Trade Policy and Firm Boundaries*

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Abstract

We examine how trade policy affects firms' organizational choices. We embed a model of firms' vertical integration decisions into a standard perfectly-competitive international trade framework. In the model, integration decisions are driven by a trade-off between the pecuniary benefits of coordinating production decisions and the managers' private benefits of operating in preferred ways. The price of output is a crucial determinant of this choice, since it affects the size of the pecuniary benefits: higher prices lead to more integration. Through its effect on product prices, trade policy also has an impact on firm boundaries. We use a unique dataset that allows us to construct firm-level indexes of vertical integration for a large set of countries. In line with the predictions of our model, we obtain three main results. First, higher tariffs lead to higher levels of vertical integration. Second, differences in ownership structure across countries, measured by the distance in sectoral vertical integration indexes, are smaller in sectors with similar levels of protection. Finally, ownership structures are more alike for members of regional trade agreements.

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1 Introduction

The boundaries of a firm mediate the way its employees trade off their private and collective goals. In a highly integrated firm with a single headquarters that owns many links in the supply chain, major production decisions can be well-coordinated to accomplish organizational goals such as profit, but can also impose high costs on subordinate managers. A less-integrated enterprise, with decision-making spread among several firm heads, may economize on private costs, but may also leave the decisions ill-coordinated, harming profit.

A vast theoretical literature has studied these and other trade-offs affecting the choice of firm boundaries, and of ownership and control structure more generally.[1] But it has largely left open the question of what determines how this trade-off is actually resolved in the market. Several recent papers have begun to address this question.[2] Market conditions are bound to affect the value of the enterprise's objective, the way its members make their trade-offs, and therefore the ownership structure that best mediates it. In particular, as pointed out by Legros and Newman (2009) and Conconi, Legros and Newman (2009), even in perfectly competitive environments there will be a systematic relationship between the boundaries of the firm and the equilibrium price level in the product market. In its starkest form, the prediction is that the higher the market price, the more integrated firms will be.

The reason for this predicted relationship is very simple. The primary decision makers—the "managers"—trade off their private benefits (doing things their way, or their view of the best way, or the easiest way) against the organizational goals (revenue, profit). When different parts of the organization are not integrated, managers make their decisions independently, taking significant account of their private benefits and rather less of the organization's, resulting in poor coordination. Integration puts the decisions in the hands of a single headquarters who has strong incentives to coordinate, maximizing the organizational objective at the expense of the other managers. Nonintegration therefore favors high private benefits and low coordination; integration generates high coordination but also high private costs. When organization value (market price) is high, this trade-off is made in favor of integration, since the organizational goal is relatively more valuable than the private ones; at low prices, the trade-off goes the other way, favoring nonintegration. Thus anything that affects equilibrium prices will have an indirect effect on the degree of integration.

Of course, in an industry composed of several enterprises facing this organizational design

[1] The "incomplete contracts" approach we follow begins with Grossman and Hart (1986) and Hart and Moore (1990), which emphasize the hold-up problem. The tradeoff we have delineated is the focus of Hart and Holmström (2009). What they have in common is that the firm's boundaries are identified with the extent of decision rights over assets and associated operations.

[2] Theoretical contributions include McLaren (2000) on hold-up and market thickness; Legros and Newman (2008) on control structures and the terms of trade in supplier markets; and Marin and Verdier (2008) on delegation and product demand elasticity. Another literature has examined the question of whether goods are sold within or across firm boundaries in the global economy. See, for example, Antras (2003), Antras and Helpman (2004), and Helpman (2006) for an overview.

trade-off, the market price will depend on the choices of ownership structure made by all the enterprises: if integration is more productive, and all enterprises integrate, prices will be lower. Market-clearing equilibrium in the product market will jointly determine quantity, price *and* ownership structures. What these models show is that the increasing relationship between integration and price that pertains to a single price-taking firm will also obtain for the relationship between the average degree of integration in the industry and the *equilibrium* price level.

Trade policy provides a natural proving ground for examining the effects of prices on organization, since it generates a plausibly exogenous source of equilibrium price variation: the degree of trade protection will obviously affect equilibrium prices, but, we shall argue, is likely to be independent of firms' boundary choices. The first-order effect of the imposition of a tariff on an import-competing good is to raise its price. Thus, all else equal, the higher the tariff, the more integrated firms in the industry should be.[3] By the same token, if tariffs in the same industry in two countries are close, equilibrium prices and their ownership structures should be similar. Thus the theory predicts convergence in ownership structure between countries with similar levels of protection. Moreover, if two countries are members of a regional trade agreement in which internal tariffs have been completely eliminated, all else equal, firms in those two economies should be equally integrated.

Empirical analysis on the effects of trade policy on organizational choices—discussed below—has been limited, largely by the absence of an international dataset sufficiently comprehensive to support studies of firm organization across a wide range of countries. We overcome this limitation by using a new dataset from Dun and Bradstreet (D&B). This contains both listed and unlisted plant-level observations in more than 200 countries for 2004. The data include ownership information about the firm's family members (number of family members, its domestic parent and its global parent) to link multi-plant firms. The dataset enables us to study the differential effects of trade policies on firms' organization structure. Over the last decades, barriers to trade have fallen in developed countries and diminished considerably in many developing countries. Despite the recent trends, restrictions to trade are still quantitatively important for many countries and sectors, allowing for comparative analysis.

In order to explore the predictions of our theory, we combine the D&B dataset with U.S. input-output tables to construct measures of vertical integration at the firm level. These indexes represent the opportunity for vertical integration between related industries.[4] Despite its limitations, this methodology allows us to analyze a large set of countries and industries, thus

[3] This statement 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.

[4] We build on the methodology of Acemoglu, Johnson and Mitton (2008), who use the 1992 U.S. input-output tables to calculate the opportunity for vertical integration for every pair of industries, by computing the dollar value of one industry required to produce a dollar's worth of the other industry. They then combine this information with data from WorldBase for the year 2002, to construct measures of vertical integration. Section 3.3 describes in detail the empirical methodology.

overcoming an important constraint in the literature (we also do not have to worry about the value of intra-firm activities being affected by transfer pricing).

We obtain data on applied most favored nation (MFN) tariffs at the 4 digit SIC level for all the WTO members for which this information is available. We also collect systematic information on all regional trade agreements (RTAs) that were in force in 2004. In order to account for various alternative factors that affect vertical integration that have been emphasized in the literature, we control for a number of country- and sector-specific variables (rule of law, financial development, capital intensity, relationship-dependence, external credit dependence).[5] We also use number of bilateral variables (distance, common border, common colonial relationship, as well as income and income per capita).

We first examine the relation between tariffs and organizational structure. Consistent with the predictions of our theoretical model, we find that higher tariffs 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 1.44 percent increase in the vertical integration index; this implies that reducing tariffs from their mean level of 5.4 percent to 1 percent reduces vertical integration by over 6 percent. Our results are robust to different specifications and subsamples.

The theoretical framework also suggests that trade policy should affect the degree of organizational convergence across countries through its effect on prices. That is, convergence in corporate organization, i.e., a tendency of industries to be characterized by the same ownership structure across countries, may not only result from global cultural transmission or technological diffusion, but also from standard neoclassical market forces, namely the law of one price (see also Conconi, Legros and Newman, 2009). In line with our predictions, we find that for a given country-pair differences in sectoral vertical integration indexes are significantly (at least at the 5 percent level) larger in those sectors in which differences in MFN-tariffs are larger.

We then examine the relation between the degree of sectoral organizational convergence and common membership in a RTA. Our theoretical model suggests that, everything else equal, full liberalization of product markets between two countries should result in the convergence of firms' ownership structure within industries. Our empirical results show that ownership structures are indeed more alike for members of RTAs. The impact on organizational convergence is stronger for older trade agreements, which are more likely to have fully eliminated trade barriers among member countries. As it is possible that countries that are more similar are also more likely to form a RTA, we use a number of controls for common relationship. We find the difference in vertical integration indexes to be around 13 percent smaller in country pairs engaged in a RTA than for a country pair without one.

As mentioned above, our empirical analysis relies on exogenous price variation induced by

[5]See e.g., Acemoglu, Aghion, Griffith, and Zilibotti (2009), Acemoglu, Johnson, and Mitton (2009), Legros and Newman (2008), McMillian and Woodruff (1999), and Rajan and Zingales (1998).

trade policy. In particular, we exploit the cross-country and cross-sectoral variation in MFN tariffs and the existence of regional trade agreements. MFN tariffs are negotiated at the GATT/WTO level over long periods of time and, as stressed by a vast political economy literature starting from the seminal paper by Finger, Hall and Nelson (1984), they are less "political" than unilateral trade barriers: protectionist pressure is usually applied to administrative measures for the regulation of imports (e.g., safeguards, anti-dumping and countervailing duties).[6] Regional trade agreements, such as free trade areas or customs unions, are also negotiated over long periods of time and regulated by GATT/WTO rules. Previous papers in the literature take RTAs as being exogenous to firms' decisions. See, for example, Trefler (2004) on the impact of the Canada-U.S. Free Trade Agreement (CUSFTA) on industry- and plant-level labor productivity, and Bustos (2009) on the impact of the Southern Common Market (MERCOSUR) on technology upgrading by Argentinean firms.

Our paper contributes to an emerging literature on general equilibrium models with endogenous organizations, and in particular to a nascent stream of the empirical work examining firms' organizational choices in a global economy. Acemoglu, Johnson, and Mitton (2009) (henceforth AJM) study the determinants of vertical integration using data from D&B in 93 countries. The authors find no evidence that contracting costs and financial development have significant effects on vertical integration. However, they find greater vertical integration in countries that have both greater contracting costs and greater financial development. They also find that countries with greater contracting costs are more vertically integrated in more capital-intensive industries. Acemoglu, Aghion, Griffith, and Zilibotti (2009) use detailed data on all British manufacturing plants from the UK Census of Production combined with input-output tables to study the determinants of backward vertical integration. Bloom, Sadun and Van Reenen (2009) study decentralization patterns in US, Europe, and Asia and find social capital variables and competition to be associated with more decentralization.

