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ABSTRACT

This paper provides evidence that market conditions matter for organization design by studying how trade policy affects vertical integration. We embed an incomplete-contract model of firm boundaries into an international trade framework. Integration decisions are driven by a tradeoff between managers' pecuniary benefits of coordinating production and their private benefits of operating in preferred ways. Integration generates more output than non-integration, but imposes a cost on managers by forcing them to accommodate to common procedures. A key implication is that higher product prices result in more integration. Since trade policy affects prices, it influences organizational decisions: higher tariffs lead to more integration; moreover, ownership structures are more alike across countries with similar levels of protection. To assess the evidence, we construct firm-level indices of vertical integration for a large set of countries from a unique dataset. Our empirical analysis, which exploits both cross-section and time-series variation in import tariffs, provides strong support for the predictions of the model.

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1 Introduction

What determines firm boundaries? When are inputs produced in house rather than being sourced from independent market suppliers? Answering these questions has been a fundamental concern of organization economics since Coase's (1937)'s seminal paper. Over the past two decades, the theory of the firm has stressed contractual incompleteness as the key to understanding vertical integration decisions. Property rights over assets, which define firm boundaries, and allocations of control over production decisions within and across those boundaries are central elements of organizational design. They are chosen to mediate how a firm's stakeholders trade off collective goals and their private interests.[1]

Recent theoretical work has examined how firms' boundary choices are affected by market conditions. In particular, market thickness, demand elasticities, and terms of trade in supplier markets can have a crucial impact of firms' vertical integration decisions (e.g., McLaren, 2000; Grossman and Helpman, 2002; Legros and Newman, 2008).[2] So far, evidence on the importance of these factors is sparse. In this paper, we exploit variation in the degree of trade protection faced by firms to show that market conditions — in particular the level of product prices — do matter for vertical integration decisions.

We adopt a simple model of firm boundaries, inspired by Hart and Holmström (2010), in which managers of different production units trade off the benefits of coordinating production decisions against the cost of accommodating to common ways of doing things. A feature of this model is that vertical integration generates more output than non-integration, but imposes a fixed cost on managers, who lose the ability to operate in their preferred ways. The price of output is then a crucial determinant of firms' boundary decisions. Specifically, the higher the market price, the more integrated firms will be.[3]

The reason for this result is that the primary decision makers — the managers — have not only a stake in the organizational goal, but also derive private, noncontractible benefits from

[1]The formal incomplete contracts approach begins with Grossman and Hart (1986) and Hart and Moore (1990), which emphasize the hold-up problem. In these papers, firm boundaries are identified with the extent of decision rights over assets and associated operations. Hart (1995) provides a summary and discussion of earlier as well as more modern approaches to the study of firm boundaries.

[2]A related literature examines whether goods are sold within or across firm boundaries in the global economy, focusing mostly on the importance of contract enforcement and relationship-specific investments. See, for example, Antras (2003), Antras and Helpman (2004), Nunn (2007), and Nunn and Trefler (2008). There is also some work on within-firm delegation decisions in the international context (e.g., Marin and Verdier, 2008; Guadalupe and Wulf, 2010; Bloom, Sadun and Van Reenen, 2010).

[3]The effect of prices on managerial conflicts and ownership decisions was first explored by Legros and Newman (2009). As stressed by Hart and Holmström (2010), production units can come into conflict about the way of doing things for different reasons. For example, employees' human capital is often tied to particular technologies, with which they are familiar and like to work. Also, future career prospects may depend on how well human capital fits firms' needs, so strategic choices concerning technology will have significant private consequences. Differences in ways of operating (e.g., engineers and marketing departments) can make coordination difficult. In a similar vein, Van den Steen (2005) stresses the importance to organization design of conflicting private benefits that stem from different corporate cultures or managerial visions.

the organization. When different parts of the organization are not integrated, managers make decisions independently, taking more into account their private benefits, and this results in poor coordination and low output. Integration puts decisions in the hands of a single headquarters with strong incentives to coordinate, so as to maximize benefits to the organization. Non-integration is thus associated with high private benefits and low coordination, integration with high coordination and high private costs. Market price enters the tradeoff because it directly affects the organization's profit objective but has a negligible impact on managers' private costs. When market price is high, the tradeoff is resolved in favor of integration, since the organizational goal is relatively more valuable than private goals. At low prices, the tradeoff goes the other way, in favor of non-integration.

The straightforward empirical strategy to verify whether product prices and the degree of vertical integration are positively correlated, as suggested by this organizational theory, would be to regress some measure of vertical integration on industry prices. The main difficulty with this approach is that it would not allow us to clearly distinguish the organizational model we have outlined, in which higher prices lead to more integration, from models that predict the same positive correlation, but with causality going the opposite way. According to these "market-foreclosure" theories, in imperfectly competitive industries, firms may integrate with their suppliers to reduce competition with their rivals, thus pushing product prices higher.[4] Testing whether product prices affect organization design thus requires an exogenous source of price variation. In this respect, trade policy provides an ideal proving ground: the degree of trade protection obviously affects equilibrium prices, but is unlikely to be affected by firms' boundary choices.

To guide our empirical analysis, we embed the incomplete contracts model of vertical integration described above into a standard perfectly-competitive international trade framework, introducing tariffs into a multi-country version of the framework developed in Conconi, Legros and Newman (2011). The main prediction of our model is that firms' ownership decisions should depend on the level of protection they face. In particular, the higher are import tariffs on the final good produced in an industry, the more integrated firms in that industry should be.[5] Moreover, if two countries' tariffs in the same industry are close, equilibrium prices and ownership structures should be similar. Analogously, if two countries are members of a regional trade agreement, all else equal, enterprises in those two economies should have similar organizational structures. That is, convergence in corporate organization — the tendency of industries to be characterized by the same ownership structure across countries — may result not only from global cultural transmission or technological diffusion, but also from standard neoclassical source, the law of one price.

Absence of an international dataset sufficiently comprehensive to support studies of firm

[4]See Salinger (1988) for an early contribution and Rey and Tirole (2007) for a survey.

[5]This can be interpreted as a statement about intensive margins — more parts of the supply chain should be part of a single firm as the price for the final good increases, or about extensive margins — a greater fraction of firms are integrated at higher prices, assuming some heterogeneity among them.

organization across a wide range of countries has limited empirical analysis of the effects of trade policy on organizational choices. We overcome this limitation by using a new dataset from Dun and Bradstreet (D&B) that contains both listed and unlisted plant-level observations for a large set of countries and territories in 2004. For each plant, the dataset includes information about its primary and secondary activities, as well as about ownership (e.g., its domestic or global parent). By combining this information with U.S. input-output tables, we are able to construct firm-level vertical integration indices that measure the fraction of inputs used in the production of a firm's final good that can be produced in house.[6] This methodology enables us to analyze firms' ownership structures in a large set of countries and industries, and thus to overcome an important constraint in the literature.

One strategy to examine the organizational effects of trade policy is to exploit cross-country and cross-sectoral variation in applied most-favored-nation (MFN) tariffs. While MFN tariffs do not change much over time, they do vary substantially both across sectors within countries and across countries for a given sector.[7] MFN tariffs are negotiated at the multilateral level over long periods of time are less "political" than administrative measures for the regulation of imports (e.g., anti-dumping and countervailing duties).[8] Firms' ownership structures, particularly the degree of vertical integration, are therefore unlikely to have a systematic impact on trade policy in general, and on MFN tariffs in particular.[9]

We collect data on applied MFN tariffs at the 4 digit SIC industry level for all members of the World Trade Organization (WTO) in 2004, and examine the relation between tariffs and firms' organizational structure. In line with the predictions of our theoretical model, we find that higher tariffs on final goods lead to more vertical integration at the firm level. The impact of tariffs on vertical integration is sizable. In our preferred estimation, a 100 percent tariff increase leads to a 2.15 percent increase in the vertical integration index, implying that increasing tariffs from 1 percent to their mean level of around 5 percent would increase vertical integration by more than 8 percent. We show that this result is robust to the inclusion of other determinants of firms' boundary choices, and to the use of different samples of countries and firms. We also find that the effect of trade policy on organization is strongest in sectors where product prices are expected to be most sensitive to tariffs.

An alternative strategy to verify the impact of trade policy on firm boundaries is to focus

[6]We follow Acemoglu, Johnson and Mitton (2009), who build on the methodology developed by Fang and Lang (2000). Section 3.3 describes the empirical methodology in detail.

[7]For example, U.S. manufacturing tariffs in 2004 averaged 2.4 percent, with a minimum of zero and a maximum of 350 percent. As an example of cross-country variation, for a sector like SIC 3631 (Household Cooking Equipment), MFN tariffs varied between zero and 29 percent, with an average of 3.15 percent.

[8]This is the reason why most empirical papers on the political economy of trade policy focus on non-tariff barriers rather than MFN tariffs. For example, Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) use data on 1983 non-tariff barrier coverage ratios for the U.S. manufacturing sector to test Grossman and Helpman (1994)'s lobbying model.

[9]Our empirical analysis controls for firm size and industry concentration, which could be correlated with both the level of trade protection (Mitra, 1999; Bombardini, 2008) and vertical integration decisions.

on trade liberalization reforms — major unilateral or multilateral liberalization episodes, or the creation of regional trade agreements — thus exploiting time variation in the degree of protectionism faced by firms. The challenge with implementing this strategy is data availability, since we can only construct firm-level vertical integration measures for recent years, during which there have been few trade liberalization reforms.[10] The only major trade liberalization episode that has occurred in recent years is arguably the entry of China into the WTO in 2001: to be accepted as a WTO member, China had to undertake a series of important tariff reductions so as to substantially expand market access for goods from foreign countries. We examine the organizational effects of these trade policy changes, comparing the ownership structure of Chinese firms before and after WTO accession (in 1999 and 2007). Consistent with the predictions of our theoretical model, we find that firm-level vertical integration has fallen more in sectors that have experienced larger tariff cuts.

As discussed above, our theoretical model also suggests that trade policy should affect the degree of organizational convergence across countries. In line with this prediction, we find that differences in sectoral vertical integration indices between two countries are significantly larger in sectors in which differences in MFN tariffs are larger. We also collect systematic information on all regional trade agreements (RTAs) in force in 2004 and examine the relation between the degree of sectoral organizational convergence and common membership in RTAs. We find that differences in vertical integration indices are around 9 percent smaller for country pairs engaged in RTAs. Moreover, vertical integration indices are more similar (by approximately 18.5 percent) in customs unions than in free trade areas. Indeed, we would expect stronger price and organizational convergence for members of customs unions, which impose common external tariffs vis-à-vis non-members.

Our paper contributes to a recent stream of empirical work that examines the determinants of firms' organizational choices. Like this paper, part of that literature focuses on vertical integration decisions (i.e., firm boundaries/ownership structure). Acemoglu, Johnson, and Mitton (2009) (henceforth AJM) study the determinants of vertical integration using D&B data for 93 countries, focusing on the role of contracting costs.[11] Acemoglu, Aghion, Griffith, and Zilibotti (2009) use data on all British manufacturing plants to study the relationship between vertical integration and rates of innovation. Aghion, Griffith and Howitt (2006) investigate whether the propensity for firms to vertically integrate varies systematically with the extent of competition in the product market. None of these papers focus specifically on how industry price levels affect integration. Breinlich (2008) finds a significant increase in the level of M&A activity in Canada

[10]Important trade liberalization episodes, such as the conclusion of the Uruguay Round of GATT/WTO trade negotiations, the North American Free Trade Agreement (NAFTA), or the free trade agreements between Eastern European countries and the European Community, all occurred in the early or mid-nineties.

[11]Individually, these costs are not found to have a significant impact on vertical integration. However, AJM find evidence of interaction effects, i.e., more vertical integration in countries with greater contracting costs and greater financial development, and stronger impact of contracting costs in more capital-intensive industries.

(but not the U.S.) as a result of trade liberalization following the 1989 Canada-United States Free Trade Agreement (CUSFTA).[12]

Another stream of the literature focuses on within-firm delegation (for a given ownership structure). Bloom, Sadun and Van Reenen (2010), using data on medium-sized manufacturing firms across a dozen countries, find that greater product market competition increases decentralization. Guadalupe and Wulf (2010) show that the CUSFTA agreement led large U.S. firms to flatten their hierarchies.

Finally, the literature on trade and organization focuses on the impact of organization design on the patterns of intra-firm trade and the location of multinational subsidiaries or suppliers (e.g., Antras, 2003; Antras and Helpman, 2004; and Grossman and Helpman, 2004), without emphasizing the role of trade policy. In addition to Conconi, Legros and Newman (2011), two notable exceptions are Ornelas and Turner (2008), which examines how trade policy affects suppliers' hold-up incentives, and Antras and Staiger (2008), which studies the trade policy implications of offshoring of intermediate inputs.

The rest of the paper is organized as follows. Section 2 presents the theoretical framework and discusses the empirical implications of our model. Section 3 describes our data and the methodology used to construct vertical integration indices. Section 4 presents our main results on tariffs and vertical integration. Section 5 analyzes the impact of trade policy on the degree of cross-country organizational convergence. The last section concludes.

2 Model

We describe a specific-factor model, in which some factors of production are mobile across sectors while others are employed only in some sectors, and international trade is driven by cross-country differences in factor endowments. As we elaborate below, what distinguishes our model from its standard formulation (e.g., Mussa, 1974) is that we replace "neoclassical" firms with "organizational" ones: production requires certain non-contractible decisions that are undertaken by managers running different supplier units, whose interests are imperfectly aligned with each other and with the goal of the enterprise; the choice of ownership structure helps to govern the tradeoff between the managers' organizational and private goals. The general property of this model is that vertical integration generates more output than non-integration, but involves higher (fixed) costs for the managers. As a result, the price of output helps determine firm boundary decisions; since tariffs affect output prices, they also influence firm boundaries.

