
COUNTRY DUMMIES	YES	YES	YES
r2_a	0.112	0.113	0.115
N	13926	13926	13926

Notes: The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

Table 10: Interaction Effects: IV regressions

	(1) VI	(2) VI	(3) VI	(4) VI
AS	-0.211***	-0.212***	-0.202*	-0.205
	(-5.67)	(-5.61)	(-2.39)	(-1.64)
AS·CI	0.00141*	0.00141*	0.00143*	0.00212*
	(2.04)	(2.03)	(2.15)	(2.24)
AS·FD	0.0111***	0.0111***	0.0115**	0.0092
	(3.86)	(3.85)	(3.43)	(1.62)
AS·TB	0.0000366**	0.0000366**	0.0000321**	0.0000296
	(3.39)	(3.39)	(3.59)	(1.72)
AS^2	0.0599	0.0599	0.0597	0.0493
	(1.74)	(1.69)	(1.669)	(0.65)
AS·GNI			0.00184	-0.000674
			(0.12)	(-0.04)
MkT Share				0.0000217
				(0.15)
Workers		-0.000000220	-0.000000215	-0.000000119
		(-0.99)	(-0.87)	(-0.85)
INDUSTRY DUMMIES	NO	YES	YES	YES
COUNTRY DUMMIES	YES	YES	YES	YES
N	13926	13926	13926	6999

Notes: The dependent variable, VI, is the ratio of value added to total sales. AS is the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings. CI is the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita (source: Doing Business Database). TB is the cost of importing a 20 foot container (source: Doing Business Database). FD is a credit information index that measures rules affecting the scope, access and the quality of credit information (source: Doing Business Database). t-statistics in parentheses. * $p<0.05$; ** $p<0.01$, *** $p<0.001$.

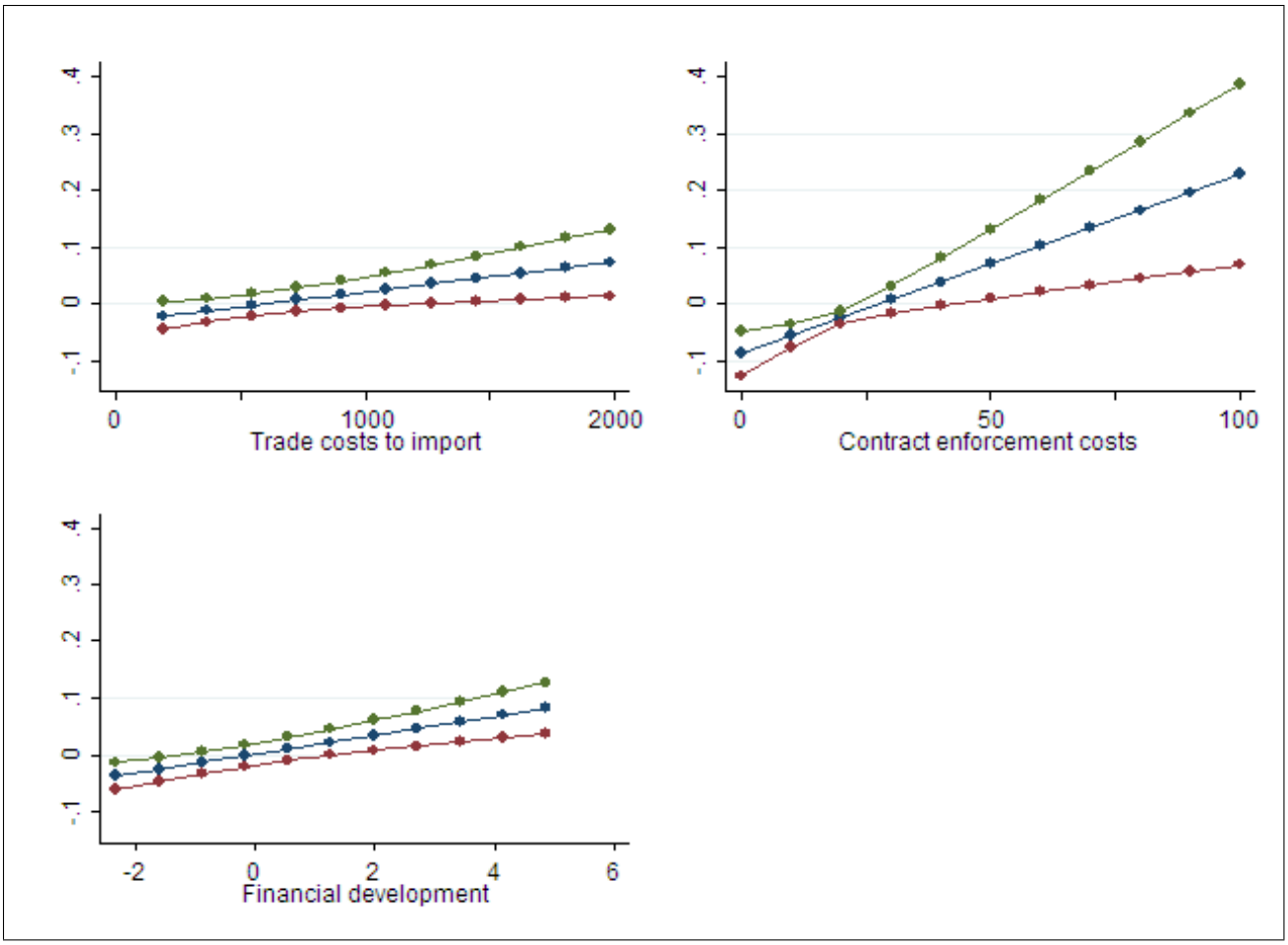

Figure 2: Marginal Effect of Asset Specificity on Vertical Integration

Notes: The central line depicts the estimated marginal effect of vertical integration (measured as the ratio of value added to total sales) on asset specificity (measured as the ratio of the value of machinery and equipment to the value of machinery and equipment, lands and buildings). The other two lines define the 5 percent confidence boundaries. " Trade costs to import" is the cost of importing a 20 foot container; "Financial development" is a credit information index that measures rules affecting the scope, access and the quality of credit information. "Contract enforcement costs" are the cost to enforce a contract in terms of court and attorney fees as a percentage of a claim assumed to be 2 times the average income per capita.