Guadalupe and Wulf (2009) investigate the effect of the 1989 CUSFTA agreement, which eliminated tariffs and other barriers between the U.S. and Canada, on hierarchies in large US firms. The authors find that competition leads firms to flatten their hierarchies. Breinlich (2008) also reveals a significant increase in the level of M&A activity in Canada (but not the U.S.) following CUSFTA. Other studies have stressed the impact of trade liberalization on the reallocation of resources across individual plants and firms (see Goldberg and Pavcnik (2004) for an overview) or in work practices (Schmitz, 2005).

Another strand of the literature has focused on how organizational design can explain the

[6] Indeed, most papers in the empirical political economy literature focus on unilateral protectionist measures. For example, Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) use data on 1983 non-tariff barrier (NTB) coverage ratios for the U.S. manufacturing sector to test the lobbying model by Grossman and Helpman (1994). Some studies find that firm size and industry concentration affect U.S. non-tariff barriers through their impact on lobbying contributions (e.g., Mitra, 1999; Bombardini, 2008). In our empirical analysis, we control for firm size. We also argue that firms' ownership structures are unlikely to have a systematic impact on trade policy in general, and on MFN tariffs in particular.

observed patterns of intra-firm trade and the location of multinational subsidiaries or suppliers (Antras, 2003; Antras and Helpman, 2004; and Grossman and Helpman, 2004). Ornelas and Turner (2008) examine how trade policy affects hold-up problems through its effect on a foreign supplier's investment incentives.

The paper is organized as follows. Section 2 presents the theoretical framework and discusses the empirical implication or our model. Section 3 describes our data and the methodology to construct vertical integration indexes. Section 4 presents and discusses the results on tariffs and vertical integration. Section 5 analyzes the effect of trade policy (tariffs and RTAs) on the degree of organization convergence within sectors across countries. Section 6 analyzes the robustness of the results. The last section concludes.

2 The Model

Our model is similar to a standard specific-factor trade model between many small countries, in which trade is the result of differences in the endowments of specific factors. We will first describe its building blocks in its closed-economy form, before looking at international trade and at the effects of trade policy.

2.1 Setup

In each economy, there are $K+1$ sectors/goods, denoted by 0 and $k = 1, \ldots, K$; good 0 is a numeraire. The representative consumer's utility (which is the same in Home and Foreign) can be written as

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

where c_0 represents the consumption of the numeraire good, and c_k represents consumption 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 of its own price alone, $D_k(p_k)$.

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 by contrast 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 firms may represent light assembly plants or some basic inputs, such as energy or various business services (e.g., IT, retailing, logistics), which can be used to produce basic consumer goods or can be combined with other inputs (B_k suppliers) to produce more complex goods.

All goods are sold under conditions of perfect competition. Good 0 is the numeraire, with price equal to 1. We assume that aggregate supply of A's exceeds that of the B_k's so that a positive amount of good 0 is produced in equilibrium.

So far, we have described a standard specific-factor model, in which A supplier firms represent the mobile factor, while B_k firms are the specific factor of production. As discussed below, the crucial novelty of our model is that production inputs are run by managers, who trade off the pecuniary benefits of coordinating their decisions with the private benefits of making these decisions in their preferred way.

An equilibrium in the supplier market consists of matches between each B_k firm and an A firm, along with a surplus allocation among all the managers. Such an allocation must be stable, in the sense that no (A, B_k) pair can form an enterprise that generates payoffs to each manager that exceed their equilibrium levels.

All A suppliers are equally productive both 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 outside option for all A's.

Individual firms

Our model of the firm relies on two key features. First, managers in each firm enjoy monetary profits as well as private non-transferable benefits associated with the operations of the firm; different managers view these operations differently and so their private benefits come into conflict. 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_i suppliers. Second, some firm decisions (e.g., choosing production techniques, deciding on marketing campaigns, etc.) cannot be agreed upon contractually; only the right to make them can be transferred through transfers of ownership.

Consider a firm composed of an A and a B_k. For each supplier, a non-contractible decision is rendered indicating the way in which production is to be carried out. Denote the A and B_k decisions respectively by $a \in [0, 1]$ and $b_k \in [0, 1]$. For efficient production, it does not matter which particular decisions are chosen, as long as there is 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 firms.

Overseeing each supplier firm is a risk-neutral manager, who bears a private cost of the decision made in his unit. The A manager's utility is $y_A - (1 - a)^2$, while the B_k manager's utility 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 the costs. Observe that A's most preferred action is 1, while B_k's is 0, so the managers disagree about the direction in which decisions should go. Since the primary function of managers is to implement decisions and convince their units to agree, they continue to bear the cost of decisions even if they don't make them.

While decisions themselves are not contractible, the *right to make them* can be contractually reassigned (e.g. via a sale of assets). This assignment of decision rights is the organizational design problem in this model. Managers can remain *non-integrated*, in which case they retain control over their respective decisions. Alternatively, they can *integrate* by engaging a headquarters (HQ), transferring to it the power to decide a and b_k and a share of the realized revenue in exchange for a fixed payment. HQ is motivated only by monetary considerations, and incurs no costs from the decisions a and b_k; it will therefore wish to maximize the income of the integrated firm.

Before production, B_k managers match with A managers, at which time they sign contracts specifying an ownership structure and a payment scheme. For simplicity, we assume that this is accomplished via a fixed payment T from the B_k to the A.[7]

For each match (A,B_k), total revenue in case of success is given by R times the product market price, p_k, which is taken as given by firms when they take their decisions and sign their contracts. Since the A's are in excess supply, they must all receive α in equilibrium. Thus T will just cover A's anticipated private cost incurred during production together with his opportunity cost α.

After contract signing, managers (or HQ) make their production decisions, output is realized, product is sold, and 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, HQ's continuation payoff is proportional to $(1 - (a - b_k)^2)Rp_k$.[8] HQ decides both a and b_k, and since its incentive is to maximize the expected revenue of the integrated firm, it chooses $a = b_k$. Among the choices in which $a = b_k$, the Pareto-dominant one is that in which $a = b_k = 1/2$, and we assume HQ implements this choice. The private cost to each supplier 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, each manager retains control of his activity. The decisions chosen are the (unique) Nash equilibrium of the game with payoffs $T - (1 - a)^2$ for A, who chooses a, and

[7] In general, the B_k may prefer to give the 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).

[8] Technically, the size of this share is indeterminate and could be pinned down in many ways that we do not model here; all that matters for our purposes is that it is positive.

$(1-(a-b_k)^2)\, Rp_k - b_k^2 - T$ for B_k, who chooses b_k. These 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 the price: as p_k becomes larger, the revenue motive becomes more important for B_k managers and this pushes them to better coordinate with their A partners. The equilibrium transfer under non-integration is $T = \alpha$, and the payoffs are α for the A's and $\frac{(Rp_k)^2}{1+Rp_k} - \alpha$ for the B_k's.

Choice of organizational form

To determine the choice of organization that the managers make, we must compare their payoffs under integration and non-integration. Notice that A suppliers obtain α in both cases. 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, despite integration's better output performance, revenues are still small enough that the B_k managers are more concerned with their private benefits and so remain non-integrated. At higher prices, B_k managers prefer integration, which allows them to achieve coordination at lower private costs.

Product market equilibrium and the OAS curve

Equilibrium for the economy comprises a general equilibrium of the supplier and product markets. We have already characterized the supplier markets, with every B_k matched to an A, who receives α, and some A's standing in alone and producing α of the numeraire.

In product market k, the large number of firms implies that with probability one, the supply is equal to the expected value of output given p_k; equilibrium requires that this price adjust so that the demand equals the 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 $R > 1/p_k$ integrate, while the remaining ones remain non-integrated, total supply at price $p_k \in [1/\overline{R}, 1/\underline{R}]$ is (recall n_k is the measure of B_k suppliers)

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

(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.)

This "Organizationally Augmented Supply" (OAS) curve incorporates the ownership structure decisions of the industry's enterprises as well as the usual price-quantity relationship. When $p_k < 1/\overline{R}$, no firm is integrated, but supply increases with price, since every non-integrated firm's expected output does. As price rises above $1/\overline{R}$, the most productive enterprises integrate, and those that remain non-integrated produce more, so that output rises further. Once p_k reaches $1/\underline{R}$, all firms are integrated, and industry output is fixed at n_k (since the mean R is 1) for prices higher than that threshold.

In the absence of trade, an equilibrium in the product market of good k is a price and a quantity that equate supply and demand: $D_k(p_k) = S(p_k)$. The degree of integration of the industry (i.e. the fraction $1 - G(1/p_k)$ of firms that integrate) is a nondecreasing function of the equilibrium price, strictly increasing on $[\underline{R}, \overline{R}]$.

2.2 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 $k = 1, \ldots, K$. 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 of countries that are relatively more endowed in the specific factors necessary to produce goods $k \in \{m+1, \ldots, K\}$; and a "Foreign" set of countries (denoted with a "*") that are relatively more endowed in the specific factors necessary to produce goods $k \in \{1, \ldots, m\}$. We thus have that $n_k < n_k^*$ 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 domestic price of good 0 in each country are equal to 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 to $p_k^{c*} = P_k$ 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 $X_k^{c*} = S(P_k) - D(P_k)$ denotes Foreign exports. For goods $k \in \{m+1, \ldots, K\}$ the market-clearing condition is given by

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

From (3) and (4) we can derive an expression for international equilibrium prices as a function of the tariffs applied by all countries, i.e., $P_k(\mathbf{t_k^c})$ for $k \in \{1, \ldots, m\}$, and $P_k(\mathbf{t_k^{c*}})$ for $k \in \{m+1, \ldots, K\}$.