Before looking at international trade and the effects of trade policy, we describe the building blocks of the model in its closed-economy form.

[12]There are also various studies on vertical integration focused on single industries, e.g., Hortaçsu and Syverson (2007) on U.S. ready-mix concrete and Woodruff (2002) on Mexican footwear.

2.1 Setup

There are $K+1$ sectors/goods, denoted by 0 and $k = 1, \ldots, K$; good 0 is a numeraire. The representative consumer's utility can be written as

$$u(c_0, \ldots, c_K) \equiv c_0 + \sum_{k=1}^{K} u_k(c_k), \tag{1}$$

where c_0 is consumption of the numeraire good, and c_k consumption of one of the other goods. The utility functions $u_k(\cdot)$ are twice differentiable, increasing, strictly concave, and satisfy the Inada conditions $\lim_{c_i \to 0} u_k'(c_k) = \infty$ and $\lim_{c_i \to \infty} u_k'(c_k) = 0$. Domestic demand for each good k can then be expressed as a function $D_k(p_k)$ of its own price.

Production of good k requires the cooperation of two types of input suppliers, denoted A and B_k. B_k suppliers generate no value without being matched with an A; A suppliers can either match with any B_k or engage in stand-alone production of the numeraire good 0. Many interpretations of the A and B_k firms are possible. For example, A suppliers may represent light assembly plants or basic inputs, such as energy, or various business services (e.g., IT, retailing, logistics) that can be used to produce basic consumer goods or combined with other inputs (B_k suppliers) to produce more complex goods.

All goods are sold under conditions of perfect competition. There is a continuum of each type of supplier, with a measure n_k of B_k's, and a unit measure of A's. We assume the aggregate supply of A's exceeds that of the B_k's (i.e., $\sum_{k=1}^{K} n_k < 1$) so that a positive amount of good 0 is produced in equilibrium. The price of the numeraire good is normalized to unity.

So far, we have described a standard specific-factor model in which A suppliers represent the mobile factor and B_k suppliers the specific factors of production. An equilibrium in the supplier market consists of a stable match between each B_k supplier and an A supplier: given the surplus allocation among all the suppliers, no (A, B_k) pair can form an enterprise that generates higher than equilibrium payoffs for each partner. All A suppliers are equally productive when matched with one of the B_k's. A stand-alone A produces α units of the numeraire good. Since the price of the numeraire is equal to unity, this also pins down the equilibrium payoff for all A's.[13].

2.2 Individual Enterprises

We adopt a simple model of firm boundaries based on a tradeoff between the pecuniary benefits of coordinating production decisions and managers' private benefits of operating in their preferred ways. As in Grossman and Hart (1986), integration and non-integration *both* suffer from incentive costs. However, in the framework described below, these emerge in a particularly tractable way:

[13]See Conconi, Legros and Newman (2011) for a more general setup, in which the outside option of the mobile factor, the A suppliers, is endogenously determined

integration, though more productive because of better coordination, imposes a fixed cost on managers, by forcing them to adopt a common "compromise" solution.[14]

Once an enterprise composed of an A and a B_k has formed in the supplier market, a non-contractible decision (e.g., choosing compatible technologies, deciding on marketing campaigns) about the way in which production is to be carried out must be made by each unit. Denote the A and B_k decisions respectively by $a \in [0,1]$ and $b_k \in [0,1]$. Successful production requires coordination between the two suppliers. More precisely, the enterprise will succeed with a probability $1-(a-b_k)^2$, in which case it generates $R>0$ units of output; otherwise it fails, yielding 0. Output realizations are independent across enterprises (A-B_k pairs). We allow R to vary across enterprises, so it can be interpreted as some measure of firm-specific productivity.

Managers are risk-neutral and bear a private cost of implementing the decision made by their units. The A manager's utility is $y_A-(1-a)^2$, the B_k manager's is $y_k-b_k^2$, where $y_A, y_k \geq 0$ are their respective incomes and $(1-a)^2$ and b_k^2 are their costs. Though both managers of the A and B_k units enjoy monetary returns, they view their operations differently: A's most preferred action is 1, while B_k's is 0. For instance, a standardized production line could be convenient for the sectorally-mobile A suppliers, but may not fit the specific design needs of the B_k suppliers. Because managers' primary function is to implement decisions and convince their workforces to comply, they bear the cost of decisions even if they don't make them.

Assignment of decision rights via possible sale of assets is the organizational design problem in the model. Managers may remain *non-integrated* and retain control over their respective decisions. Or they can choose to *integrate* into a single firm by engaging a headquarters (HQ), transferring to it, in exchange for an acquisition feww, a share of the realized revenue and the power to decide a and b_k. HQ is motivated only by monetary considerations (the desire to maximize the integrated firm's income) and incurs no costs for operating in a particular way.

Before production, B_k managers match with A managers and sign contracts specifying an ownership structure and payment scheme. For simplicity, we take the payment scheme to be a fixed payment T from B_k to A. Because A's are in excess supply, they must all receive α in equilibrium. Thus T will just cover A's anticipated private cost of production together with the opportunity cost α.[15]

For each match (A,B_k), total revenue in event of success is given by the number of units produced, R, times the product market price, p_k, which is taken as given and correctly anticipated when managers and HQ's sign the contracts and make their decisions. After contracts are signed, managers and HQ's make their production decisions, output is realized, product is sold, and

[14]It is this feature that leads to the main comparative static for our empirical investigation: at low prices, revenues are small enough that managers are more concerned with their private benefits and remain non-integrated; at higher prices, output is more valuable, so managers prefer vertical integration.

[15]In general, B_k may prefer to give A a positive contingent share of revenue. This complicates notation but does not change any qualitative conclusion regarding the dependence of integration on price (see Legros and Newman, 2009).

revenue shares are distributed.

Integration

HQ's are elastically supplied at a cost normalized to zero. After paying its acquisition fee and receiving its compensating share of revenue, an HQ's payoff is proportional to $(1-(a-b_k)^2)Rp_k$.[16] HQs decide both a and b_k, and since their incentive is to maximize he integrated firms' expected revenue, they choose $a = b_k$. Among the choices in which $a = b_k$, the Pareto-dominant one is that in which $a = b_k = 1/2$, which minimizes the total cost of the A and B_k managers. We assume HQs implement this choice. The private cost to each manager is then $\frac{1}{4}$, and the payoffs to the A and B_k managers are equal to α and $Rp_k - \alpha - \frac{1}{2}$, respectively (thus $T = \alpha + \frac{1}{4}$).

Non-integration

Under non-integration, managers retain control of their respective activities. The decisions chosen are the (unique) Nash equilibrium of the game with payoffs $T - (1-a)^2$ for A, who chooses a, and $(1-(a-b_k)^2)\,Rp_k - b_k^2 - T$ for B_k, who chooses b_k. Nash decisions are $a = 1$ and $b_k = Rp_k/(1+Rp_k)$, with resulting expected output $1 - \frac{1}{(1+Rp_k)^2}$. Notice that output increases with price: as p_k becomes larger, the revenue motive becomes more important for B_k managers, pushing them to better coordinate with their A partners. The equilibrium transfer from B_k to A under non-integration is $T = \alpha$; the payoffs are α for A's and $\frac{(Rp_k)^2}{1+Rp_k} - \alpha$ for B_k's.

Choice of Ownership Structure

To determine managers' choice of firm boundaries, we must compare their payoffs under integration and non-integration. Notice that A suppliers obtain α in both cases, so they are indifferent about the organizational choice. B_k suppliers obtain a higher payoff under integration if and only if $Rp_k - \frac{1}{2} > \frac{(Rp_k)^2}{1+Rp_k}$ or $p_k > 1/R$. Thus managers' organizational choices depend on product prices. At low prices, revenues are small enough that integration's better output performance is not valuable enough to the B_k to be worth the private cost he would have to bear; thus, B_k opts for the "quiet life" of non-integration, wherein both profits and costs are low. At higher prices, the B_k manager's revenue motive now makes higher output and therefore coordination more valuable. Coordinating under non-integration would entail large and costly concessions from B_k to A, who chooses $a = 1$ independently of the price; the compromise choice $a = b_k = \frac{1}{2}$, is now preferable, so B_k chooses to integrate. Clearly, the price at which an enterprise integrates is lower when its productivity R is higher.

[16] The size of HQ's share is indeterminate and could be pinned down in many ways not modeled here; all that matters for our purposes is that it is positive.

2.3 Product Market Equilibrium and the OAS Curve

A general equilibrium for the economy entails clearing supplier and product markets. We have already characterized the supplier market: some A suppliers produce by themselves α units of the numeraire good; others are matched with B_k suppliers for the production of goods $k = 1, \ldots, K$ and receive α.

In product market k, the large number of enterprises implies that with probability one the supply is equal to the expected value of output given p_k; equilibrium requires that this price adjusts so that demand equals supply.

To derive industry supply, suppose R is distributed in the population according to some continuous c.d.f. $G(R)$ with mean 1 and support $[\underline{R}, \overline{R}]$. Since all enterprises in industry k with $R < 1/p_k$ remain non-integrated, and the remaining ones integrate, total supply at price $p_k \in [1/\overline{R}, 1/\underline{R}]$ is (recall that n_k is the measure of B_k suppliers)

$$S(p_k) = n_k \left[\int_{\underline{R}}^{1/p_k} R(1 - (\frac{1}{1+Rp_k})^2) dG(R) + \int_{1/p_k}^{\overline{R}} R dG(R) \right]. \tag{2}$$

If $p_k < 1/\overline{R}$, supply is $n_k \int_{\underline{R}}^{\overline{R}} R(1 - (\frac{1}{1+Rp_k})^2) dG(R)$; if $p_k > 1/\underline{R}$, it is n_k.

Figure 1: The OAS and market equilibrium

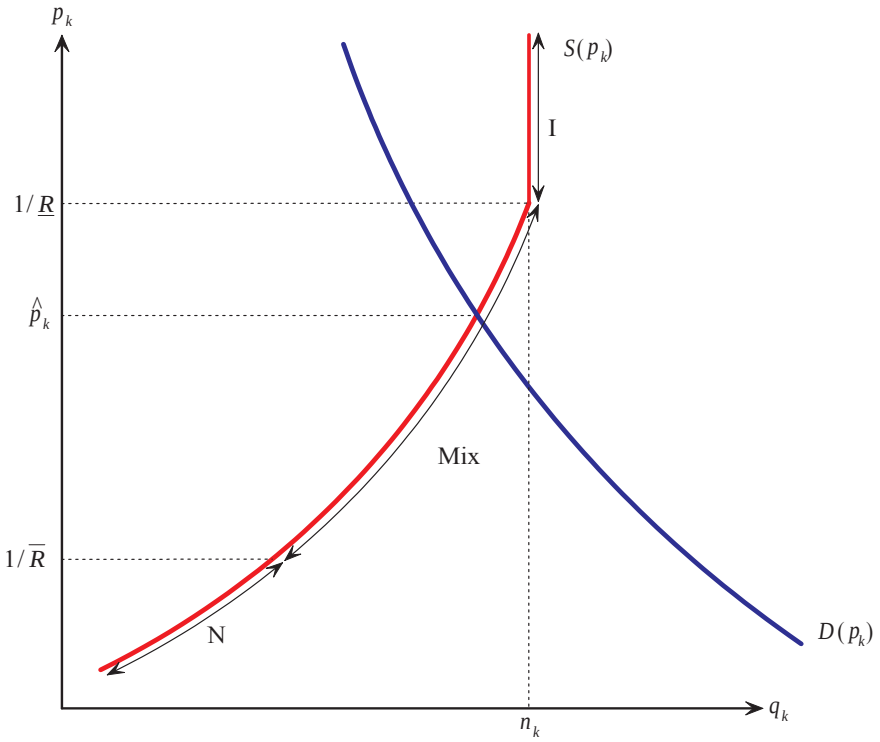


Figure 1 depicts the Organizationally Augmented Supply (OAS) curve, which incorporates

the ownership structure decisions of the industry's enterprises as well as the usual price-quantity relationship. It also illustrates the price regions indicated by the black arrows in which enterprises are all non-integrated (**N**), all integrated (**I**), and the middle range in which only the more productive ones integrate (**Mix**). When $p_k < 1/\overline{R}$, the industry is entirely non-integrated, but supply increases with price, since non-integration expected output increases. As price rises above $1/\overline{R}$, the most productive enterprises integrate, producing more than they would under non-integration; those that remain non-integrated also produce more, so that industry output rises further. Once p_k reaches $1/\underline{R}$, all firms are integrated and industry supply is fixed at n_k (the mean R being 1) for prices higher than that threshold. In the absence of trade, the equilibrium price $\hat{p}_k$ equates domestic supply and demand.

Observe that, for a given market price p_k, more productive enterprises (those with higher R) are more likely to be vertically integrated. The degree of integration of the industry (i.e., the fraction $1 - G(1/\hat{p}_k)$ of firms that integrate) is therefore a nondecreasing function of the equilibrium price, strictly increasing on $[\underline{R}, \overline{R}]$.

2.4 Trade Policy and Firms' Organization

The world consists of C small countries, indexed by c, which have identical demands and technologies in the production of all goods. Trade is the result of endowment differences between countries. In particular, we assume that the countries can be divided into two homogeneous groups: a "Home" set H of countries relatively more endowed in the specific factors necessary to produce goods $k \in \{m+1, \ldots, K\}$; and a "Foreign" set F of countries (denoted with a "*") relatively more endowed in the specific factors necessary to produce goods $k \in \{1, \ldots, m\}$. We thus have $n_k < n_k^*$ for $k \in \{1, \ldots, m\}$ and $n_k > n_k^*$ for $k \in \{m+1, \ldots, K\}$. Good 0, the numeraire, is always traded freely across countries. We choose units so that the international market-clearing and the domestic price of good 0 in each country equal unity.