The trade balance condition for a Home country requires

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

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

In our model, trade policies have an effect on organizational choices through their impact on product prices. In particular, our analysis of the OAS implies that an increase in t_k^c leads to an increase in the domestic price of good k; a firm with productivity R will choose integration over nonintegration if this price exceeds $1/R$. Comparing two otherwise identical Home countries c and c', with $t_k^c > t_k^{c'}$, the domestic price and therefore degree of integration in industry k will be higher in c than in c'.

Our theoretical framework 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 the degree of integration within a sector k will depend on the differences in their applied tariffs: the more similar are 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 c, c' that has signed a RTA, eliminating all tariffs between each other. This implies that their domestic prices will be equal in all sectors, leading to full convergence in organizational choices.

For the purpose of our empirical analysis, we can reformulate the predictions of our theoretical model as follows:

1. Higher tariffs lead to a higher degree of vertical integration within sectors.

2. Country pairs have more similar ownership structures in sectors with closer levels of protection.

3. RTAs lead to organizational convergence among member countries.

3 Data and Descriptive Statistics

3.1 The WorldBase Database

We use data from WorldBase, a database of public and private plant-level observations in more than 200 countries and territories compiled by Dun & Bradstreet (D&B) for 2004.[9] The leading U.S. source of commercial credit and marketing information since approximately 1845, D&B presently operates in the 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™, Risk Management Solutions™, Sales & Marketing Solutions™, and Supply Management Solutions™. These products provide information about the "activities,

[9]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.

decision makers, finances, operations and markets" of the potential customers, competitors and suppliers to the clients of D&B. D&B compiles their data from a wide range of sources. Sources include partner firms in dozens of countries, telephone directory records, websites, and self-registering firms. All information is verified centrally via a variety of manual and automated checks.

Early uses of the D&B data include Caves' (1975) size and diversification pattern comparisons between Canadian and U.S. domestic plants as well as subsidiaries of U.S. multinationals in Canada, and Lipsey's (1978) comparisons of the D&B data with existing sources and observations regarding the reliability of the data for U.S. More recently, Harrison, Love, and McMillian (2004) use D&B's cross-country foreign ownership information. Other research that has used D&B data includes Black and Strahan's (2002) study of entrepreneurial activity in the United States, and 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.

In our view, D&B's WorldBase, while not without problems, is the best database to analyze our question. In particular it has four main advantages over most other sources. First, the data include public and private plants and information to aggregate plants to the firm level. Second, data sources restricted to Europe such as Amadeus are not useful for our purposes because they do not have broad coverage of countries and in particular of developing countries, with different levels of trade barriers. WorldBase by contrast has data in more than 200 countries and territories. Third, Dun & Bradstreet compile their data from a wide range of sources, whereas other databases collect primarily from national firm registries. All information is verified centrally via a variety of manual and automated checks. The wide variety of sources from which Dun & Bradstreet 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 reliability of their dataset.[10]

[10] See Alfaro and Charlton (2009) for a more detailed discussion of the WorldBase data and comparisons with other data sources. To give some sense of the coverage of the Dun & Bradstreet sample used in this study, we compare our data with that collected by the U.S. Census Bureau, Statistics of U.S. Businesses. The U.S. 2001-2002 business census recorded 24,846,832 establishments. Our data include 6,185,542 establishments (from which we exclude establishments in the total sample without the year started). About three quarters of all U.S. establishments have no payroll. Most are self-employed persons operating unincorporated businesses that might or might not be the owner's principal source of income. The U.S. census records 7,200,770 'employer establishments' with total sales of $22 trillion. Our data include 4,293,886 establishments with more than one employee with total sales of $17 trillion. The U.S. census records 3.7 million small employer establishments (fewer than 10 employees). Our data include 3.2 million U.S. firms with more than one and fewer than 10 employees. In our data, 6.1 percent of establishments are new (we define as new an establishment having a year started date less than two years previous). The U.S. Census reported 12.4 percent of establishments to be new in 2001-2002, for firms with 1-4 employees this was 15.9 percent, for firms with more than 500 employees 11 percent. Comparison by sectors (excluding a number of individual industries, such as religious organizations, certain government-owned establishments and others which are hard to map given the different classification or compare) show similar patterns.

3.2 The Sample

We use data from the 2004 WorldBase file excluding records lacking primary industry and year started (these restrictions were imposed by cost considerations) for a total of more than 24 million observations. The unit of observation in WorldBase is the establishment (a single physical location where 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. The data base allows linking plants to firms by using information on its domestic parent and its global parent using the DUNS numbers. Our analysis is at the firm level, that is, we consider all plants connected by the same global or domestic parent as one unit (see discussion below).

The paper uses four categories of data which WorldBase record 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 up to 5 secondary industries, listed in descending order of importance.[11]

2. Ownership information: information about the firm's family members (number of family members, its domestic parent and its global parent).[12]

3. Location information including the country, state, city, and street address of each family member. We use the country location information to link establishments within a family to the relevant tariff data.

4. Basic operational information: sales and employment.

We excluded 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 discussion below). As a robustness check, we also exclude countries for which we have less than 1000 plants that are part of firms with at least 20 employees (see also Klapper, Laeven and Rajan, 2006).

We focus on manufacturing firms (i.e., firms with a primary SIC code between 2000 and 3999), to which our theory of vertical integration fits best. We exclude government/public sector firms, firms in the service sector (for which we have no tariff data) or in agriculture (due

[11] 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. In 1963, the firm introduced the Data Universal Numbering System—The D&B D-U-N-S Number—used to identify businesses numerically for data-processing purposes. The system supports the linking of plants and firms across countries and tracking of the history of plants including potential name changes.

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

to the existence of many non-tariff barriers), as well as firms producing primary commodities (i.e., mining and oil and gas extraction).

We exclude firms with less than 20 employees, since our theory does not apply to self-employment or to very small firms with little prospect of vertical integration (see also Acemoglu, Aghion, Griffith, and Zilibotti, 2009).[13]

In the main analysis, we exclude multinationals, i.e., firms with plants in more than one country. Theoretically and empirically, multinationals pose the challenge of identifying the relevant prices and tariffs (potentially magnified by issues of transfer pricing). 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. We defined MNCs firms as those foreign-owned establishments belonging to the same global ultimate.[14]

Our final sample includes data for 108 countries (significant variation in our variables of interest). Table A-2 in the Appendix lists the countries included in our dataset and the sample frame.

3.3 Vertical Integration Indices

Constructing measures of vertical integration is difficult, as the exercise is highly demanding in terms of data, requiring firm-level information on the 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 data available for a wide sample of developed and developing countries.

To measure the extent of vertical integration of a given firm, we build on the methodology used by AJM (2009). We combine information on plants' activities and ownership structure from the WorldBase dataset with input-output data to determine related industries and to construct vertical integration coefficients V_j^f, where j is any sector in which firm f is active. Notice 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).[15] We instead have information on a broader sample of more than 24 million establishments in the 2004 WorldBase file. As discussed below, this allows us to link establishments to firms.

Given the difficulty of finding input-output matrices for all the countries in our dataset, we follow AJM (2009) and use the U.S. input-output tables to measure vertical linkages within firms. As the authors note, input-output tables from the U.S. should be informative about input

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

[14]We include multinationals in the robustness analysis.

[15]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".

flows across industries to the extent that these are determined by technology.[16]

The input-output data come from the Bureau of Economic Analysis (BEA), Benchmark IO Tables, which include the make table, use table, and the direct and total requirements coefficients 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 data use the SIC industry classification. The BEA website provides a concordance guide between both, but it is not a one-to-one key.[17]

We match the 4-digit SIC codes of each plant in each firm with the 6-digit IO codes, using the BEA's concordance guide. For the codes for which the matching was not one-to-one, we randomized between possible matches to chose one 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 (the key is almost one-to-one).

For every pair of industries, i, j, the input-output accounts allow one to calculate the dollar value of i required to produce a dollar's worth of j. Combining the SIC information for each plant in each firm, the matching codes, and the input-output information for the US, we construct the input-output coefficients for each firm f, IO_{ij}^f. 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 is 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. By adding up the input-output coefficients IO_{ij}^f for all inputs i, we arrive at the firm's degree of vertical integration in j.

To illustrate the procedure, consider the following example from AJM (2009). They consider a Japanese establishment, which according to WorldBase has 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

[16]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. On the other hand, it also mitigates the possibility that the IO structure and control variables are endogenous.

[17]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.

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. Furthermore, this plant has the internal capability to produce those stampings, and we therefore assume that it produces all the stampings it needs for automobiles itself.[18] The bottom row shows the sum of the IO_{ij}^{f} for each industry: for example, 12.3 cents worth of the inputs required to make autos can be produced within this plant. We would then say that the degree of vertical integration for this plant is 12.3 in autos.

Rather than the plant, however, our main unit of observation are all plants that belong to the same *firm*, i.e., all plants that report to the same headquarters or ultimate parent. For example, if the plant in the example above is reported as being the headquarters of another Japanese plant (subsidiary), we consider the activities of both plants when constructing a measure of vertical integration for the firm. In the case of multi-plant firms, restricting the analysis to plant level may underestimate the number of activities carried out within the boundaries of a firm.

We can now describe the methodology we used to construct construct the firm-level vertical integration indexes. For a given firm f with primary sector is k located in country c, we define the integration index in activity j as

$$V_j^{f,k,c} = \sum_i IO_{ij}^{f,k}, \tag{6}$$

the sum of the IO coefficients for each industry in which the firm is active. Our main 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 that are connected by the same global ultimate or headquarters), we consider the main activity of the headquarters or the ultimate parent.[19]

As an alternative measure, we also construct an index based on all the firm's activities:

$$\overline{V}^{f,k,c} = \frac{1}{N_f} \sum_j V_j^{f,k,c}, \tag{8}$$

where N_f is the number of industries in which firm f is active. This represents the average opportunity for vertical integration in all lines of a business in which the firm is active.

Our approach for identifying vertical integration suffers from the data limitation that we do not observe intra-firm transactions. Instead, we infer it from information about the goods pro-

[18] 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.