Each country c imposes an exogenously-given ad valorem tariff $t_k^c \geq 0$ on import-competing good k. In sectors $k \in \{1, \ldots, m\}$ domestic prices are thus equal to $p_k^c = (1 + t_k^c)P_k$ in Home countries and $p_k^{c*} = P_k$ in Foreign countries, where P_k denotes the international price. This is the solution to the following market-clearing condition:

$$\sum_c M_k^c\Big((1+t_k^c)P_k\Big) = \sum_{c*} X_k^{c*}(P_k), \tag{3}$$

where $M_k^c = D\Big((1+t_k^c)P_k\Big) - S\Big((1+t_k^c)P_k\Big)$ denotes Home imports and $X_k^{c*} = S(P_k) - D(P_k)$ Foreign exports. For goods $k \in \{m+1, \ldots, K\}$ the market-clearing condition is

$$\sum_{c*} M_k^{c*}\Big((1+t_k^{c*})P_k\Big) = \sum_c X_k^c(P_k). \tag{4}$$

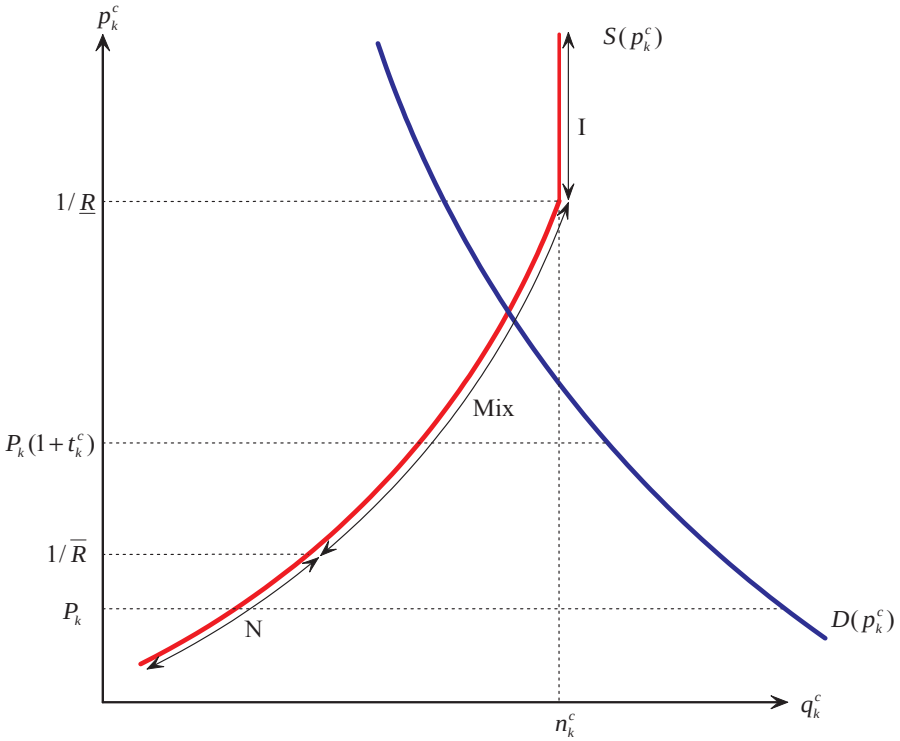
From (3) and (4) we can derive an expression for international equilibrium prices as a function of the tariffs applied by all countries, that is, $P_k(\mathbf{t_k})$ for $k \in \{1, \ldots, m\}$, and $P_k(\mathbf{t_k^*})$ for $k \in \{m+1, \ldots, K\}$, where $\mathbf{t_k} = \{t_k^c\}_{c \in H}$ and $\mathbf{t_k} = \{t_k^{c^*}\}_{c^* \in F}$ (the separable form of demand ensures that the world product price in one sector depends only on tariffs imposed by importing countries in that sector).

The trade balance condition for a Home country c requires

$$\sum_{k=1}^{m} P_k M_k^c\Big((1+t_k^c)P_k\Big) - \sum_{k=m+1}^{K} P_k X_k^c(P_k) + Z_0^c = 0, \tag{5}$$

where Z_0^c denotes the net transfer of the numeraire good to settle the trade balance. A similar condition must hold for a Foreign country.

Figure 2: Firm organization in the presence of a tariff



Trade policies affect ownership structures through their impact on product prices. In particular, an increase in t_k^c leads to an increase in the domestic price of good k; an enterprise with productivity R will choose integration if that price exceeds $1/R$. Figure 2 depicts the OAS curve of industry k in country c. In this example, absent any tariff, the domestic price would be equal to the world price P_k, and all firms in the domestic industry would be non-integrated. Now consider a non-prohibitive tariff t_k^c that raises the domestic price to $p_k^c = P_k(1+t_k^c)$, which lies between $1/\overline{R}$ and $1/\underline{R}$. At this price, more productive enterprises (with $R > 1/p_k^c$) will integrate

and less productive ones will remain non-integrated. Clearly, a lower tariff would lead to fewer integrated firms, a higher one to more. Integration thus increases with the tariff level.

The model can also be used to examine how trade policy affects the degree of organizational convergence across countries. In particular, for a given country pair cc', the difference in degree of integration within a sector k will depend on the differences in their applied tariffs: the more similar t_k^c and $t_k^{c'}$, the smaller the difference between p_k^c and $p_k^{c'}$ and the more similar firms' organizational choices within industry k.

Finally, consider a country pair cc' that has signed a regional trade agreement that eliminates all tariffs between them. This implies that prices should tend to convergence across member countries. We would also expect customs unions, in which members adopt common external tariffs, to be characterized by more similar ownership structures than free trade areas, in which differences in external tariffs, together with problems in implementing rules of origins, reduce the extent of price and organizational convergence.[17]

For the purpose of our empirical analysis, the main results of our theoretical model can be summarized as follows:

1. Higher tariffs on final goods should lead firms to be more vertically integrated.

2. Country pairs should have more similar ownership structures in sectors where they have similar levels of protection; RTAs, especially customs unions, should display similar ownership structures among members.

Sections 4 will examine the empirical validity of the first of these predictions, while Section 5 will focus on the second.

3 Data and Descriptive Statistics

3.1 The WorldBase Database

We use data for 2004 from Dun & Bradstreet's WorldBase, a database of public and private plant-level observations in more than 200 countries and territories.[18] The leading U.S. source of commercial credit and marketing information since approximately 1845, Dun & Bradstreet (D&B) presently operates in different countries and territories either directly or through affiliates, agents, and associated business partners.

WorldBase is the core database with which D&B populates its commercial data products including Who Owns Whom^{TM}, Risk Management Solutions^{TM}, Sales & Marketing Solutions^{TM},

[17] See Cadot, de Melo, and Olarreaga (1999), for a comparison of different types of regional trade agreements and a discussion of rules of origin in free trade areas.

[18] The dataset is not publicly available but was released to us by Dun and Bradstreet. For more information see: http://www.dnb.com/us/about/db_database/dnbinfoquality.html.

and Supply Management Solutions^{TM}. These products provide information about the "activities, decision makers, finances, operations and markets" of the clients' potential customers, competitors and suppliers. D&B compiles their data from a wide range of sources, including partner firms in dozens of countries, telephone directory records, websites, and self-registration. All information is verified centrally via a variety of manual and automated checks.

Early uses of D&B data include Caves' (1975) analysis of size and diversification patterns between Canadian and U.S. plants. More recently, Harrison, Love, and McMillian (2004) used D&B's cross-country foreign ownership information. Other studies that have used D&B data include Black and Strahan's (2002) study of entrepreneurial activity in the United States, Acemoglu, Johnson, and Mitton's (2009) cross-country study of concentration and vertical integration, and Alfaro and Charlton's (2009) analysis of vertical and horizontal activity by multinationals.

WorldBase, albeit not without problems, is best suited to our analysis having four main advantages over most other sources. First, the data include both listed and non-listed plants, and information that supports aggregation at the firm level. Second, Amadeus and other data sources restricted to Europe are not useful for our purposes because they lack broad coverage of countries in particular developing countries, with different levels of trade barriers. WorldBase by contrast has data in more than 200 countries and territories. Third, D&B compiles data from a wide range of sources, whereas other databases collect data primarily from national firm registries. The wide variety of sources from which D&B collects data reduces the likelihood that the sample frame will be determined by national institutional characteristics. Finally, over its many years in business, D&B has devised many methods of checking its data and assuring the reliability of its dataset.[19]

3.2 The Sample

We use data from the 2004 WorldBase file, excluding records that lack primary industry and year started, for a total of more than 24 million observations. The unit of observation in WorldBase is the establishment (a single physical location at which business is conducted or services or industrial operations are performed) rather than the firm (one or more domestic establishments under common ownership or control). Establishments, which we also refer to as plants, have their own addresses, business names, and managers, but might be partly or wholly owned by other firms. Plants can be linked via information on domestic and global parents using the DUNS numbers.[20] Our analysis is at the firm level, that is, we consider all plants connected by

[19]See Alfaro and Charlton (2009) for a more detailed discussion of the WorldBase data and comparisons with other data sources.

[20]D&B uses the United States Government Department of Commerce, Office of Management and Budget, Standard Industrial Classification Manual 1987 edition to classify business establishments. The Data Universal Numbering System — The D&B D-U-N-S Number — introduced in 1963, to identify businesses numerically for data-processing purposes, supports the linking of plants and firms across countries and tracking of plants histories

the same global or domestic parent to be one unit (see discussion below).

We use four categories of data recorded by WorldBase records for each establishment:

1. Industry information: the 4-digit SIC code of the primary industry in which each establishment operates, and for most countries, the SIC codes of as many as five secondary industries, listed in descending order of importance.

2. Ownership information: information about the firms' family members (number of family members, its domestic parent and its global parent).[21]

3. Location information: country, state, city, and street address of each family member (used to link establishments within a family to the relevant tariff data).

4. Basic operational information: sales and employment.

We exclude countries and territories with fewer than 80 observations and those for which the World Bank provides no data. We further restricted the sample to Word Trade Organization (WTO) members for which we have data on tariffs/regional trading arrangements (see the discussion below).

We focus on manufacturing firms (i.e., firms with a primary SIC code between 2000 and 3999), which best fit our theory of vertical integration. We exclude government/public sector firms, firms in the service sector (for which we have no tariff data) or agriculture (due to the existence of many non-tariff barriers), and firms producing primary commodities (i.e., mining and oil and gas extraction).

We exclude firms with fewer than 20 employees, as our theory does not apply to self-employment or small firms with little prospect of vertical integration (see also Acemoglu, Aghion, Griffith, and Zilibotti, 2010).[22]

We focus on firms that operate in only one country, since this provides a cleaner analysis of the effects of tariffs and RTAs on firms' ownership structure. This is because the degree of vertical integration of these firms depends only on the prices of the country in which they are located. In the case of multinational corporations (MNCs), on the other hand, it is harder to identify the relevant prices and tariffs. Moreover, focusing on national firms, avoids issues having to do with the strategic behavior of multinationals across markets (e.g., transfer pricing, tariff jumping).[23] Multinationals are included in the robustness analysis. There, we split MNCs into

including name changes.

[21]D&B also provides information about the firm's status (joint-venture, corporation, partnership) and its position in the hierarchy (branch, division, headquarters).

[22]Restricting the analysis to firms with more than 20 employees enables us to correct for possible differences in the the collection of small firms data across countries.

[23]We describe an establishment as foreign-owned if it satisfies two criteria: (1) it reports to a global parent firm, and (2) the parent firm is located in a different country. Parents are defined in the data as entities that have legal and financial responsibility for another firm. For purposes of matching the tariff data, we use the SIC code of the domestic parent for multinationals.

separate entities — one for each country — in order to link organizational structure to domestic tariffs.

Table A-1 in the Appendix lists the countries included in our main sample.[24] As a robustness check, we also exclude countries for which we have fewer than 1,000 plants that are part of firms with at least 20 employees (see also Klapper, Laeven, and Rajan, 2006). The countries included in this restricted sample are listed in Table A-2.

We next describe the construction of firm-level vertical integration indices, and all other variables used in our empirical analysis. Appendix Table A-3 presents summary statistics for all variables.

3.3 Vertical Integration Indices

Constructing measures of vertical integration is highly demanding in terms of data, requiring firm-level information on sales and purchases of inputs by various subsidiaries of a firm. Such data are generally not directly available and, to the best of our knowledge, there is no source for such data for a wide sample of developed and developing countries.

To measure the extent of vertical integration for a given firm, we build on the methodology used by AJM. We combine WorldBase information on plant activities and ownership structure with input-output data to determine related industries and construct the vertical integration coefficients $V_j^{f,k,c}$ in activity j, where k is the primary sector in which firm f in country c is active. Note that the sample in AJM is restricted to a maximum of the 30,000 largest records per country in the 2002 WorldBase file (a limit imposed by cost constraints).[25] Having information for a broader sample of more than 24 million establishments in the 2004 WorldBase file, we are able, as discussed below, to link establishments to firms.

Given the difficulty of finding input-output matrices for all the countries in our dataset, we follow AJM in using the U.S. input-output tables to provide a standardized measure of input requirements for each sector. As the authors note, the U.S. input-output tables should be informative about input flows across industries to the extent that these are determined by technology.[26]

The input-output data are from the Bureau of Economic Analysis (BEA), Benchmark IO Tables, which include the make table, use table, and direct and total requirements coefficients

[24] Further restrictions were imposed by data availability constraints related to the control variables as explained in the next subsections.

[25] For many countries, this restriction is not binding. For countries with more than 30,000 observations, AJM select the 30,000 largest, ranked by annual sales. They include all industries, except those operating only in "wholesale trade" and "retail trade."

[26] Note that the assumption that the U.S. IO structure carries over to other countries can potentially bias our empirical analysis against finding a significant relationship between vertical integration and prices by introducing measurement error in the dependent variable of our regressions. In addition, using the US input-output tables to construct vertical integration indices for other countries mitigates the possibility that the IO structure and control variables are endogenous.

tables. We use the Use of Commodities by Industries after Redefinitions 1992 (Producers' Prices) tables. While the BEA employs six-digit input-output industry codes, WorldBase uses the SIC industry classification. The BEA website provides a concordance guide, but it is not a one-to-one key.[27] For codes for which the match was not one-to-one, we randomized between possible matches in order not to overstate vertical linkages. The multiple matching problem, however, is not particularly relevant when looking at plants operating only in the manufacturing sector (for which the key is almost one-to-one).

For every pair of industries, i, j, the input-output accounts support calculation of the dollar value of i required to produce a dollar's worth of j. We construct the input-output coefficients for each firm f, IO_{ij}^f by combining the SIC information for each plant in each firm, the matching codes, and the U.S. input-output information. Here, $IO_{ij}^f \equiv IO_{ij} * I_{ij}^f$, where IO_{ij} is the input-output coefficient for the sector pair ij, stating the cents of output of sector i required to produce a dollar of j, and $I_{ij}^f \in \{0, 1\}$ is an indicator variable that equals one if and only if firm f owns plants in both sectors i and j. A firm that produces i as well as j will be assumed to supply itself with all the i it needs to produce j; thus, the higher IO_{ij} for an i-producing plant owned by the firm, the more integrated in the production of j the firm will be measured to be. Adding up the input-output coefficients IO_{ij}^f for all inputs i, gives the firm's degree of vertical integration in j.

To illustrate the procedure, consider the following example from AJM (2009) of a Japanese establishment with, according to WorldBase, one primary activity, automobiles (59.0301), and two secondary activities, automotive stampings (41.0201) and miscellaneous plastic products (32.0400). The IO_{ij} coefficients in the three activities for this plant are:

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

The table is a restriction of the economy-wide IO table to the set of industries in which this establishment is active (i.e., it contains all of the positive IO_{ij}^f values). For example, the IO_{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 worth of autos. Because this plant has the internal capability to produce stampings, we assume it produces itself all the stampings it needs.[28] The bottom row shows the sum of the IO_{ij}^f for each industry. For example, given that 12.3 cents worth of the inputs required to make autos can be produced within this plant, we would say

[27] This concordance is available upon request. The BEA matches its six-digit industry codes to 1987 U.S. SIC codes http://www.bea.gov/industry/exe/ndn0017.exe.

[28] Many industries have positive IO_{ij} coefficients with themselves; for example, miscellaneous plastic products are required to produce miscellaneous plastic products. Any firm that produces such a product will therefore be measured as at least somewhat vertically integrated.

that the degree of vertical integration for this plant is 0.123.

Our main unit of observation, however, is all plants that belong to the same *firm*, that is, all plants that report to the same headquarters. For example, if the plant in the example above is reported to be the headquarters of another Japanese plant (subsidiary), we consider the activities of both plants in constructing a measure of vertical integration for the firm. In the case of multi-plant firms, restricting analysis to the plant level may underestimate the number of activities carried out within the firm's boundaries.

For firm f in primary sector k located in country c, we define the integration index in activity j as

$$V^j_{f,k,c} = \sum_i IO^{f,k}_{ij}, \tag{6}$$

the sum of the IO coefficients for each industry in which the firm is active. Our measure of vertical integration is based on the firm's primary activity:

$$V_{f,k,c} = V^j_{f,k,c}, j = k. \tag{7}$$

In the case multi-plant firms (plants connected by the same global ultimate or headquarters), we consider the main activity of the headquarters or domestic parent.[29]

The approach we follow to identify vertical integration infers a firm's level of vertical integration from information about the goods it produces in each of its establishments and the aggregate input-output relationship among those goods. The advantage of this method is that one need not worry about the value of intra-firm activities being affected by transfer pricing. Another advantage is that using I-O tables avoids the arbitrariness of classification schemes that divide goods into "intermediate" and other categories (Hummels, Ishii, and Yi, 2001).[30]

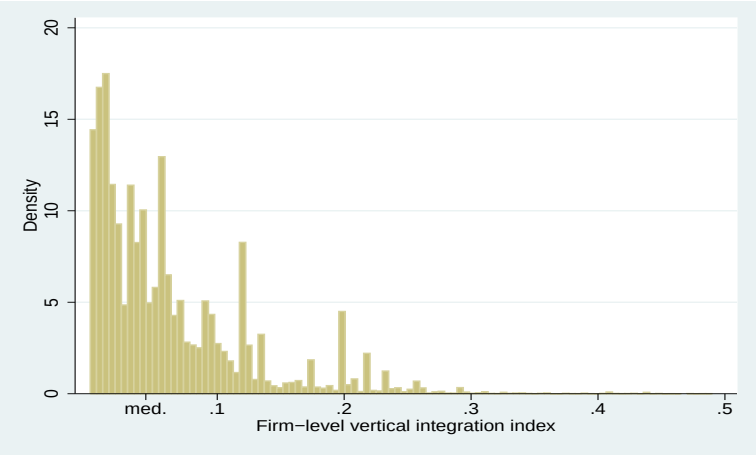
Summary statistics for firm-level vertical integration are presented in Appendix Table A-3, while Table A-4 reports average vertical integration indices by sector (at the 2-digit SIC level).[31] Table A-5 compares the firm-level vertical integration index across the different samples. Our

[29]It should be noted that this measure does not consider payments to capital and labor services and is thus always less than unity. Indeed, in the U.S. an industry pays on average around 56 % of gross output to intermediates, the rest being value added. Thus, even a fully vertically integrated firm in a typical sector would have an index of only 0.56.

[30]An alternative would be to measure actual intra-firm transactions for a large set of countries. A recent study by Hortaçsu and Syverson (2009) on U.S. firms combines Census data, the Commodity Flow Survey, and ZIP code information to measure intra-firm trade, finding that shipments from upstream units to downstream units are rather low. If shipments between different units of the same firms are indeed very limited, we could be overestimating the degree of vertical integration for multi-plant firms. This, however, does not represent a serious concern for our analysis, since most firms in our dataset have only one establishment (see Table A-3). Restricting the sample to single-plant firms yields qualitatively similar results, which are available upon request.

[31]Differences in methodology and samples restrict comparisons with AJM. However, the authors report a mean of 0.0487 and median of 0.0334 for their vertical integration index. For our main sample, the primary sector vertical integration index has a mean of 0.0627 and a median of 0.0437 (see Table A-3). The ordering of industries by degree of vertical integration in Table A-4 is also similar to that reported by AJM.

Figure 3: Firm-level vertical integration index



main sample consists of 196,586 domestic manufacturing firms with at least 20 employees located in 80 countries. The histogram in Figure 3 reports the distribution of vertical integration indices for all firms in our main sample. According to our measure, most firms produce relatively few inputs in house: the median vertical integration index is around 0.044 and the mean is 0.063.

3.4 Trade Policy

To empirically assess the impact of market prices on ownership structure, we use data on applied most-favored-nation (MFN) tariffs and on Regional Trade Agreements (RTAs), which offer a plausibly exogenous source of price variation to the boundaries of the firm. As argued in the introduction, ownership structure is unlikely to have a systematic impact on the determination of trade policies in general, and MFN tariffs in particular. These are negotiated at the multilateral level over long periods of time and are less "political" than unilateral forms of protection such as anti-dumping duties.[32] RTAs are regulated by GATT/WTO rules (GATT Article XXIV and the Enabling Clause) and are also likely to be independent of firms' organizational choices.

Tariffs

We collect applied MFN tariffs at the 4-digit SIC level for all WTO members for which this information is available. We restrict the set of countries to WTO members, because they are

[32]No theory relates firms' vertical integration decisions to the incentives to form a lobbying group. Even if one allows that lobbying can play a role in determining MFN tariffs, it is not obvious how the direction of the political pressure (pro or anti trade) and its extent (e.g., size of campaign contributions) could be systematically related to firms' organizational choices across a large set of countries and sectors. However, MFN tariffs may be correlated with other (omitted) variables associated with both firms' potential to lobby and the incentives to vertically integrate. For example, larger firms, which are more likely to vertically integrate, may be more effective at lobbying for protection (e.g., Mitra, 1999; Bombardini, 2008). For this reason, in our empirical analysis we control for firm size, industry concentration and other variables suggested by the literature.

constrained under Article I of the GATT by the MFN principle of non-discrimination: each country c must apply the same tariff t_k^c to all imports of good k that originate in other WTO member countries; preferential treatment is allowed only for imports that originate in RTA members or in developing countries.

The source for MFN tariffs is the World Integrated Trade Solution (WITS) database, which combines information from the UNCTAD TRAINS database (default data source) with the WTO integrated database (alternative data source). Tariffs are for 2004 unless unavailable for that year in which case the closest available data point in a five year window around 2004 (2002-2006) is chosen with priority given to earlier years.[33] The original classification for tariff data is the harmonized system (HS) 6-digit classification. Tariffs are converted to the more aggregate SIC 4-digit level using internal conversion tables of WITS. Here, SIC 4-digit level MFN tariffs are computed as simple averages over the HS 6 digit tariffs.

We also construct for each 4-digit SIC sector and every country the fraction of imports to which MFN tariffs apply using information on RTAs (see below) and subtracting from total sectoral imports those that originate in countries with which the importer has a common RTA. Bilateral import data at the 4-digit SIC level for 2004 are from the COMTRADE database.

RTAs

We collect information on RTAs in force in 2004 from the WTO Regional Trade Agreements Information System (RTA-IS).[34,35] The legal basis for the creation of RTAs can be found in GATT/WTO Article XXIV (for agreements involving developed member countries) and the Enabling Clause (for agreements among only developing countries). Under Article XXIV, member countries can form free trade areas (FTAs) or customs unions (CUs) covering "substantially all trade", that require complete duty elimination and fixed timetables for implementation. The conditions contained in the Enabling Clause being much less stringent, RTAs between developing member countries may effectively involve less trade liberalization. Thus we construct the dummy *RTA* that equals one whenever two countries belong to a common trade agreement formed under Article XXIV. This variable does not include a number of preferential trade agreements under the Enabling Clause that do not imply the full elimination of trade barriers. Alternatively, we construct separate dummy variables for customs unions and free trade agreements. We expect the former, which imply a common external tariff and no internal trade barriers, to have a stronger effect on organizational convergence than the latter, which permit member countries to maintain different external tariffs.

[33]For example, if data are available for 2003 and 2005, but not 2004, the 2003 data are chosen.

[34]Available online (http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx).

[35]Note that the dataset does not include trade preferences under the Generalized System of Preferences (GSP), such as the U.S. African Opportunity Act program or the E.U. Everything but Arms program.

3.5 Other Controls

We collect a number of country- and sector-specific variables to control for alternative factors emphasized in the literature on vertical integration.

In terms of country-specific variables, the empirical and theoretical literatures have studied the role of institutional characteristics and financial development.[36] We use the variable "rule of law" from Kaufmann, Kraay, and Mastruzzi (2003) as a measure of the *Legal quality* of a country's institutions. This is a weighted average of a number of variables (perception of incidences of crime, effectiveness and predictability of the judiciary, and enforceability of contracts) between 1997 and 1998. The variable ranges from 0 to 1 and is increasing in the quality of institutions. We also use private credit by deposit money banks and other financial institutions as a fraction of GDP in 2004 taken from Beck, Demigurc-Kunt, and Levine (2006) as a measure of a country's *Financial development*.

We also include different kinds of sector-specific variables, to proxy for exogenous variation in sector characteristics suggested by the literature, such as the severity of hold-up problems. First, we construct sectoral *Capital intensity* at the 4-digit-SIC level for the United States. Data comes from the NBER-CES manufacturing industry database (Bartelsmann and Gray, 2000). In line with the literature, capital intensity is defined as the log of total capital expenditure relative to value added averaged over the period 1993-1997. Second, we use Nunn's (2007) measure of *Relationship specificity*, which proxies for the severity of hold-up problems. For each sector in the U.S., this variable measures the fraction of inputs not sold on an organized exchange or reference priced. We convert the data for 1997 from the BEA's input-output classification to 4-digit U.S.-SIC.[37] Third, we follow Rajan and Zingales (1998) in constructing the variable *External dependence*, which measures (at the sectoral level, using the U.S. as a benchmark) the fraction of investment that cannot be financed with internal cash flows. The authors identify an industry's need for external finance (the difference between investment and cash generated from operations) under two assumptions: (i) that U.S. capital markets, especially for the large, listed firms they analyze, are relatively frictionless enabling us to identify an industry's technological demand for external finance; (ii) that such technological demands carry over to other countries. Following their methodology, we construct similar data for the period 1999-2006.[38] Finally, to control for domestic industry concentration, we construct *Herfindahl* indices for each country-

[36]Poor legal institutions may affect vertical integration decisions through their impact on the severity of hold-up problems. A sufficient level of financial development may be necessary for upstream and downstream firms to be able to integrate. As AJM note, the effect of each of these variables may be ambiguous when considered separately and there are more robust predictions of their combined effect.