[19] As mentioned above, we exclude multinationals from the main analysis.

duced in each of the firm's establishments and the aggregate input-output relationship between those goods. The advantage of our method is that we have a large amount of data for many countries and industries and do not have to worry about the value of intra-firm activities being affected by transfer pricing. Hummels, Ishii, and Yi (2001) argue that another advantage of using I-O tables is that they avoid the arbitrariness of classification schemes that divide goods into "intermediate" and other categories. However, our index represents the opportunity of vertical integration. Firms may exercise this opportunity in different ways, as they may still, for example, purchase or sell inputs from/to third parties.[20]

Table 1 presents summary statistics for our vertical integration indexes. Appendix table A-1 compares the indices across the different samples.[21]

3.4 Trade Policy

A further challenge in empirically assessing the impact of market prices on ownership structure is the simultaneous determination of the two—prices should affect ownership structure but at the same time ownership structure has an influence on market prices—. We use trade policy to deal with this endogeneity problem and argue that most-favored-nation (MFN) tariffs and RTAs offer a plausibly exogenous source of price variation to the boundaries of the firm. Of course, one might still worry about the political economy determinants of these policies. However, as argued in the introduction, MFN tariffs 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. Some papers in the literature have pointed out that industry concentration and firm size may affect lobbying contributions and trade policy outcomes (e.g., Mitra, 1998; Bombardini, 2008). These studies are based on US non-tariff barriers in the manufacturing sector. In our empirical analysis, we control for firm size. We also argue that firms' ownership structure is unlikely to have a systematic impact on the determination of trade policies in general, and on MFN tariffs in particular.[22] Concerning regional trade agreements such as free trade areas or customs unions, these are also negotiated over long periods of time and regulated by GATT/WTO rules. Previous

[20]Hortacsu and Syverson (2009) combine Census data and the Commodity Flow survey (a random sample of an establishment shipments in each four weeks during the year, one in each quarter) and ZIP code information to measure intra-firm trade. They find that shipments from firms' upstream units to their downstream units are surprisingly low. This result is at odds with international trade studies, which show that intra-firm trade accounts for roughly one-third of international shipments (e.g., Bernard, Jensen, Redding and Schott, 2008); however, as a robustness check, we also perform the analysis using plant-level vertical integration measures.

[21]Differences in methodology and samples restrict comparisons with AJM. However, the authors report mean of 4.87 and a median of 3.34 in their vertical integration index. For the average vertical integration index, the mean ranges from 3.5 to 6.6 and the median from 1.5 to 5.1. For the primary sector vertical integration index, the mean ranges from 3.5 to 7.1 and the median from 1.2 to 5.1.

[22]There is no theory relating a firm's boundaries with its incentives to form a lobby 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., the size of the campaign contributions) could be systematically related to firms' organization decisions across a very large set of countries and sectors.

papers in the literature (e.g., Trefler, 2004; Bustos, 2009) take RTAs as being exogenous to firms' decisions.

3.4.1 Tariffs

We collect applied MFN tariffs at the 4 digit SIC level for all the WTO members for which this information is available. We restrict the set of countries to WTO members, which are 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 in sector k originated in other WTO members; preferential treatment is only allowed for imports originating from members of RTAs or from developing countries.

The data 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 they are not available for that year. In this case tariff data are chosen as the closest available data point in a five year window around 2004 (2002-2006) giving priority to earlier years.[23] 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. To do this, we use information on RTAs and subtract 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 come from the COMTRADE database.

3.4.2 RTAs

We collect information on regional trade agreements (RTAs) that were in force in 2004 from the WTO Regional Trade Agreements Information System (RTA-IS).[24] The database includes all RTAs in force.[25] We construct a dummy that equals one whenever two countries are members in a common RTA. The legal basis for the creation of RTAs can be found in Article XXIV of the GATT/WTO (for agreements involving developed member countries) and in the Enabling Clause (for agreements amongst developing countries only). Under Article XXIV, member countries can form free trade areas (FTAs) or customs unions (CUs) covering 'substantially all trade', requiring complete duty elimination and fixed timetables for implementation. The conditions contained in the Enabling Clause are much less stringent, so RTAs between developing member countries may effectively involve less trade liberalization. Therefore, we construct a second indicator

[23] I.e., if data for 2003 and 2005 are available, but not 2004, 2003 is chosen.

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

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

variable that only includes free trade agreements and customs union but excludes a number of preferential trade agreements under the enabling clause that do not imply the full elimination of trade barriers.

We also construct a variable *RTAage* that equals the age of the trade agreement in years, since we expect older trade agreements to have a larger impact on firms' organizational structure.

3.5 Other Controls

In order to control for alternative factors that explain vertical integration emphasized by the literature we also collect a number of country- and sector-specific variables. 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 (perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts) that measure individuals' perceptions of the effectiveness and predictability of the judiciary and the enforcement of contracts in each country 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 combine these country-specific measures with sector-specific information from the US, to proxy for exogenous variation in sector characteristics.

First, we construct sectoral *Capital intensity* at the 4-digit-SIC level for the US. Data comes from the NBER-CES manufacturing industry database (Bartelsmann and Gray, 2000). Following Acemoglu, Johnson and Mitton (2006), 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 (2008) measure of *Relationship dependence* for the US, which proxies for the severity of hold-up problems. For each sector this variable measures the fraction of inputs that are 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 US-SIC.[26]

Third, we follow Rajan and Zingales (1998) and construct the variable *External dependence*, which measures sectoral dependence on external credit for the US as 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

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

methodology, we construct similar data for the period 1999-2006.[27]

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 for a common colonial relationship (current or past).

Finally, we use information on GDP and GNI per capita for the year 2004 from the World Development indicators 2008.

Table 1 presents summary statistics for our control variables and Table A-4 in the Appendix is the correlation table.

4 Tariffs and Vertical Integration

In this section, we assess the empirical validity of the first prediction of our theoretical model, examining whether higher tariffs lead to more vertical integration at the firm level. To do so, we estimate the following panel regression model:

$$\log(V^{f,k,c}) = \alpha + \beta_1 \log(t_k^c) + \beta_2 \log(Employment_f) + \beta_3 \mathbf{X}_{k,c} + \delta_k + \delta_c + \epsilon_{f,c}. \tag{9}$$

Note that, for the variables expressed in logs, the estimated coefficients can be interpreted as elasticities. We take logs of tariffs (which are already expressed in ad-valorem terms) in order to mitigate problems with outliers. While the distribution of tariffs is extremely skewed, log tariffs are approximately normally distributed.[28] The dependent variable is the (log) vertical integration index of firm f located in country c, with primary sector k, as defined in (7). In alternative specifications, we also use the average vertical integration index defined in (8). Our main regressor of interest is the log MFN tariff applied by country c in sector k ($\log(t_{k,c})$). The set of explanatory variables includes a firm's number of employees in logs ($log(Employment_f)$), which allows us to control for the relation between firm's size and ownership structure. The vector $\mathbf{X}_{k,c}$ consists of different interactions between sector and country characteristics (e.g., interaction between a sector's capital intensity and a country's level of financial development). We also include sector fixed effects at the 4-digit 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

[27] 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 is defined as cash flow from operations. Industries with negative external finance measures have cash flows that are higher than their capital expenditures.

[28] See Table 1 for summary measures of the distribution of MFN tariffs. Our main sample corresponds to column 6 in Table 1. Taking logs of variables removes some observations. However, the vertical integration index equals zero only in 1439 cases. since more observations are lost as a combination of zeros of dependent and explanatory variables that are zero (many tariffs are zero) we do not use a Tobit analysis. Below we present results using log (1+ variables) obtaining similar results.

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.[29] 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.

The results are reported in Table 2. Consider first the left-hand panel, which reports the results of the regressions using the main vertical integration index ($V^{f,k,c}$). Column (1) presents the results of the basic specification, which only includes the MFN tariff, firm size, and country and sector fixed effects. In line with what predicted by our theoretical model, tariffs have a positive and significant effects on a firm's level of vertical integration. The estimate for β_1 implies that a 100 percent tariff increase leads to a 1.44 percent increase in the vertical integration index. In terms of economic magnitudes this implies that reducing tariffs from their mean level in manufacturing of 5.4 percent to 1 percent (a 440 percent decrease) reduces vertical integration by 0.0144*440=6.16 percent. Hence, the impact of tariffs on vertical integration is sizable.

In columns (2)-(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.* Notice that the tariff coefficient becomes larger—a 100 percent tariff increase now leads to a 2.3-2.4 percent increase in the vertical integration index—and is now significant at the 1 percent level. The estimates for the interaction terms are also highly significant and indicate that more capital intensive sectors are more integrated in countries with more developed financial markets, and less integrated in countries with better legal institutions. In column (3), we include two alternative interaction terms: that between *External dependence* and *Financial development*; and that between *Relationship specificity* and *Legal quality.* Again, tariffs are positive and highly significant, while the interaction terms are insignificant.[30]

The right-hand panel of Table 2 reports the results of regressions in which we used a firm's average vertical integration as our dependent variable ($\overline{V}^{f,k,c}$). The results on tariffs are consistent, but somewhat less significant. This is not surprising, since in our regressions we consider the effects of MFN tariffs applied to the primary activity of the firm, rather than to all of them.

As a first robustness check, we check if the results of the effect on tariffs on vertical integration (9) is affected by using $log(1 + variable)$ for the dependent and the explanatory variables, which allows to keep the observations with zero tariffs. From Table 3 we see that results remain hardly affected even though we add more than 50.000 observations to the sample. The magnitude of the

[29] D&B samples establishments in the formal sector (and their 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 1000 plants that are part of firms with at least 20 employees.

[30] These results are broadly consistent with the theoretical framework described by AJM. In their empirical analysis they do not find a significant effect for the interaction between *Capital intensity* and *Financial development.*

tariffs coefficient drops slightly but it remains positive and significant at the 1 to 5 percent level in all specifications. Results are again slightly weaker when using the average vertical integration index.

5 Trade Policy and Organization Convergence

The theoretical framework discussed in Section 2 suggests that trade policy should affect the degree of organizational convergence across countries through its effect on prices. The focus of this section is on cross-country differences in ownership structure at the sectoral level. For each country, we thus construct an industry measure of vertical integration by estimating the following regression model:

$$V^{f,k,c} = \beta \log(Employment_f) + V_{kc} + \epsilon_{f,c}. \tag{10}$$

The estimate for the sector-country dummy V_{kc} gives us a measure of the average level of vertical integration of industry k in country c, controlling for the effect of firm size on the average level of vertical integration in that industry-country pair.

5.1 Tariff Differences

We verify first 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 those sectors characterized by similar levels of protection. To verify this, we estimate the following model:

$$\log|\hat{V}_{k,c} - \hat{V}_{k,c'}| = \alpha + \beta_1 \log|t^c_{kc} - t^{c\prime}_k| + \beta_2 \log|\mathbf{X}_{k,c} - \mathbf{X}_{k,c'}| + \delta_k + \delta_{cc'} + \epsilon_{k,c,c'}. \tag{11}$$

The dependent variable is the log of the absolute difference between countries c and c' in the estimated vertical integration indexes for sector k (from equation (10) above). 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. Notice that, since we are including dyad fixed effects ($\delta_{cc'}$), β_1 is identified by the cross-sectoral variation in the tariff difference for a given country pair.

In the first column of Table 4 the only explanatory variable is the log-difference in tariffs. In line with our predictions, we find that for a given country-pair differences in sectoral vertical integration indexes are significantly (at the 5 percent level) larger in those sectors in which differences in MFN-tariffs are larger. A 100 percent increase in the difference in MFN tariffs leads to a roughly 0.8 percent increase in the difference in vertical integration indexes.

The second column adds the product of the sectoral import shares to which MFN tariffs apply and the interaction of this product with the difference in MFN tariffs. The positive effect of differences in MFN tariffs on differences in vertical integration seems to be larger if MFN tariffs affects a larger fraction of trade for both countries. The marginal effect of log MFN tariffs evaluated at the mean of the log product of MFN import shares is 0.01, which is strongly significant.[31] The third column adds interactions between capital intensity and the log difference in legal quality and the log difference in financial development. The coefficient on the difference in MFN tariffs increases in magnitude becomes significant at the one percent level. The interaction term of capital intensity with the difference in financial development is positive and strongly significant, while the interaction term of capital intensity with legal quality is surprisingly negative and strongly significant. Finally, column four includes as alternative control variables the log difference in financial development interacted with external dependence and the log difference in legal quality interacted with relationship-dependence. Again, the coefficient on the difference in MFN-tariffs is not affected and is significant at the one percent level, while both interaction terms are positive but not very significant.

In the right hand panel of Table 4 we repeat the same specifications with the average (over all firm activities) sectoral vertical integration index. Results on the impact of tariff differences remain robust to using this alternative measure of vertical integration, but are slightly less significant.

5.2 Regional Trade Agreements

In the remaining of this section, we examine the relation between the degree of sectoral organizational convergence and common membership in a regional trade agreement. Note however that, unlike for the previous regressions, it is harder to give a causal interpretation to these regression results, since it is possible that countries that are generally more similar are also more likely to form a RTA.

To assess the validity of our third empirical prediction, we explore how the existence of a RTA between two countries affects the extent to which these countries have similar vertical integration structures at the industry level.

$$\log |\hat{V}_{k,c} - \hat{V}_{k,c'}| = \alpha + \beta_1 RTA_{cc'} + \beta_2 AgeRTA_{cc'} + \beta_3 \mathbf{X}_{cc'} + \delta_k + \delta_c + \delta_{c'} + \epsilon_{k,c,c'}. \qquad (12)$$

The dependent variable is as in model (11). The main regressor of interest is now a $RTA_{cc'}$, a dummy that equals one if countries c and c' are member of the same regional trade agreement. We also include the age of the trade agreement to capture the effect that older RTAs are likely to have a larger impact on difference in organizational structure. The vector $\mathbf{X}_{c,c'}$ captures a series

[31] The t-statistic for the marginal effect evaluated at the mean of the log product of MFN import shares is 2.87.

of bilateral controls, such as dummies for contiguity, common language, colonial relationship, as well as variables capturing the distance between the two countries, the difference in legal quality, differences in financial development, differences in GDP and in GDP per capita. Finally, we include sector fixed effects (δ_k) and country fixed effects (δ_c and $\delta_{c'}$).

Table 5 presents the results for this regression. In the first column of the left panel, we include only a dummy for regional trade agreements. Indeed, the coefficient of RTA is negative and significant at the one percent level.[32] It implies that if a country pair has a RTA the difference in vertical integration indices is around 13.6 percent smaller than for a country pair without a RTA. The second column adds the age of the RTA as an additional control variable. The coefficients for RTA and for age are both negative and significant at the one percent level. Thus, as expected, country pairs with older RTAs have a more similar organizational structure than countries with young RTAs. The coefficients imply that country pairs that have a RTA with an average age (13.7 years) have a roughly 16 percent smaller difference in vertical integration indices than country pairs without a RTA ($-0.06 - 0.0385 * \log(13.7) \approx -0.16$).

In the third column, we add a series of bilateral control variables that may have an influence on the similarity of organizational structure. The coefficient of RTA is reduced somewhat in size but remains significant at the one percent level. Contiguity and common language have a significant negative effect on the distance in vertical integration indices and so has distance, while the dummy for common colony is insignificant. Differences in legal quality, in GDP and in GDP per capita have a significant positive effect on the difference in vertical integration, while differences in financial development surprisingly seem to have a negative effect. The fourth column presents results for a stricter definition of RTAs, which includes only free trade agreements and custom unions (notified under GATT Article XXIV) but excludes weaker forms of preferential trade agreements (notified under the Enabling Clause). Again, results remain very similar and the coefficient is significant at the one-percent level.

6 Robustness checks

First, we repeat the three sets of regressions (9), (11), and (12) for the sample of countries for which we observe at least 1000 plants that are part of firms with at least 20 employees. Table A-5 presents the results for specification (9) in logs. It is obvious that the results remain almost unchanged. The point estimates for tariff coefficient remain very similar in magnitude and also the significance of the estimates is not affected by restricting the sample of countries. Table A-6 repeats the same regressions using $\log(1 + \textit{variable})$, which exploits also the observations with zero tariffs. Coefficients for tariffs drop slightly in magnitude but remain strongly significant.

[32] SE are clustered by sector. Clustering at the country-pair level, which would be appropriate here, is not possible because the panel is strongly unbalanced across sectors so that the clustered variance-covariance-matrix becomes numerically singular.

Turning to the results on organizational convergence, we find that tariff differences continue to have a significant positive effect on differences in vertical integration in three out of four specifications when using our main vertical integration index (see Table A-7). Results for the average vertical integration index also remain stable. Again, they are slightly weaker than for the primary index (see right panel of Table A-7). Finally, results for regional trade agreements are also very robust, as is apparent from Table A-8. Having a RTA reduces differences in vertical integration by roughly 5 percent when controlling for sector and country effects. The estimate of the coefficient for RTA is robust across specifications and always significant at the one percent level.

In a second set of regressions we include multinational firms - defined at the world level - in the sample. Again, we first report results for regression (9). In Table A-9 one sees that, not surprisingly, multinational firms are much more vertically integrated (multinationals have a 37% higher level of vertical integration than non-multinationals). Moreover, the impact of tariffs on vertical integration drops by an order of ten in the first specification and by an order of two when controlling for other sector-country variables, where it remains significant at the ten percent level. In Table A-10 we repeat the regressions using $\log(1 + variable)$. The coefficient for tariffs now becomes insignificant and for some specifications the point estimates are negative.

When considering the impact of tariff differences on differences in vertical integration indices in Table A-11, we find that tariff differences have no longer a significant impact on differences in vertical integration in most specifications. Finally, having a RTA continues to reduce differences in vertical integration by around 5 percent, as one can see from A-12 and the significant impact of RTA remains robust and significant at the one percent level across specifications.

The fact that multinationals seem to react very differently to tariffs may have a number of explanations. First, multinationals are usually active in many sectors and therefore the primary SIC code of their global ultimate is not necessarily a good measure of their primary activity. Second, the correct product price is likely to be different from that of the multinational's primary activity in the country in which the global headquarters is located; in fact, given that the firm has plants in different countries, it is not clear what is the relevant product price and what tariffs are distorting it. Third, we assign a common level of vertical integration to the whole multinational firm and therefore differences in domestic prices as proxied by differences in tariffs, are unlikely to be a good measure of the output prices relevant for integration at the global scale. The fact that our results for RTAs seem to be much less affected by the inclusion of multinationals points in this direction: countries that have a RTA should have similar price levels and therefore the integration decision of the multinational should be the same in these countries.

7 Discussion

We have found evidence, suggested by theory, that firm boundaries depend on the prices of the products they sell: the higher are prices, the more integrated firms will be. More generally, when equilibrium prices converge across economies, so do ownership structures.

Since we do not have price data, our approach has mainly relied on competitive equilibrium reasoning applied to tariffs: when these are high, so are the prices received by protected industries. Such industries should be more integrated than otherwise similar unprotected industries.

Our empirical results imply that in fact higher prices, as proxied by MFN tariffs cause more vertical integration the firm level. Moreover, convergence in prices, as measured by more similar MFN tariffs and RTAs, leads to convergence in organizational structure.