[37]Nunn's dataset is available at http://www.economics.harvard.edu/faculty/nunn.

[38]An industry's external financial dependence is obtained by calculating the industry median of external financing of U.S. companies using data from Compustat calculated as: (Capex-Cashflow)/Capex, where Capex is defined as capital expenditures and Cashflow as cash flow from operations. Industries with negative external finance measures have cash flows that are higher than their capital expenditures.

sector using sales of all plants in that sector.[39]

In the regressions on organizational convergence, we also use a number of bilateral variables from CEPII: bilateral distance measured as the simple distance between the most populated cities (in km), dummies for contiguity, for common official or primary language, and common colonial relationship (current or past). In some specifications, we also use information on GDP for the year 2004 obtained from the World Development indicators 2008.

4 Tariffs and Vertical Integration

In this section, we assess the empirical validity of the main prediction of our theoretical model that higher tariffs lead to more vertical integration at the firm level. The section is divided in four parts. First, we exploit cross-sectional variation in applied MFN tariffs to verify whether trade policy affects firms' ownership structures in the way predicted by our model. Second, we report the results of a series of estimations aimed at verifying whether tariffs affect firms' ownership structure through their impact on product prices. Third, we exploit time-series variation in the degree of protection faced by firms, examining the organizational effects of China's accession to the WTO. Finally, we discuss the results of a series of additional robustness checks using different samples.

4.1 Cross-sectional evidence

To examine the organizational effects of trade policy, we first exploit variation in applied MFN tariffs across countries and sectors. We estimate the following panel regression model:

$$V_{f,k,c} = \alpha + \beta_1 Tariff_{k,c} + \beta_2 Employment_f + \beta_3 \mathbf{X}_{k,c} + \delta_k + \delta_c + \epsilon_{f,k,c}. \quad (8)$$

The dependent variable is the vertical integration index of firm f with primary sector k located in country c, as defined in (7). We take logs of (one plus) the vertical integration index to mitigate problems with outliers.[40]

Our main regressor of interest is the variable $\text{Tariff}_{k,c}$, which is the log of (one plus) the MFN tariff applied in sector k by country c.[41] Our model predicts that higher final good tariffs within

[39] These include sales by foreign-owned plants that operate in the given country-sector.

[40] Alternatively, we tried using as our dependent variable average vertical integration, $\overline{V}_{f,k,c} = \frac{1}{N_f} \sum_j V^j_{f,k,c}$, where N_f is the number of industries in which firm f is active. The results on tariffs are consistent, but somewhat less significant. This is not surprising, as our regressions consider the effects of MFN tariffs applied to a firms' primary activity not to all of its activities. We also used the log of the vertical integration index (removing zero observations) obtaining similar results. There are very few zeros in the dependent variable, so there is no need to perform a Tobit analysis. All results not shown due to space considerations are available upon request.

[41] Tariffs are expressed in ad-valorem terms. In the main specifications, we use log of (one plus MFN tariff) in order to be able to include zero tariffs. Although the distribution of tariffs is extremely skewed, log tariffs are approximately normally distributed. Using, in alternative specifications, the log of the tariff variable yields

an industry should lead firms in that industry to be more vertically integrated. We thus expect the coefficient β_1 to be positive.

The set of additional explanatory variables includes number of employees, $Employment_f$, which allows us to control for the relation between firm size and ownership structure.[42] Recall that our model predicts that more productive firms, as proxied by firm size, are more likely to be integrated for a given market price.[43] We thus expect the coefficient β_2 to be positive.

The vector $\mathbf{X}_{k,c}$ consists of different interactions between sector and country characteristics, previously suggested by papers on the determinants of vertical integration (e.g., interaction between a sector's *Capital intensity* and a country's level of *Financial development*). All variables are expressed in logs. We also include sector fixed effects at the 4-digit SIC level (δ_k), which allows us to capture cross-industry differences in technological or other determinants of vertical integration (e.g., a sector's *Capital intensity*). Finally, we add country fixed effects (δ_c), which capture cross-country differences in institutional determinants of vertical integration (e.g., a country's level of *Financial development* and the quality of its contracting institutions) and also control for country-specific differences in the way firms are sampled.[44] Given that tariffs vary only at the sector-country level, while the dependent variable varies at the firm level, we cluster standard errors at the sector-country level.

Table 1 reports the main results. Notice that, in all specifications, the estimated coefficient for the MFN tariff is positive and significant. Thus, consistently with the first prediction of our theoretical model, higher tariffs lead firms to be more vertically integrated. Column (1) presents the results of the basic specification, which includes the MFN tariff, firm size, and country and sector fixed effects. The estimate for β_1 implies that a 100 percent tariff increase leads to a 2.15 percent increase in the vertical integration index. In terms of economic magnitudes, this implies that an increase in manufacturing tariffs from 1 percent to their mean level of 4.85 percent (a 385 percent increase) increases vertical integration by 0.0215*385=8.28 percent.

Note that tariffs act as a proxy variable for domestic prices. Thus, the estimate for β_1 can be interpreted as the impact of prices on vertical integration if and only if prices and tariffs vary one to one. This would be true for a competitive economy that is small and imposes a specific tariff. In the case of ad-valorem tariffs, this relation would be weaker. If a country is large, i.e., can affect world prices, imposing a tariff will have an impact on the world price and the elasticity

similar results.

[42]Our dataset contains different numbers of firms from different countries. This variation in the selection of samples of 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). Controlling for firm size alleviates this problem.

[43]See, for example, Bernard, Jensen, Eaton, and Kortum (2003) for evidence on the close relationship between firm size and productivity.

[44]D&B samples establishments in the formal sector (and there are, of course, differences in the size of the formal sector across rich and poor countries). In the robustness checks, we try an alternative way to control for this by restricting the sample to countries for which we have at least 1,000 plants that are part of firms with at least 20 employees.

of domestic prices with respect to tariffs will also be less than one.[45] Moreover, if firms have market power, tariff will tend to have smaller effects on domestic prices (see Section 4.2). These arguments imply that the estimate for β_1 should be interpreted as a lower bound on the impact of prices on vertical integration. The true impact is likely to be substantially larger.

Turning to the effect of firm size on vertical integration, we find that, holding constant the domestic price level, larger firms are more vertically integrated. A 100 percent increase in employment leads to a 4.25 percent increase in the firm's level of vertical integration.[46]

In columns (2) and (3) we add different sets of controls to account for other determinants of vertical integration, as suggested by the literature. In column (2), we include two interaction terms, one between *Capital intensity* and *Financial development* and one between *Capital intensity* and *Legal quality*. Note that the tariff coefficient remains relatively unchanged and significant at the one-percent level. The estimate for the interaction term between *Capital intensity* and *Financial development* is also highly significant, indicating that more capital intensive sectors are more integrated in countries with more developed financial markets. The interaction term between *Capital intensity* and *Legal quality* has the expected negative sign but it is not significant. In column (3), we include two alternative interaction terms, one between *Relationship specificity* and *Legal quality* and one between *External dependence* and *Financial development*. Again, tariffs are positive and highly significant and the interaction terms insignificant.[47]

As mentioned above, the determination of MFN tariffs is arguably less political than other forms of protection (e.g., anti-dumping duties). Although there is no theory suggesting that vertically integrated firms should be particularly interested or able to obtain high levels of protection, one may worry that MFN tariffs could be correlated with omitted variables associated with firms' ownership structures. For example, larger firms, which are more likely to be vertically integrated, may be more effective at lobbying for protection, leading to higher MFN tariffs. The results discussed so far already control for firm size and unobserved industry and country

[45]Denote the domestic price of good k in country c as $p_{k,c} = (1 + t_{k,c})P_k$, where P_k is the world price of good k. Then $\frac{\partial p_{k,c}}{\partial t_{k,c}} \frac{t_{k,c}}{p_{k,c}} = \frac{t_{k,c}}{1+t_{k,c}} + \frac{\partial P_k}{\partial t_{k,c}} \frac{t_{k,c}}{P_k}$, where the first part on the right is the direct impact of an ad-valorem tariff on domestic prices (< 1) and the second term is the terms of trade effect (< 0). Notice also that, to the extent that countries are able to manipulate tariffs to improve their terms of trade, high tariffs are likely to be observed precisely in sectors in which they increase domestic prices only by a small amount. Broda, Limao and Weinstein (2008) provide evidence that non-WTO countries exploit their market power in trade by setting higher tariffs on goods that are supplied inelastically. Ludema and Mayda (2010) provide similar evidence for WTO countries.

[46]One may be concerned about endogeneity of firm size with respect to vertical integration, since the integration decision affects firm size. This could upward bias the coefficient of firm size and make all estimates inconsistent. To address this issue, we have instrumented firm employment with predicted employment that we obtain by regressing firm employment on a set of sector-country dummies. We find that the coefficient of employment increases to 0.675 for the basic specification (column 1), while the tariff coefficient remains unaffected – the estimate is 0.0222 and strongly significant. Estimates for the other specifications also remain the same and are omitted for the sake of space but are available on request. Thus, potential endogeneity of employment does not affect the tariff coefficient.

[47]These results are broadly consistent with the theoretical framework described by AJM. Their empirical analysis finds a significant negative effect of the interaction between *Capital intensity* and *Legal Quality*, but does not find a significant effect for the interaction between *Capital intensity* and *Financial development*.

characteristics. In addition, columns (4)-(6) in Table 1 include *Herfindahl* indices to control for the possibility that high industry concentration leads to both high tariffs and vertical integration. As seen in the table, point estimates for the tariff coefficient remain similar in terms of both magnitude and significance. The *Herfindahl* indices, however, are not significant.

4.2 Interactions with Sector Characteristics

Next, we discuss a series of additional estimations that we have performed to verify whether tariffs affect firms' ownership structure through their impact on product prices. The results of these estimations are presented in Table 2.

First, we would expect a tariff to have a larger impact on the domestic price of the importing country – and thus on firm organization – when the share of trade to which it applies is larger. To verify this, in column (1) we have added to our basic controls the variable *MFN share*, capturing the fraction of imports to which MFN tariffs apply in a given country and sector, and the interaction between this variable and the MFN tariff. The coefficient in the first row now measures the impact of tariffs when the *MFN share* is zero. Not surprisingly, this coefficient is non-significant, since in this case MFN tariffs should have no impact on the price faced by domestic firms. The interaction term is instead positive and significant at the one-percent level, indicating that the effect of MFN tariffs on vertical integration is positive and increasing in their importance for import volumes.[48]

In columns (2) and (3) we verify whether the effect of tariffs on firms' vertical integration is larger in more competitive industries. Indeed, there is a presumption that tariff pass-through should be larger when firms have no market power (see, for example, Helpman and Krugman (1989), Chapter 3). Broda, Limao and Weinstein (2007) provide empirical evidence on the relation between tariff pass-through on domestic prices and market power. They estimate import demand elasticities and find the implied pass-through to be significantly higher for commodities than for differentiated products (defined according to Rauch (1999)'s classification). Their findings imply that sectors with more homogeneous products should be characterized by higher import demand elasticities and larger tariff pass-through.[49]

In column (2), we interact our tariff variable with the import demand elasticities estimated by Broda, Greenfield, Weinstein (2006).[50] In particular, for each country and sector, we construct a dummy for *High import elasticity*, which is equal to one whenever the elasticity is above the median for the country. In this specification, the partial effect of MFN tariff is $\hat{\beta}_1 + \hat{\beta}_6 \times$ *High Import Elasticity*. The coefficient β_1 now measures the impact of MFN tariffs on vertical

[48] Evaluated at the mean *MFN share*, the effect of the MFN tariff is 0.0185, with a standard error of 0.006, and is significant at the one percent level.

[49] Similarly, Campa and Goldberg (2005) find a larger exchange rate pass-through for commodities than for differentiated products

[50] We thank David Weinstein for making this data available to us.

integration when the import elasticity is low. The coefficient is 0.019 and significant at the one percent level. The coefficient of MFN tariffs when the elasticity is high is $\hat{\beta}_1+\hat{\beta}_6 = 0.019+0.011 = 0.03$ and significantly (at the 5 percent level) larger than when the elasticity is low. Thus, tariffs have a stronger effect on firm organization in sectors in which products are more homogeneous.

Finally, as an alternative test for the relation between tariff pass-through and domestic market power, in column (3) we include an interaction between MFN tariffs and the *Herfindahl* indices we have constructed for each country-sector. In this specification, the partial effect of the tariff is $\hat{\beta}_1 + \hat{\beta}_8 \times$ *Herfindahl*, while the coefficient $\hat{\beta}_1$ now measures the impact of MFN tariffs on vertical integration when the concentration index is zero. Notice that $\hat{\beta}_1$ is now 0.0298 and significant at the one percent level; $\hat{\beta}_8$ is negative (-0.0480) and significant at the one percent level. This implies that tariffs have a smaller effect on vertical integration when the industry concentration index is high.[51] Therefore – as expected – tariffs have a stronger effect on the degree of firms' vertical integration in less concentrated sectors.

Specifications (4)-(6) simply repeat specifications (1)-(3), adding some additional controls emphasized by the literature on vertical integration (interactions a sector's capital intensity with a country's financial development and legal quality). These results confirm that tariffs have a larger effect on firm-level vertical integration precisely in those sectors in which tariff changes should lead to larger prices changes.