To give this result the causal interpretation suggested by our theory, it is necessary to assume that tariff levels are exogenous to the ownership structure of firms. The most plausible channel through which tariffs are related to industrial structure is lobbying. Most theories of lobbying cite the size of firms (more at stake) and concentration of industries (easier to overcome collective action problems) as important determinants of trade protection. We emphasize that our results hold even though we have tried to control for these factors. Finally, there is no theory we are aware of that suggests a systematic positive relation between lobbying, vertical integration and MFN tariffs which could cause a spurious correlation between vertical integration and MFN tariffs.[33]

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[33]Indeed, in terms of our model, it is tempting to assert that integrated firms are better at lobbying for tariff protection, just as they better coordinate production decisions. But this works only insofar as lobbying involves HQ marshaling the firm's managers and employees to behave in ways that affect policy, which is something rather different from implementing production decisions. If lobbying depends instead on mechanisms such as bribery, then it is firm size rather than integration that is likely to matter most, and we have controlled for this. Moreover, in the model, it is the (non-integrated) B_k manager, with an undiluted revenue stake, who would actually have the stronger incentive to lobby. In other words, it seems just as likely that non-integration would be a force for high tariffs as integration.

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Table 1: Summary Statistics

	Mean	Median	Min	Max	Std. Dev.	N
MFN tariffs	5.40%	2.84%	0%	2553%	8.870	256915
Log (distance MFN tariffs)	1.688	1.897	-4.605	7.845	1.301	225758
Log (distance Ver. Int. Index, Prim. Sect.)	0.385	0.544	-13.377	4.194	1.386	225758
Log (distance Vert. Int. Index, Average)	0.234	0.409	-10.795	3.842	1.296	225758
Log (Capital intensity)	-2.902	-2.857	-4.994	-1.354	0.458	387
Log (Relationship specificity)	-0.526	-0.456	-3.449	-0.014	0.356	387
Financial dependence	-0.524	-0.756	-15.523	53.628	3.058	387
Legal quality	0.670	0.663	0.210	0.972	0.189	90
Financial development	0.704	0.711	0.030	1.821	0.444	90
Log (GDP)	26.093	26.161	20.482	30.085	1.525	90
Log (GNI per capita)	9.486	9.811	6.346	10.671	0.927	90
Mean log (distance Legal quality)	0.191	0.178	0.000	0.566	0.124	90
Log (distance Financial Development)	0.414	0.409	0.000	0.956	0.254	90
Log (distance GDP)	26.539	26.591	12.743	30.085	1.812	90
Log (distance GNI per capita)	9.094	9.398	0.000	10.657	1.185	90
Log (distance)	8.620	9.011	4.665	9.892	0.971	90
RTA	0.394	0.000	0.000	1.000	0.449	90
FTA	0.262	0.000	0.000	1.000	0.440	90
Age RTA	13.697	15.000	1.000	44.000	8.605	90
Contiguity	0.041	0.000	0.000	1.000	0.197	90
Colonial Relationship	0.033	0.000	0.000	1.000	0.178	90
Common Language	0.121	0.000	0.000	1.000	0.326	90

Notes: Vertical integration indices constructed using plant level data from 2004 WorldBase, Dun & Bradstreet. Tariff data from TRAINS/WTO. Info on regional trade agreements (RTAs) from WTO. Financial development from Beck, Demigurc-Kunt and Levine (2006). Legal quality from Kaufmann, Kraay, and Mastruzzi (2003). GDP and GNI from World Bank. Capital Intensity from NBER-CES manufacturing industry database. Relationship specificity from Nunn (2008). Financial dependence from Compustat following Rajan and Zingales (1998).

Table 2: Tariffs and Vertical Integration, Firm Level Analysis (Manuf. Firms)

	(1)	(2)	(3)	(4)	(5)	(6)
	Vert. Int. Index, Primary Sector			Vert. Int. Index, Average		
log (Tariff)	0.0144*	0.0228***	0.0241***	0.0076	0.0159**	0.0171**
	(0.0074)	(0.0072)	(0.0073)	(0.0072)	(0.0071)	(0.0072)
log (Emp.)	0.0341***	0.0383***	0.0382***	0.0612***	0.0748***	0.0748***
	(0.0054)	(0.0069)	(0.0069)	(0.0048)	(0.0059)	(0.0059)
log (Cap. int.) x log (Fin. dev.)		0.0555**			0.0484*	
		(0.0253)			(0.0293)	
log (Cap. int.) x log (Legal qual.)		-0.249***			-0.218**	
		(0.0921)			(0.105)	
Ext. dep. x log (Fin. dev.)			-0.0009			-0.0006
			(0.0027)			(0.0026)
log (Rel. spec). x log (Legal qual.)			0.0455			0.0409
			(0.0413)			(0.0399)
R2	0.059	0.065	0.064	0.04	0.047	0.047
# Observations	200093	170867	170867	200541	171252	171252
Number of SIC1	387	386	386	387	386	386
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 is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6) all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., no MNCs, tariff data.

Table 3: Tariffs and Vertical Integration, Firm Level Analysis (Manufacturing Firms)

	(1)	(2)	(3)	(4)	(5)	(6)
	Vertical Integration Index, Primary Sector			Vertical Integration Index, Average		
log (1+Tariff)	0.0094**	0.0180***	0.0185***	0.0012	0.0087*	0.0093**
	(0.00446)	(0.0049)	(0.0051)	(0.0047)	(0.0045)	(0.0045)
log (Employment)	0.0308***	0.0350***	0.0350***	0.0511***	0.0597***	0.0597***
	(0.0081)	(0.0093)	(0.0094)	(0.0079)	(0.0080)	(0.0080)
log (Cap. int.) x log (Fin. dev)		0.0393***			0.0369**	
		(0.0137)			(0.0165)	
log (Cap. int.) x log (Legal qual.)		-0.138**			-0.134**	
		(0.0557)			(0.0592)	
Ext. dep. x log (Fin. dev.)			-0.0002			-0.0005
			(0.0012)			(0.0012)
log (Rel. spec). x log (Legal qual.)			0.0121			0.0193
			(0.0293)			(0.0275)
R2	0.060	0.064	0.064	0.041	0.046	0.046
# Observations	256889	226174	226174	256889	226174	226174
Number of SIC1	387	387	387	387	387	387
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 is the log of one plus the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms ≥ 20 empl., no MNCs, tariff data.

Table 4: Tariffs and Organizational Convergence, Country-Industry Differences in Vertical Integration (Manufacturing Sector)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log (Diff. Vert. Int. Index, Primary Sector)				Log (Diff. Vert. Int. Index, Average)			
log (diff. Tariffs)	0.00786**	0.00771*	0.00986***	0.00961**	0.00750***	0.00335	0.00696**	0.00288
	(0.00309)	(0.00401)	(0.00338)	(0.00445)	(0.00276)	(0.00359)	(0.00307)	(0.00398)
log (product Import shares)		0.00168				0.00528**		
		(0.00264)				(0.0025)		
log (diff. Tariffs) x log (Import shares)		0.00599				0.0141**		
		(0.00814)				(0.00707)		
log (Cap. int.) x log (diff. Fin. dev.)			0.0198***				0.00159	
			(0.00641)				(0.00562)	
log (Cap. int.) x log (diff. Legal qual.)			-0.0135**				-0.0155***	
			(0.00628)				(0.00589)	
log (Ext. dep.) x log (diff. Fin. dev.)				0.000465				-0.0004
				(0.000739)				(0.000759)
log (Rel. spec.) x log (diff. Legal qual.)				0.0123*				0.00207
				(0.00687)				(0.00628)
R2	0.085	0.086	0.089	0.108	0.135	0.141	0.135	0.165
# Observations	225758	196681	182474	99234	225781	196700	182494	99243
# country pairs	4404	3532	3454	3185	4404	3532	3454	3186
Sector Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
Diadic Fixed Effect	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
Sample	All	All	All	All	All	All	All	All

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the absolute difference between countries c and c' in the estimated vertical integration index in the primary sector k. In columns (1)-(4), the vertical integration index considers only the primary sector; in columns (5)-(8), all manufacturing sectors in which the firm is involved. Sample includes firms ≥ 20 empl., no MNCs, tariff data.

Table 5: RTAs and Organizational Convergence, Country-Industry Differences in Vertical Integration (Manuf. Sector)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log (Diff. Vert. Int. Index, Primary Sector)				Log (Diff. Vert. Int. Index, Average)			
RTA	-0.136***	-0.0606***	-0.0462***		-0.116***	-0.0828***	-0.0366***	
	(0.00864)	(0.0115)	(0.00902)		(0.008)	(0.01)	(0.00868)	
Log (Age RTA)		-0.0385***				-0.0171***		
		(0.00473)				(0.00392)		
Contiguity			-0.140***				-0.118***	
			(0.015)				(0.0145)	
Colonial Relat.			0.0439**				0.0337	
			(0.0216)				(0.0212)	
Common Language			-0.0438***				-0.0493***	
			(0.00961)				(0.00867)	
log (distance)			0.00975**				0.0161***	
			(0.00488)				(0.00546)	
log (diff. Legal qual.)			0.806***				0.698***	
			(0.0492)				(0.0494)	
log (diff. Fin. dev.)			-0.116***				-0.119***	
			(0.0187)				(0.0182)	
log (diff GDP)			0.0215***				0.0203***	
			(0.00296)				(0.00269)	
log (diff GNI per capita)			0.0210***				0.00746**	
			(0.0035)				(0.00308)	
Free Trade Agreements				-0.101***				-0.0861***
				(0.00986)				(0.00888)
R2	0.079	0.079	0.088	0.078	0.047	0.047	0.052	0.046
# Observations	324671	324671	260750	324671	324730	324730	260799	324730
# Sectors	458	458	458	458	458	458	458	458
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Sector	Sector	Sector	Sector	Sector	Sector	Sector	Sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the absolute difference between countries c and c' in the estimated vertical integration index in the primary sector k. In columns (1)-(4), the vertical integration index considers only the primary sector; in columns (5)-(8), all manufacturing sectors in which the firm is involved. Sample includes firms ≥ 20 empl., no MNCs, tariff data.

Table A-1: Sample Comparisons: Vertical Integration Indices

		All			Manufacturing		
	all plants	firms >0 empl	firms $\geq$ 20empl	firms $\geq$ empl.	firms $\geq$ 20 empl. count. with $\geq$ 1000 obs.	firms $\geq$ 20 empl. no MNCs,	firms $\geq$ 20 empl. count. With $\geq$ 1000 obs., no MNCs
# of plants (thousands)	24698	20533	2162	441	435	257	245
# of conn. plants (thousands)	1378	1145	741	108	108	31	30
# of firms (thousands)	23,695	19,685	1,542	358	352	238	226
# of MNCs (thousands)	28,662	28,207	24,631	15,317	15,232	0	0
Mean, vert. int. prim. sect.	0.0359	0.0357	0.0575	0.0717	0.0717	0.0631	0.0629
Median, vert. int. prim. sect.	0.0121	0.0100	0.0257	0.0509	0.0478	0.0439	0.0439
Min, vert. int. prim. sect.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Max, vert. int. prim. sect.	0.8333	0.8333	0.8333	0.8333	0.8333		0.8333
St. Dev., vert. int. prim. sect.	0.0540	0.0551	0.0741	0.0749	0.0748	0.0633	0.0629
Mean, vert. int. av	0.0355	0.0352	0.0551	0.0665	0.0665	0.0575	0.0572
Median, vert. int. av.	0.0151	0.0130	0.0334	0.0506	0.0506	0.0439	0.0437
Min, vert. int. av.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Max, vert. int. av.	0.5349	0.5349	0.5349	0.5198	0.5198	0.5198	0.5198
St. Dev., vert. int. av.	0.0504	0.0512	0.0603	0.0588	0.0588	0.0527	0.0522
Mean, firm empl.	441	530	5010	3949	3966	252	245
Median, firm empl.	1	2	52	60	60	45	45
Min, firm empl.	0	1	20	20	20	20	20
Max, firm empl.	349,980	349,980	349,980	349,980	349,980	72,144	72,144
St. Dev., empl.	6,242	6,843	20,550	19,055	19,113	1,518	1,512

Notes: Plant- and firm-level data from 2004 WorldBase data, Dun & Bradstreet.

Table A-2: Sample Frame

WB Code	Freq.	Percent	Cum.	WB Code	Freq.	Percent	Cum.
AGO	8	0.00	0.00	KOR	3,103	1.21	65.91
ALB	4	0.00	0.00	KWT	66	0.03	65.94
ARE	442	0.17	0.18	LTU	221	0.09	66.02
ARG	1,031	0.40	0.58	LVA	137	0.05	66.08
AUS	5,911	2.30	2.88	MAR	610	0.24	66.31
AUT	1,819	0.71	3.59	MDG	19	0.01	66.32
BEL	1,399	0.54	4.13	MEX	3,081	1.20	67.52
BEN	4	0.00	4.13	MLI	13	0.01	67.53
BFA	9	0.00	4.14	MOZ	18	0.01	67.53
BGD	6	0.00	4.14	MRT	3	0.00	67.53
BGR	380	0.15	4.29	MUS	50	0.02	67.55
BOL	56	0.02	4.31	MWI	2	0.00	67.55
BRA	6,062	2.36	6.67	MYS	3,560	1.39	68.94
CAF	1	0.00	6.67	NER	1	0.00	68.94
CAN	8,141	3.17	9.84	NGA	134	0.05	68.99
CHE	1,508	0.59	10.42	NIC	22	0.01	69.00
CHL	469	0.18	10.61	NLD	1,940	0.76	69.76
CHN	28,487	11.09	21.69	NOR	1,522	0.59	70.35
COG	9	0.00	21.70	NPL	1	0.00	70.35
COL	563	0.22	21.92	NZL	1,110	0.43	70.78
CRI	183	0.07	21.99	OMN	70	0.03	70.81
CZE	2,008	0.78	22.77	PAK	4	0.00	70.81
DEU	21,420	8.34	31.11	PAN	70	0.03	70.84
DNK	1,011	0.39	31.50	PER	896	0.35	71.19
DOM	226	0.09	31.59	PHL	355	0.14	71.32
ECU	188	0.07	31.66	PNG	6	0.00	71.33
EGY	613	0.24	31.90	POL	470	0.18	71.51
ESP	2,363	0.92	32.82	PRT	5,764	2.24	73.75
EST	170	0.07	32.89	PRY	50	0.02	73.77
FIN	782	0.30	33.19	ROM	655	0.25	74.03
FRA	16,623	6.47	39.66	RWA	2	0.00	74.03
GAB	3	0.00	39.66	SAU	329	0.13	74.16
GBR	8,611	3.35	43.01	SEN	47	0.02	74.17
GEO	7	0.00	43.02	SGP	864	0.34	74.51
GHA	82	0.03	43.05	SLV	133	0.05	74.56
GRC	2,234	0.87	43.92	SVK	321	0.12	74.69
GTM	93	0.04	43.95	SVN	518	0.20	74.89
HND	80	0.03	43.99	SWE	1,833	0.71	75.60
HRV	171	0.07	44.05	TGO	4	0.00	75.60
HTI	4	0.00	44.05	THA	508	0.20	75.80
HUN	2,510	0.98	45.03	TTO	81	0.03	75.83
IDN	238	0.09	45.12	TUN	996	0.39	76.22
IND	2,629	1.02	46.15	TUR	2,691	1.05	77.27
IRL	676	0.26	46.41	TZA	26	0.01	77.28
ISR	1,838	0.72	47.13	UGA	40	0.02	77.29
ITA	8,965	3.49	50.61	URY	115	0.04	77.34
JAM	47	0.02	50.63	USA	57,929	22.55	99.89
JOR	148	0.06	50.69	VEN	256	0.10	99.99
JPN	35,862	13.96	64.65	ZAF	1	0.00	99.99
KEN	139	0.05	64.70	ZMB	17	0.01	99.99
				ZWE	18	0.01	100.00
				Total	256,915	100	

Notes: Data from 2004 WorldBase data, Dun & Bradstreet. (Sample $\geq$ 20 employees, tariff data, employment, NO MNCs.

Table A-3: Sample Frame: Restricted Sample

WB code	Freq.	Percent	Cum.
ARG	1,031	0.42	0.42
AUS	5,911	2.41	2.84
AUT	1,819	0.74	3.58
BEL	1,399	0.57	4.15
BRA	6,062	2.48	6.63
CAN	8,141	3.33	9.95
CHE	1,508	0.62	10.57
CHN	28,487	11.64	22.20
CZE	2,008	0.82	23.02
DEU	21,420	8.75	31.77
DNK	1,011	0.41	32.19
ESP	2,363	0.97	33.15
FRA	16,623	6.79	39.94
GBR	8,611	3.52	43.46
GRC	2,234	0.91	44.37
HUN	2,510	1.03	45.39
IND	2,629	1.07	46.47
ISR	1,838	0.75	47.22
ITA	8,965	3.66	50.88
JPN	35,862	14.65	65.53
KOR	3,103	1.27	66.80
MEX	3,081	1.26	68.06
MYS	3,560	1.45	69.51
NLD	1,940	0.79	70.30
NOR	1,522	0.62	70.92
NZL	1,110	0.45	71.38
PRT	5,764	2.35	73.73
SGP	864	0.35	74.08
SWE	1,833	0.75	74.83
TUN	996	0.41	75.24
TUR	2,691	1.10	76.34
USA	57,929	23.66	100.00
Total	244,825	100	

Notes: Data from 2004 WorldBase data, Dun & Bradstreet. (Sample $\geq$ 20 employees, tariff data, employment, NO MNCs.

Table A-4: Correlation Table

	Log (dist Vert. Ind., Prim. Sect.)	Log (dist. Vert. Int. Average)	RTA	Log (dist.)	Log (dist. Fin. dev.)	Log (dist. Legal quality)	Log (dist. GDP)	log (dist. GNI per cap.)
Log (dist. Ver. Int., Prim. Sect.)	1.0000							
Log (dist. Vert. Int., Average)	0.6201	1.0000						
RTA	-0.0376	-0.0334	1.0000					
Log (dist.)	-0.0275	-0.0048	-0.4791	1.0000				
Log (dist. Fin. dev.)	0.0072	0.0055	-0.1510	0.0964	1.0000			
Log (dist. Legal qual.)	0.0764	0.0778	-0.2583	0.1804	0.6031	1.0000		
Log (dist. GDP)	-0.0345	-0.0482	-0.1681	0.0533	0.2916	0.0049	1.0000	
log (dist. GNI per capita)	0.0586	0.0629	-0.2626	0.1231	0.5508	0.7203	0.2031	1.0000

Notes: Plant and firm level data from 2004 WorldBase data, Dun & Bradstreet.

Table A-5: Robustness 1: Tariffs and Vertical Integration, Firm-Level Analysis (Manufacturing Firms), Countries $\geq$ 1000 plants

	(1)	(2)	(3)	(4)	(5)	(6)
	Vert. Int. Index, Primary Sector			Vert. Int. Index, Average		
log (tariff)	0.0141*	0.0231***	0.0253***	0.00782	0.0166**	0.0186**
	(0.0079)	(0.0078)	(0.0078)	(0.0075)	(0.0076)	(0.0075)
log (emp.)	0.0340***	0.0378***	0.0379***	0.0618***	0.0759***	0.0760***
	(0.0058)	(0.0075)	(0.0075)	(0.0051)	(0.0063)	(0.0063)
log (K. int.) x log (fin. dev)		0.0707**			0.0658*	
		(0.0303)			(0.0353)	
log (K. int.) x log (legal qual.)		-0.325***			-0.300**	
		(0.12)			(0.137)	
ext. dep. x log (fin. dev.)			0.0787			0.0714
			(0.0563)			(0.0557)
log (rel. spec). x log (legal qual.)			0.00137			0.00107
			(0.0031)			(0.0031)
R2	0.060	0.065	0.065		0.047	0.046
# Observations	188931	161700	161700	189353	162065	162065
Number of SIC1	384	383	383	384	383	383
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 is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., countries $\geq$ 1000 plants, no MNCs, tariff data.