4.3 China's Accession to the WTO

As noted in the introduction, China's accession to the WTO in 2001 is arguably the only major trade liberalization episode that has occurred in the last decade, for which we can use D&B data to construct vertical integration measures. To be accepted as a member of the WTO, China agreed to undertake a series of important commitments to better integrate in the world economy and offer a more predictable environment for trade and foreign investment in accordance with WTO rules.[52] In particular, China had to substantially expand market access to goods from foreign countries, reducing its import tariffs from an average of 13.3 percent in 2001 to 6.8 percent by the end of the implementation period.[53]

Our identification strategy is based on the comparison of two periods, a pre-accession one and a post-accession one, to verify whether firm-level vertical integration was reduced by more in those sectors that experienced larger tariff cuts. We thus construct vertical integration measures for all Chinese manufacturing firms that are in the WorldBase dataset for the years 1999 (pre

[51] Evaluated at the mean of *Herfindahl*, the partial effect of tariffs is 0.023 with a standard error of 0.0057 and is significant at the one percent level. Note that in this specification also the direct effect of *Herfindahl*, $\hat{\beta}$, (which measures the effect of concentration on vertical integration when tariffs are zero) is positive and significant at the one percent level.

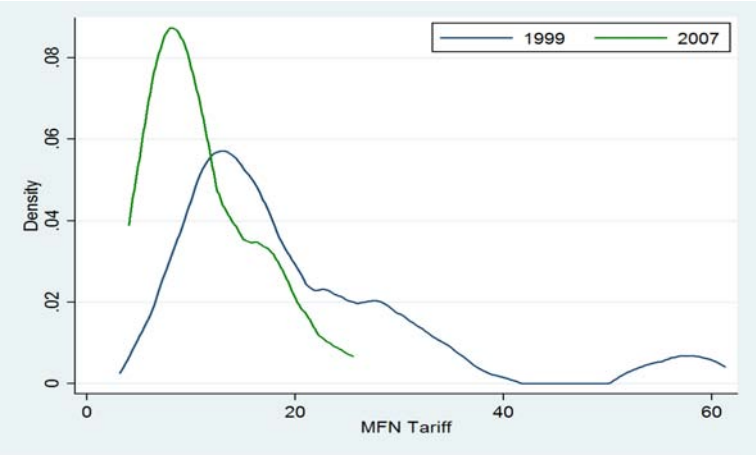
[52] A detailed list of China's commitments can be found in its Protocol of Accession. China's accession implied few trade policy changes for other WTO members, since most of them had already been granting it MFN status.

[53] The implementation period lasted until 2010, though most tariff reductions had to be completed by 2005.

accession) and 2007 (post accession), following the same procedure described in Section 3.3. We use 2007 instead of 2004 as the post-accession period because we expect firms' ownership structure to react slowly to price changes induced by tariff reductions.

Figure 4 provides the histograms of the MFN tariffs applied by China in 1999 and 2007. This is based on those manufacturing sectors for which we observe firms (with at least 20 employees, excluding multinationals) in both years, consisting of almost 29,000 firms that we observe in at least one year. For the sectors in this sample, applied tariffs fell from an average 20 to an average of 9.9 percent between 1999 and 2007, with a lot variation across sectors.[54] At the same time, the average level of vertical integration for the sample of firms declined from 0.111 to 0.084.

Figure 4: Chinese import tariffs, 1999 and 2007



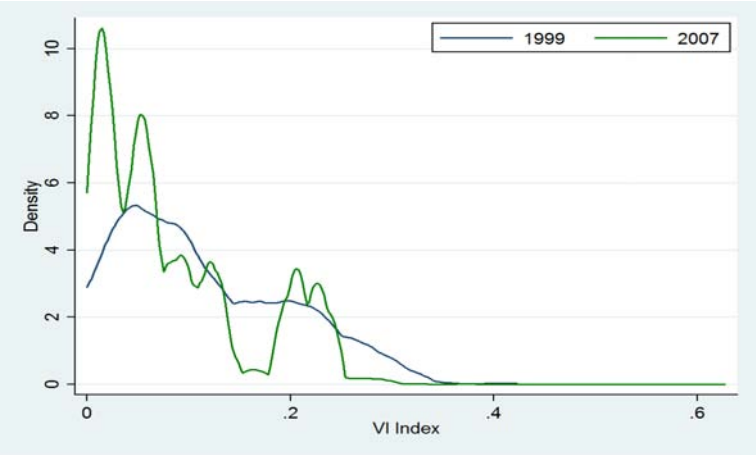
In what follows, we examine whether Chinese firms have adjusted their ownership structure following WTO accession. To this purpose, we run two sets of regressions. First, we use the same specification as in our main test (8), using only those sectors for which we observe some firms in both 1999 and in 2007:

$$V_{f,k,t} = \alpha + \beta_1 \mathit{Tariff}_{k,t} + \beta_2 \mathit{Employment}_{f,t} + \beta_3 \mathit{Herfindahl}_{k,t} + \delta_k + \delta_t + \epsilon_{f,k,t}. \quad (9)$$

We expect the coefficient of $\mathit{Tariff}_{k,t}$ to be positive. Notice that, by controlling for sector fixed effects, we exploit the time variation of tariffs within sectors. Specifically, the tariff coefficient is identified by the deviation of firm-level vertical integration from its sector mean that is due to the time variation in tariffs relative to their sector mean. Given that we only consider sectors for which we can observe firms in both periods, sector averages of vertical integration and tariffs are well identified. General trends in vertical integration, which may be due to other reforms

[54]The maximum reduction in tariffs was 415 percent (SIC 3578, Calculating and Accounting Machines), the median reduction was 51 percent. Only in a few sectors, tariffs did not change or actually increased (e.g., SIC 2084 Wines, Brandy and Brandy Spirits).

Figure 5: Chinese vertical integration indices, 1999 and 2007



that occurred in China over the sample period, are picked up by time dummies.[55]

In a second set of regressions, we focus on within-firm variation in VI indices. Unfortunately, the overlap between the firms sampled in 1999 and 2007 is small. Once we exclude multinationals and plants with less than 20 employees, as we have done in our earlier analysis, there are 144 firms that we can observe in both years. For this set of firms, we take time differences of equation (9) and estimate

$$\Delta V_{f,k} = \alpha + \beta_1 \Delta Tariff_k + \beta_2 \Delta Employment_f + \beta_3 \Delta Herfindahl_k + \beta_4 Privatization_k + \Delta \epsilon_{f,k}. \quad (10)$$

We expect the coefficient of ΔMFN_k to be positive. In these regressions, we control not only for changes in firm size and industry concentration, but also for changes in the degree of state ownership, by including the variable *Privatization*. This measures the fraction of government-owned firms that were privatized in a given sector (at the 2-digit industry level) between 1999 and 2004 and is taken from Bai, Lu and Tao (2009).

Table 3 presents the results for both sets of regressions. Columns (1)-(3) reports the results for the regressions with sector dummies. In all specifications, we find a positive and significant (at the one percent level) coefficient on the tariff variable, implying larger reductions in vertical integration in sectors that have experienced larger tariff reductions. The coefficient magnitude is around 0.03, which is slightly larger than our cross-section estimates. The coefficient on employment is also positive, significant and also similar to the cross-section results in terms of magnitude. Finally, the level of industry concentration has no significant effect on vertical integration.

Turning to the specification in differences, in columns (4)-(7) we obtain similar results. The

[55]In these regressions, unobserved firm-specific effects are implicitly assumed to be common for all firms in a given sector.

coefficient of tariff changes is always positive, significant and very similar in magnitude to the specification with sector dummies. In column (5) we add changes in firms' employment as control, which leaves the tariff coefficient unaffected. Column (6) adds *Privatization* as a control, which is insignificant and also leaves the coefficient of tariffs unchanged.[56] Finally, in column (7), we also control for changes in industry concentration by including a Herfindahl index, which further reduces sample size to 71 observations because information on sales is missing for some sectors. While changes in tariffs remain positive and significant, changes in industry concentration have no significant effect.

4.4 Robustness Checks

In the remainder of the section, we discuss the results of a series of additional estimations to verify the robustness of our results on tariffs and firms' vertical integration. The tables reporting these results are in the Appendix.

In a first set of regressions, we add multinational firms to the main sample. As noted above, because multinational firms have plants in different countries, the relevant product price for their organizational decisions and what tariffs might be distorting it is unclear. We thus split multinationals into separate entities by country and use the primary activity of the respective domestic ultimate to which a plant belonging to a multinational reports as the decisive price.[57] Table A-6 reports the results for specification (8) including multinationals. We find that the coefficient for MFN tariffs remains positive and strongly significant in all specifications.

We then repeat our main analysis for the sample of countries for which we observe at least 1,000 plants that are part of firms with at least 20 employees. Results for specification (8), presented in Table A-7, are almost unchanged. Point estimates for the tariff coefficient remain similar in magnitude, and the significance of the estimates is not affected by restricting the sample of countries.[58]

Our theoretical model predicts that a firm should be more integrated when the tariff on its *final* product is higher. Tables 1-A-7 provide strong empirical support for this prediction. One could be concerned, however, that these results may driven by input tariffs, which are often highly correlated with tariffs on final goods. To deal with this concern, we have run a series of additional estimations in which we have included input tariffs. We construct sector-country-specific input tariffs as weighted averages of 4-digit SIC applied MFN tariffs, using normalized

[56] As an alternative we have also used information on government ownership from World Base, which, however, is highly incomplete for 1999. Results are unaffected by using this alternative control.

[57] Note also that because multinationals are usually active in many sectors the primary SIC code of their global ultimate is not necessarily a good measure of their primary activity.

[58] In a series of additional regressions we used an alternative measure of vertical integration, constructed based on all the firm's activities rather than its primary activity: $\overline{V}_{f,k,c} = \frac{1}{N_f} \sum^j V^j_{f,k,c}$, where N_f is the number of industries in which firm f is active. The coefficients for MFN tariffs remained strongly significant but, not surprisingly, they dropped slightly in magnitude. The results of these regressions are available upon request.

IO-coefficients from the US input-output table as weights. We rerun all the versions of our main specification (8) that are reported in Table 1, adding log input tariffs or log one plus input tariffs as an additional control variable. In all specifications, our main result continues to hold, i.e., the higher the tariff on the final good produced by a firm, the more vertically integrated the firm is. The coefficient of final good tariffs is unaffected in size and remains significant at the one percent level.[59]

5 Trade Policy and Organizational Convergence

The purpose of this section is to assess the validity of the second prediction of our model on the relationship between cross-country differences in ownership structure and their trade policies. For each country, we construct an industry measure of vertical integration by estimating the following regression model:

$$V_{f,k,c} = \beta Employment_f + V_{k,c} + \epsilon_{f,c}. \tag{11}$$

The estimate for the sector-country dummy $\hat{V}_{k,c}$ gives us a measure of the average level of vertical integration of industry k in country c, controlling for the effect of firm size (employment) on the average level of vertical integration in that industry-country pair. All variables are expressed in logs.

5.1 Tariff Differences

We first examine whether cross-country differences in sectoral organizational structure are affected by differences in tariffs. Our model predicts that, for a given country-pair cc', organizational differences should be smaller for sectors characterized by similar levels of protection. To verify this, we estimate the following model:

$$|\hat{V}_{k,c} - \hat{V}_{k,c'}| = \alpha + \beta_1 |Tariff_{k,c} - Tariff_{k,c'}| + \beta_2 |\mathbf{X}_{k,c} - \mathbf{X}_{k,c'}| + \delta_k + \delta_{c,c'} + \epsilon_{k,c,c'}. \tag{12}$$

The dependent variable is the absolute difference between countries c and c' in the estimated vertical integration indices for sector k (from equation (11) above). All differences are expressed in logs. The main regressor of interest is the (log of the) absolute difference between these countries' MFN tariffs in sector k. The term $|\mathbf{X}_{k,c} - \mathbf{X}_{k,c'}|$ captures differences in other sector-country characteristics that may affect the degree of organizational convergence. Note that, because we are including dyad fixed effects ($\delta_{c,c'}$), β_1 is identified by the cross-sectoral variation

[59] The results of these estimations are available upon request. The coefficient on input tariffs is also positive and of similar magnitude as the one on final tariffs, but is only significant in some of the specifications.

in the tariff difference for a given country pair. To allow for correlation of the errors between sectors for a given country pair, we cluster standard errors by dyad.

In the first column of Table 4, the only explanatory variable is the log-difference in MFN tariffs. In line with our predictions, we find that, for a given country-pair differences in sectoral vertical integration indices are significantly (at the one percent level) larger in sectors in which differences in MFN tariffs are larger. A 100 percent increase in the difference in MFN tariffs leads to a roughly 0.9 percent increase in the difference in vertical integration indices.

The second column adds interactions between *Capital intensity* and differences in *Financial development* and *Legal quality*. The coefficient on the difference in MFN tariffs remains relatively unchanged in magnitude and is significant at the 5 percent level. The interaction term of *Capital intensity* with *Legal quality* is positive and strongly significant while the interaction term of *Capital intensity* with the difference in *Financial development* is positive but not significant. The third column includes, as alternative control variables, the difference in *Financial development* interacted with *External dependence*, and the difference in *Legal quality* interacted with *Relationship-dependence*. Whereas the coefficient on the difference in MFN tariffs is relatively higher and significant at the 5 percent level, both interaction terms are negative with the relation between *Legal quality* and *Relationship-dependence* variables being significant.

In the middle and right panel of Table 4, we report the results of robustness checks using different samples. As done for the results presented in Section 4, we first try adding multinationals to our main sample, and then restrict the sample to countries for which we observe at least 1,000 plants that are part of firms with at least 20 employees. Adding multinationals to the analysis, we find in columns (4)-(6) that the impact of tariff differences on differences in vertical integration remains positive and highly significant in all specifications. With respect to the results on organizational convergence when the sample size is restricted, tariff differences continue to have a significant positive effect on differences in vertical integration in all specifications, as can be seen from columns (7)-(9).

5.2 Regional Trade Agreements

In the remainder of this section, we examine the relation between the degree of sectoral organizational convergence and common membership in a regional trade agreement. In contrast to the previous regressions, a causal interpretation of these regression results is more difficult, since it is possible that countries that are generally more similar are more likely to form RTAs.

To assess the validity of our third empirical prediction, we explore how RTAs affect the extent to which two countries have similar vertical integration structures at the industry level.

$$|\hat{V}_{k,c} - \hat{V}_{k,c'}| = \alpha + \beta_1 RTA_{c,c'} + \beta_2 \mathbf{X}_{c,c'} + \delta_k + \delta_c + \delta_{c'} + \epsilon_{k,c,c'}. \tag{13}$$

The dependent variable is as in model (12), expressed as before in logs. The main regressor

of interest is now $RTA_{c,c'}$, a dummy that equals one if countries c and c' are members of the same RTA. The vector $\mathbf{X}_{c,c'}$ captures a series of bilateral controls, such as dummies for contiguity, common language, and colonial relationship, as well as variables that capture the distance between countries, and differences in GDP (differences expressed in logs of absolute values). Finally, we include sector fixed effects (δ_k) and country fixed effects (δ_c and $\delta_{c'}$). Standard errors are clustered by country-pair.

Table 5 presents the results for this regression. The left panel presents the estimates obtained when using our main sample. In the first column of the left panel, in which we include only a dummy for regional trade agreements, the coefficient of RTA is negative and significant at the one-percent level. This implies that the difference in vertical integration indices for a country pair in an RTA is about 9.2 percent smaller than for a country pair without an RTA. The results for an alternative specification, which separates customs unions (CUs) from free trade areas (FTAs), are presented in column two. As expected, the quantitative impact on organizational convergence is greater for CUs than for FTAs. Country pairs that belong to the same CU have a approximately 18.5% smaller difference in organizational structure than country pairs without a RTA, while membership to FTAs has no significant impact on differences in organizational structure. In the third column, we keep the coefficients for CUs and FTAs separate and add a series of bilateral control variables that may have an impact on similarity of organizational structure. The coefficient for CUs is reduced somewhat in size, but remains significant at the 10 percent level. Contiguity and common language have a significant negative effect on the difference in vertical integration indices, while differences in GDP have a significant positive effect. Colonial relationship and distance do not significantly affect the degree of organizational convergence.

The middle and right panels of Table 5 show that the results for regional trade agreements are also robust to using different samples. Membership in RTAs, and CUs in particular, continues to reduce differences in vertical integration among member countries when we include multinationals in our analysis, as shown in columns (4)-(6). The results continue to hold when we restrict the sample to the subset of countries for which we have more than 1000 observations, though the coefficient for CUs is insignificant in column (9), where we control for other country-pair variables. Note however, that in this case we have only 33 country pairs instead of 101.[60]

6 Conclusions

Traditional organizational economics has studied ownership decisions without much regard for markets. Given technology and contractibility, there is a uniquely optimal organizational design, the one that delivers the goods at least cost. Demand plays no role.

[60]Note that we have more countries (101 instead of 80) than in the tariff regressions. This is because tariff data are not available for some countries, whereas data on RTAs are.

This paper provides evidence for the more recent view that markets do matter and that demand is an essential determinant of firm boundaries. Demand affects product prices, prices affect profitability, and profitability affects the tradeoffs organization designers face when determining ownership structures. This causal link is captured by a model in which vertical integration generates more output than non-integration because of its comparative advantage in coordinating operating decisions. But it imposes higher private costs on enterprise managers, forcing them to accommodate to common ways of doing things. At low prices, the productivity gains from integrating have little value, and managers choose non-integration. At high prices, the relative value of coordination increases, favoring integration.

To assess the validity of the model's predictions, we examine the organizational effects of trade policy, which provides a source of price variation that is exogenous to firms' ownership decisions. We use a new dataset that enables us to construct firm-level vertical integration indices for a large set of countries. To study the link between product prices and firm boundaries, we exploit cross-country and cross-sectional differences in applied MFN tariffs, as well as time variation in the degree of protection faced by firms. In line with the model's predictions, we find that market conditions — in particular the level of product prices — do affect vertical integration: higher tariffs on final goods lead firms to be more vertically integrated, and this effect is stronger in sectors where product prices are expected to be more sensitive to tariffs.

Our empirical results thus lend support to a simple model of the determination of firm boundaries. As such, they have implications beyond the positive theory of the firm. If integration generates more output than non-integration, as it does in our model, then organizational choices affect consumer welfare and aggregate economic performance (Legros and Newman, 2009; Conconi, Legros and Newman, 2011). This calls for a reassessment of the effects not only of tariffs, but of any price-distorting policy, in light of its potential impact on the organization and productivity of firms.

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Table 1: Tariffs and Firm-Level Vertical Integration

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Tariff}_{k,c}$	0.0215***	0.0214***	0.0212***	0.0225***	0.0223***	0.0220***
	(0.0061)	(0.0059)	(0.0060)	(0.0060)	(0.0058)	(0.0059)
Employment_f	0.0425***	0.0425***	0.0425***	0.0442***	0.0442***	0.0442***
	(0.0045)	(0.0045)	(0.0045)	(0.0048)	(0.0048)	(0.0048)
$\text{Capital intensity}_k$ x $\text{Financial Development}_c$		0.0319**			0.0396**	
		(0.0147)			(0.0193)	
$\text{Capital intensity}_k$ x Legal Quality_c		-0.0837			-0.1030	
		(0.0580)			(0.0731)	
$\text{Relation Specificity}_k$ x Legal Quality_c			-0.0349			-0.0409
			(0.0296)			(0.0347)
$\text{External Dependence}_k$ x $\text{Financial Development}_c$			0.0000			-0.0001
			(0.0013)			(0.0017)
$\text{Herfindahl}_{k,c}$				0.0110	0.0113	0.0106
				(0.0231)	(0.0229)	(0.0230)
# Observations	196,586	196,586	196,586	178,199	178,199	178,199
# Sectors	386	386	386	386	386	386
R^2	0.122	0.122	0.122	0.123	0.123	0.123
Sector Fixed Effect	YES	YES	YES	YES	YES	YES
Country Fixed Effect	YES	YES	YES	YES	YES	YES
Cluster	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector

Notes: Robust standard errors in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log of one plus the vertical integration index of firm f, with primary sector k, located in country c. The sample includes firms ≥ 20 employees in the manufacturing sector, excluding MNCs.

Table 2: Tariffs and Firm-Level Vertical Integration, Interactions with Sector Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Tariff}_{k,c}$	0.0050	0.0191***	0.0298***	0.0058	0.0183***	0.0295***
	(0.0078)	(0.0062)	(0.0060)	(0.0080)	(0.0061)	(0.0059)
Employment_f	0.0426***	0.0429***	0.0442***	0.0426***	0.0429***	0.0441***
	(0.0045)	(0.0047)	(0.0048)	(0.0045)	(0.0046)	(0.0047)
$\text{MFN share}_{k,c}$	-0.017			-0.0148		
	(0.0198)			(0.0197)		
$\text{Tariff}_{k,c}$ x $\text{MFN share}_{k,c}$	0.0248***			0.0233***		
	(0.0073)			(0.0075)		
$\text{High import elasticity}_{k,c}$		-0.0239***			-0.0256***	
		(0.0081)			(0.0081)	
$\text{Tariff}_{k,c}$ x $\text{High import elasticity}_{k,c}$		0.0110**			0.0125***	
		(0.0046)			(0.0045)	
$\text{Herfindahl}_{k,c}$			0.0846***			0.0835***
			(0.0313)			(0.0312)
$\text{Tariff}_{k,c}$ x $\text{Herfindahl}_{k,c}$			-0.0480***			-0.0472***
			(0.0104)			(0.0103)
$\text{Capital Intensity}_k$ x $\text{Financial Development}_c$				0.0290*	0.0378***	0.0382*
				(0.0149)	(0.0141)	(0.0199)
$\text{Capital Intensity}_k$ x Legal Quality_c				-0.0733	-0.118**	-0.0957
				(0.0586)	(0.0545)	(0.0749)
# Observations	196,586	173,587	178,199	196,586	173,587	178,199
# Sectors	386	358	386	386	358	386
R^2	0.122	0.129	0.123	0.123	0.129	0.123
Sector Fixed Effect	YES	YES	YES	YES	YES	YES
Country Fixed Effect	YES	YES	YES	YES	YES	YES
Cluster	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log of one plus the vertical integration index of firm f, with primary sector k, located in country c. The sample includes firms ≥ 20 employment in the manufacturing sector, excluding MNCs.

Table 3: Tariffs and Firm-Level Vertical Integration, China's Accession to the WTO

	(1)	(2)	(3)	(4)	(5)	(6)	
	Vertical Integration			Change in Vertical Integration			
$\text{Tariff}_{k,t}$	0.0318***	0.0319***	0.0364**				
	(0.0095)	-0.0095	-0.0158				
$\text{Employment}_{f,t}$		0.00167***	0.00182***				
		(0.0003)	(0.0004)				
$\text{Herfindahl}_{k,t}$			-0.00361				
			(0.0112)				
Change Tariff_{k}				0.0343*	0.0344*	0.0346*	0.0433*
				(0.0204)	(0.0195)	(0.0197)	(0.0232)
$\text{Change Employment}_{f}$					-0.0002	-0.00024	-0.00152
					(0.0002)	(0.0071)	(0.0107)
Privatization_{k}						-0.035	0.0414
						(0.08)	(0.117)
$\text{Change Herfindahl}_{k}$							-0.0326
							(0.0314)
Observations	28,872	28,872	13,641	144	144	144	74
Sectors	88	88	88	88	88	88	88
R^2	0.921	0.922	0.903	0.039	0.039	0.04	0.082
Sector Fixed Effect	YES	YES	YES	NO	NO	NO	NO
Time Fixed Effect	YES	YES	YES	YES	YES	YES	YES
Cluster	Sector	Sector	Sector	Sector	Sector	Sector	Sector

Notes: Robust standard errors in parentheses denoting *** 1%, **5%, and *10% significance. In columns (1)- (3), the dependent variable is the log of one plus the vertical integration index of firm f, with primary sector k; in columns (4)-(6), it is the change in the log of one plus the vertical integration index between 1999 (pre accession) and 2007 (post accession). The sample includes Chinese firms observed in 1999 and 2007 $\geq$ 20 employees in the manufacturing sector, excluding MNCs.

Table 4: Tariff Differences and Organizational Convergence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Main Sample			Including Multinationals			Countries $\geqslant$ 1,000 plants	
Diff. Tariffs$_{k,c,c'}$	0.0089***	0.0086**	0.0095**	0.0199***	0.0208***	0.0217***	0.0091**	0.0070*	0.0087**
	(0.0034)	(0.0037)	(0.0037)	(0.0030)	(0.0034)	(0.0034)	(0.0040)	(0.0043)	(0.0043)
Cap. Intensity$_k$ x diff.		0.0020			0.0029			-0.0118	
Fin. Development$_{c,c'}$		(0.0066)			(0.0066)			(0.0075)	
Cap. Intensity$_k$ x diff.		0.0419***			0.0477***			0.0568***	
Legal Quality$_{k,c,c'}$		(0.0062)			(0.0063)			(0.0074)	
Ext. Dependence$_k$ x diff.			-0.0057			-0.00673***			-0.00582***
Fin. Development$_{c,c'}$			(0.0009)			(0.0008)			(0.0010)
Rel. Specificity$_k$ x diff.			-0.0553***			-0.0519***			-0.0650***
Legal Quality$_{c,c'}$			(0.0061)			(0.0061)			(0.0075)
# Observations	212,770	171,908	171,908	233,105	187,182	187,182	142,573	121,709	121,709
# Country pairs	80	80	80	80	80	80	33	33	33
R^2	0.164	0.164	0.165	0.146	0.147	0.148	0.171	0.172	0.172
Sector Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diadic Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair

Notes: Robust standard errors in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log of (one plus) the absolute difference between countries c and c' in the estimated vertical integration index of firms with primary sector k. In columns (1)-(3) the sample include firms $\geq$ 20 employees in the manufacturing sector, excluding MNCs; in columns (4)-(6), the sample includes MNCs; in columns (7)-(9), the sample includes firms $\geq$ 20 employment in the manufacturing sector, excluding MNCs, located in countries with at least 1,000 plants.

Table 5: Regional Trade Agreements and Organizational Convergence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Main Sample			Including Multinationals			Countries ≥ 1000 plants		
$RTA_{c,c'}$	-0.0921***			-0.0874***			-0.0474		
	(0.0235)			(0.0205)			(0.0299)		
Customs $Union_{c,c'}$		-0.185***	-0.0760*		-0.177***	-0.0748*		-0.127***	-0.0132
		(0.0376)	(0.046)		(0.0323)	(0.0396)		(0.0489)	(0.061)
Free Trade $Area_{c,c'}$		-0.0404	0.0203		-0.0356	0.0222		-0.00944	0.0531
		(0.0266)	(0.0264)		(0.0234)	(0.0236)		(0.032)	(0.0336)
$Contiguity_{c,c'}$			-0.196***			-0.155***			-0.237***
			(0.0754)			(0.0641)			(0.0852)
Common $Colony_{c,c'}$			0.0663			0.0631*			0.000
			(0.0421)			(0.0348)			(0.0746)
Common $Language_{c,c'}$			-0.119***			-0.109***			-0.159***
			(0.0313)			(0.0275)			(0.0433)
$Distance_{c,c'}$			0.0188			0.0220*			0.0145
			(0.0146)			(0.0129)			(0.0211)
Difference $GDP_{c,c'}$			0.0389***			0.0357***			0.0280**
			(0.0087)			(0.0074)			(0.0121)
# Observations	299,649	299,649	299,649	328,756	328,756	328,756	210,475	210,475	210,475
# Country pairs	101	101	101	101	101	33	33	33	33
R^2	0.109	0.109	0.111	0.09	0.091	0.093	0.118	0.119	0.122
Sector Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair	Country-pair

Notes: Robust standard errors in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log of (one plus) the absolute difference between countries c and c' in the estimated vertical integration index in the primary sector k. In columns (1)-(3), the sample includes firms ≥ 20 employees in the manufacturing sector, excluding MNCs; in columns (4)-(6), the sample includes MNCs; in columns (7)-(9), the sample includes firms ≥ 20 employment in the manufacturing sector, excluding MNCs, located in countries with at least 1,000 plants.

Appendix (not for publication)

Table A-1: Sample Frame

WB code	Freq.	Percent	Cum.	WB code	Freq.	Percent	Cum.
ALB	4	0.00	0.00	MAR	603	0.31	61.52
ARG	998	0.51	0.51	MDG	18	0.01	61.53
AUS	5,079	2.58	3.09	MEX	2,641	1.34	62.87
AUT	1,464	0.74	3.84	MLI	13	0.01	62.88
BEL	928	0.47	4.31	MOZ	16	0.01	62.89
BEN	4	0.00	4.31	MUS	46	0.02	62.91
BFA	8	0.00	4.32	MWI	2	0.00	62.91
BGD	6	0.00	4.32	MYS	3,101	1.58	64.49
BGR	360	0.18	4.50	NER	1	0.00	64.49
BOL	55	0.03	4.53	NIC	21	0.01	64.50
BRA	5,594	2.85	7.38	NLD	676	0.34	64.84
CAN	7,469	3.80	11.18	NOR	847	0.43	65.27
CHE	1,150	0.58	11.76	NZL	959	0.49	65.76
CHL	454	0.23	11.99	OMN	67	0.03	65.80
COL	550	0.28	12.27	PAK	4	0.00	65.80
CRI	176	0.09	12.36	PER	888	0.45	66.25
CZE	1,736	0.88	13.24	PHL	351	0.18	66.43
DEU	19,302	9.82	23.06	PNG	4	0.00	66.43
DNK	425	0.22	23.28	POL	446	0.23	66.66
ECU	183	0.09	23.37	PRT	5,433	2.76	69.42
ESP	2,322	1.18	24.55	PRY	50	0.03	69.45
FIN	448	0.23	24.78	ROM	614	0.31	69.76
FRA	8,965	4.56	29.34	RWA	2	0.00	69.76
GAB	3	0.00	29.34	SAU	314	0.16	69.92
GBR	6,622	3.37	32.71	SEN	47	0.02	69.94
GHA	81	0.04	32.75	SGP	790	0.40	70.35
GRC	2,231	1.13	33.89	SLV	129	0.07	70.41
GTM	93	0.05	33.93	SWE	689	0.35	70.76
HND	77	0.04	33.97	TGO	4	0.00	70.76
HUN	2,346	1.19	35.17	THA	507	0.26	71.02
IDN	233	0.12	35.29	TTO	79	0.04	71.06
IND	2,592	1.32	36.60	TUN	991	0.50	71.57
IRL	587	0.30	36.90	TUR	2,557	1.30	72.87
ISR	1,538	0.78	37.68	TZA	24	0.01	72.88
ITA	8,426	4.29	41.97	UGA	37	0.02	72.90
JAM	43	0.02	41.99	URY	114	0.06	72.96
JOR	148	0.08	42.07	USA	52,917	26.92	99.87
JPN	34,441	17.52	59.59	VEN	231	0.12	99.99
KEN	134	0.07	59.66	ZAF	1	0.00	99.99
KOR	3,060	1.56	61.21	ZMB	17	0.01	100.00
				Total	196,586	100.00	

Notes: Data from 2004 WorldBase data, Dun & Bradstreet. Sample includes firms $\geq$ 20 employees in the manufacturing sector, excluding MNCs.

Table A-2: Sample Frame: Restricted Sample

WB code	Freq.	Percent	Cum.
ARG	998	0.53	0.53
AUS	5,079	2.68	3.21
AUT	1,464	0.77	3.98
BEL	928	0.49	4.47
BRA	5,594	2.95	7.43
CAN	7,469	3.95	11.37
CHE	1,150	0.61	11.98
CZE	1,736	0.92	12.9
DEU	19,302	10.2	23.09
DNK	425	0.22	23.32
ESP	2,322	1.23	24.54
FIN	448	0.24	24.78
FRA	8,965	4.74	29.52
GBR	6,622	3.5	33.01
GRC	2,231	1.18	34.19
HUN	2,346	1.24	35.43
IND	2,592	1.37	36.8
IRL	587	0.31	37.11
ISR	1,538	0.81	37.92
ITA	8,426	4.45	42.37
JPN	34,441	18.19	60.56
KOR	3,060	1.62	62.18
MEX	2,641	1.39	63.58
MYS	3,101	1.64	65.21
NLD	676	0.36	65.57
NOR	847	0.45	66.02
NZL	959	0.51	66.52
PRT	5,433	2.87	69.39
SGP	790	0.42	69.81
SWE	689	0.36	70.18
TUN	991	0.52	70.7
TUR	2,557	1.35	72.05
USA	52,917	27.95	100
Total	189,324	100	

Notes: Data from 2004 WorldBase data, Dun & Bradstreet. Sample includes firms $\geq$ 20 employment in the manufacturing sector located in countries with at least 1000 plants, excluding MNCs.

Table A-3: Summary Statistics

	Median	Mean	Std. Dev.	N
Vertical Integration Index$_{f,k,c}$	0.044	0.063	0.063	196,586
Tariff$_{k,c}$	2.480	4.849	7.253	196,586
Employment$_f$	38.000	98.936	472.395	196,586
Herfindahl$_{k,c}$	0.053	0.132	0.188	196,586
Capital Intensity$_k$	-2.857	-2.902	0.458	387
Relationship Specificity$_k$	-0.456	-0.526	0.356	387
Financial Dependence$_k$	-0.756	-0.524	3.058	387
Financial Development$_c$	0.332	0.554	0.479	80
Legal Quality$_c$	0.545	0.583	0.209	80
Difference Ver. Int. Index$_{k,c,c'}$	-1.593	-1.707	1.614	299,649
Difference GDP$_{c,c'}$	0.450	0.201	1.812	299,649
Distance$_{c,c'}$	9.017	8.629	0.965	299,649
Regional Trade Agreement (RTA)$_{c,c'}$	0.000	0.263	0.440	299,649
Free Trade Agreement (FTA)$_{c,c'}$	0.000	0.148	0.355	299,649
Customs Union (CU)$_{c,c'}$	0.000	0.115	0.319	299,649
Contiguity$_{c,c'}$	0.000	0.041	0.139	299,649
Colonial Relationship$_{c,c'}$	0.000	0.020	0.178	299,649
Common Language$_{c,c'}$	0.000	0.122	0.328	299,649

Notes: Vertical integration indices, employment and Herfindahl constructed using plant-level data from 2004 WorldBase, Dun & Bradstreet. Tariff data from TRAINS/WTO. Information on regional trade agreements from WTO. Capital Intensity from NBER-CES manufacturing industry database. Relationship specificity from Nunn (2007). Financial dependence from Compustat, following Rajan and Zingales (1998). Financial development from Beck, Demigurc-Kunt and Levine (2006). Legal quality from Kaufmann, Kraay, and Mastruzzi (2004). GDP from World Bank. Contiguity, colonial relationship, and common language from CEPII. Vertical integration index, MFN tariffs, employment and Herfindahl are in levels; all other variables are in logs, with the exception of RTA, FTA, CU, contiguity, colonial relationship, and common language, which are indicator variables.

Table A-4: Vertical Integration by 2-digit SIC industry

Industry	SIC	VI index
TEXTILES	22	0.115
APPAREL	23	0.111
CHEMICALS	28	0.098
PRIMARY METAL PRODUCTS	33	0.091
ELECTRICAL MACHINERY	36	0.089
TRANSPORTATION EQUIPMENT	37	0.067
PETROLEUM REFINING	29	0.062
LEATHER	31	0.062
RUBBER AND PLASTICS	30	0.060
MACHINERY, EXCEPT ELECTRICAL	35	0.060
MANUFACTURING NEC	39	0.059
LUMBER AND WOOD PRODUCTS	24	0.059
FOOD AND KINDRED PRODUCTS	20	0.056
TOBACCO MANUFACTURES	21	0.053
STONE, CLAY, GLASS, & CONCRETE	32	0.049
FABRICATED METAL PRODUCTS	34	0.039
PRINTING AND PUBLISHING	27	0.039
SCIENTIFIC INSTRUMENTS	38	0.036
PAPER AND ALLIED PRODUCTS	26	0.034
FURNITURE AND FIXTURES	25	0.022

Notes: Data from 2004 WorldBase data, Dun & Bradstreet. Sample includes firms $\geq$ 20 employment in the manufacturing sector, excluding MNCs.

Table A-5: Sample Comparisons: Vertical Integration Indices

	Main sample	Excluding countries $<$ 1,000 plants	Including MNCs
# of plants	225,212	217,723	279,869
# of connected plants	29,214	29,008	64,789
# of connected firms	6,830	6,768	10,224
# of firms	196,586	189,324	215,286
# of MNCs	0	0	18,700
Mean, Vertical integration index	0.0627	0.0640	0.0640
Median, Vertical integration index	0.0437	0.0439	0.0439
Min, Vertical integration index	0.0000	0.0000	0.0000
Max, Vertical integration index	0.8333	0.8333	0.8333
St. dev., Vertical integration index	0.0633	0.0623	0.0645

Notes: Plant- and firm-level data from 2004 WorldBase data, Dun & Bradstreet. All samples include firms $\geq$ 20 employees in manufacturing sectors. Column (1) is the main sample; columns (2) and (3) are samples used in robustness checks.

Table A-6: Tariffs and Firm-Level Vertical Integration, Including Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Tariff}_{k,c}$	0.0182***	0.0179***	0.0179***	0.0193***	0.0190***	0.0189***
	(0.0061)	(0.0061)	(0.0061)	(0.0061))	(0.0060)	(0.0061)
Employment_f	0.0610***	0.0610***	0.0610***	0.0644***	0.0644***	0.0644***
	(0.0062)	(0.0062)	(0.0062)	(0.0061)	(0.0060)	(0.0061)
Multinational_f	-0.0238***	-0.0237***	-0.0239***	-0.0199**	-0.0198**	-0.0200**
	(0.0082)	(0.0082)	(0.0082)	(0.0089)	(0.0089)	(0.0089)
$\text{Capital Intensity}_k$ x $\text{Financial Development}_c$		0.0291*			0.0364*	
		(0.0149)			(0.0193)	
$\text{Capital Intensity}_k$ x Legal Quality_c		-0.0977*			-0.1180*	
		(0.0571)			(0.0706)	
$\text{Relation Specificity}_k$ x Legal Quality_c			-0.0224			-0.0303
			(0.0253)			(0.0308)
$\text{External Dependence}_k$ x $\text{Financial Development}_c$			-0.0006			-0.0006
			(0.0011)			(0.0015)
$\text{Herfindahl}_{k,c}$				0.0163	0.0169	0.0160
				(0.0227)	(0.0224)	(0.0226)
# Observations	215,286	215,286	215,286	193,938	193,938	193,938
# Sectors	386	386	386	386	386	386
R^2	0.117	0.118	0.117	0.119	0.119	0.119
Sector Fixed Effect	YES	YES	YES	YES	YES	YES
Country Fixed Effect	YES	YES	YES	YES	YES	YES
Cluster	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log one plus the vertical integration index of firm f, with primary sector k, located in country c. The sample includes firms $\geq$ 20 employment in the manufacturing sector, including MNCs.

Table A-7: Tariffs and Firm-Level Vertical Integration, Countries $\geq$ 1,000 plants

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Tariff}_{k,c}$	0.0214***	0.0212***	0.0213***	0.0228***	0.0225***	0.0227***
	(0.0059)	(0.0057)	(0.0060)	(0.0061)	(0.0058)	(0.0062)
Employment_f	0.0439***	0.0439***	0.0439***	0.0449***	0.0449***	0.0449***
	(0.0046)	(0.0046)	(0.0046)	(0.0048)	(0.0048)	(0.0048)
$\text{Capital Intensity}_k$ x $\text{Financial Development}_c$		0.0368**			0.0418**	
		(0.0174)			(0.0213)	
$\text{Capital Intensity}_k$ x Legal Quality_c		-0.0998			-0.111	
		(0.0742)			(0.0875)	
$\text{Relation Specificity}_k$ x Legal Quality_c			-0.0210			-0.0232
			(0.0379)			(0.0441)
$\text{External Dependence}_k$ x $\text{Financial Development}_c$			0.0011			0.0005
			(0.0016)			(0.0019)
$\text{Herfindahl}_{k,c}$				0.0089	0.0089	0.0087
				(0.0252)	(0.0250)	(0.0251)
# Observations	189,324	189,324	189,324	174,479	174,479	174,479
# Sectors	386	386	386	386	386	386
R^2	0.124	0.124	0.124	0.123	0.123	0.123
Sector Fixed Effect	YES	YES	YES	YES	YES	YES
Country Fixed Effect	YES	YES	YES	YES	YES	YES
Cluster	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector	Country-sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable: log of one plus the vertical integration index of firm f, with primary sector k, located in country c. The sample includes firms $\geq$ 20 employment in manufacturing sectors, excluding MNCs, located in countries with at least 1,000 plants.