Table A-6: Robustness 2: Tariffs and Vert. Integration, Firm-Level Analysis (Manufacturing Firms), Countries $\geq$ 1000 plants

	(1)	(2)	(3)	(4)	(5)	(6)
	Vert. Int. Index, Primary Sector			Vert. Int. Index, Average		
log (1+tariff)	0.00971**	0.0194***	0.0205***	0.0019	0.0103**	0.0115**
	(0.0047)	(0.0054)	(0.0057)	(0.0049)	(0.0048)	(0.0048)
log (emp.)	0.0310***	0.0352***	0.0352***	0.0517***	0.0606***	0.0607***
	(0.0082)	(0.0096)	(0.0096)	(0.008)	(0.0079)	(0.0079)
log (K. int.) x log (fin. dev)		0.0465***			0.0465**	
		-0.0166			(0.0185)	
log (K. int.) x log (legal qual.)		-0.175**			-0.180**	
		(0.0792)			(0.0777)	
ext. dep. x log (fin. dev.)			0.0287			0.0363
			(0.042)			(0.0393)
log (rel. spec). x log (legal qual.)			0.00133			0.000689
			(0.0014)			(0.0015)
R2	0.060	0.064	0.064	0.040	0.046	0.046
# Observations	244803	216320	216320	244803	216320	216320
Number of SIC1	387	387	387	387	387	387
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 is the log (1+ the vertical integration index of firm f located in country c with primary sector k). In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., countries $\geq$ 1000 plants, no MNCs, tariff data.

Table A-7: Robustness: Tariffs and Org. Conv., Country-Industry Differences in Vertical Integration (Manufacturing Sector), Countries $\geq$ 1000 plants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Diff. Vert. Int. Index, Primary Sector				Log Diff. Vert. Int. Index, Average			
log (diff. Tariffs)	0.00735**	0.00789*	0.00806**	0.0066	0.00771**	0.00264	0.00677*	-0.00172
	(0.0037)	(0.0048)	(0.004)	(0.0052)	(0.0034)	(0.0043)	(0.0036)	(0.0046)
log (Product MFN Import shares)		-0.00196				0.00965***		
		(0.0033)				(0.003)		
log (diff. Tariffs) x log (Import shares)		-0.00514				0.0106		
		(0.0101)				(0.0086)		
log (Cap. int.) x log (diff. Fin. devel.)			-0.00252				-0.00641	
			(0.0082)				(0.0073)	
log (Cap. int.) x log (diff. Legal qual.)			-0.0088				-0.00627	
			(0.0074)				(0.007)	
log (Ext. dep.) x log (diff. Fin. dev.)				0.000322				-0.00033
				(0.0008)				(0.0008)
log (Rel. spec.) x log (diff. Legal qual.)				0.0158**				0.00619
				(0.0078)				(0.0074)
R2	0.106	0.106	0.109	0.130	0.145	0.146	0.148	0.180
# Observations	147642	135310	125751	70302	147652	135320	125761	70305
# country pairs	956	863	809	809	956	863	809	809
Sector Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
Diadic Fixed Effect	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
Sample	All	All	All	All	All	All	All	All

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., countries $\geq$ 1000 plants, no MNCs, tariff data.

Table A-8: Robustness: RTAs and Org. Conv., Country-Industry Differences in Vert. Int. (Manuf. Sector), Countries $\geq$ 1000 plants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Diff. Vert. Int. Index, Primary Sector				Log Diff. Vert. Int. Index, Average			
RTA	-0.0533***	-0.0382***	-0.0243***		-0.0576***	-0.0454***	-0.0173***	
	(0.0044)	(0.0057)	(0.0046)		(0.0041)	(0.0052)	(0.0040)	
Log (Age RTA)		-0.0382***				-0.00599***		
		(0.0057)				(0.0018)		
Contiguity			-0.0623***				-0.0648***	
			(0.0076)				(0.0065)	
Colonial Relat.			-0.0351**				-0.00207	
			(0.0145)				(0.0137)	
Common Language			-0.0231***				-0.0295***	
			(0.0051)				(0.0046)	
log (distance)			0.00321				0.0123***	
			(0.0026)				(0.0025)	
log (diff. legal qual.)			0.323***				0.377***	
			(0.0257)				(0.0265)	
log(diff. fin. dev.)			-0.0571***				-0.0839***	
			(0.0083)				(0.0079)	
log (Diff GDP)			0.00602***				0.00583***	
			(0.0012)				(0.0010)	
log (Diff GNI per capita)			-0.00022				-0.00048	
			(0.0016)				(0.0014)	
Free Trade Agreements				-0.0244***				-0.0287***
				(0.0044)				(0.0039)
R2	0.083	0.084	0.084	0.083	0.059	0.059	0.063	0.058
# Observations	223887	223887	191459	223887	223887	223887	191459	223887
# Sectors	458	458	458	458	458	458	458	458
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Sector	Sector	Sector	Sector	Sector	Sector	Sector	Sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., countries $\geq$ 1000 plants, no MNCs.

Table A-9: Robustness: Tariffs and Vertical Integration, Firm Level Analysis (Manufacturing Firms), Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)
	Vert. Int. Index, Primary Sector			Vert. Int. Index, Average		
log (Tariff)	0.00146	0.0146*	0.0166*	0.000813	0.0128	0.0147*
	(0.0102)	(0.0084)	(0.0085)	(0.0095)	(0.0078)	(0.0080)
log (emp.)	0.119***	0.132***	0.132***	0.126***	0.141***	0.141***
	(0.0049)	(0.0052)	(0.0052)	(0.0044)	(0.0044)	(0.0045)
Multinational	0.373***	0.320***	0.320***	0.463***	0.461***	0.403***
	(0.0342)	(0.0332)	(0.0332)	(0.0295)	(0.0292)	(0.0280)
log (Cap. int.) x log (Fin. dev).		0.104***			0.0839***	
		(0.0300)			(0.0323)	
log (Cap. int.) x log (Legal qual.)		-0.437***			-0.381***	
		(0.1070)			(0.1140)	
Ext. dep. x log (Fin. dev.)			0.0805*			0.0698
			(0.0466)			(0.0433)
log (Rel. spec). x log (Legal qual.)			-0.00031			-0.00116
			(0.0029)			(0.0025)
R2	0.171	0.178	0.178	0.236	0.252	0.252
# Observations	246616	215073	215073	247475	215859	215859
Number of SIC1	387	387	387	387	387	387
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 is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., MNCs, tariff data.

Table A-10: Robustness: Tariffs and Vertical Integration, Firm Level Analysis (Manuf. Firms), Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)
	Vert. Int. Index, Primary Sector			Vert. Int. Index, Average		
log (1+tariff)	-0.00606	0.00731	0.00823	-0.00585	0.00613	0.00712
	(0.0064)	(0.0055)	(0.0057)	(0.0069)	(0.0053)	(0.0053)
log (Employment)	0.100***	0.109***	0.108***	0.106***	0.115***	0.115***
	(0.0049)	(0.0038)	(0.0038)	(0.0037)	(0.0026)	(0.0026)
Multinational	0.264***	0.233***	0.233***	0.341***	0.307***	0.307***
	(0.0221)	(0.0267)	(0.0268)	(0.0161)	(0.0186)	(0.0186)
log (Cap. int.) x log (Fin. dev).		0.0703***			0.0615***	
		(0.0162)			(0.0180)	
log (Cap. int.) x log (Legal qual.)		-0.247***			-0.243***	
		(0.0678)			(0.0637)	
Ext. dep. x log (Fin. dev.)			0.0412			0.0494*
			(0.0306)			(0.0281)
log (Rel. spec). x log (Legal qual.)			-0.00022			-0.00133
			(0.0012)			(0.0012)
R2	0.200	0.208	0.207	0.294	0.310	0.310
# Observations	319526	286265	286265	319526	286265	286265
Number of SIC1	387	387	387	387	387	387
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 is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., MNCs, tariff data.

Table A-11: Robustness: Tariffs and Org. Convergence, Country-Industry Differences in Vert. Int. (Manuf. Sector), Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Diff. Vert. Int. Index, Primary Sector				Log Diff. Vert. Int. Index, Average			
log (diff. Tariffs)	0.000276	-0.00461	-0.00117	-0.0025	0.00529**	-0.00299	0.00383	-0.00023
	(0.0027)	(0.0034)	(0.0030)	(0.0040)	(0.0026)	(0.0033)	(0.0030)	(0.0039)
log (product MFN import shares)		0.000733				-0.00051		
		(0.0023)				(0.0022)		
log (diff. Tariffs) x log (Import shares)		0.0173**				0.0263***		
		(0.0070)				(0.0066)		
log (Cap. int.) x log (diff. Fin. dev.)			0.0234***				0.00805*	
			(0.0057)				(0.0048)	
log (Cap. int.) x log (diff. Legal qual.)			-0.00643				-0.0161***	
			(0.0063)				(0.0053)	
log (Ext. dep.) x log (diff. Fin. dev.)				0.00163**				-0.00047
				(0.0007)				(0.0006)
log (Rel. spec.) x log (diff. Legal qual.)				0.000138				-0.00675
				(0.0068)				(0.0055)
R2	0.100	0.101	0.106	0.109	0.119	0.124	0.123	0.134
# Observations	251350	218887	201828	109986	251378	218910	201852	109997
# country pairs	4593	3580	3608	3225	4593	3580	3608	3226
Sector Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
Diadic Fixed Effect	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
Sample	All	All	All	All	All	All	All	All

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., MNCs, tariff data.

Table A-12: Robustness: RTAs and Org. Convergence, Country-Industry Diff. in Vert. Integration (Manuf. Sector), Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Diff. Vert. Int. Index, Primary Sector				Log Diff. Vert. Int. Index, Average			
RTA	-0.0565***	-0.0179***	-0.0183***		-0.0642***	-0.0296***	-0.0220***	
	(0.0049)	(0.0059)	(0.0043)		(0.0049)	(0.0057)	(0.0041)	
Log (Age RTA)		-0.0199***				-0.0179***		
		(0.0023)				(0.0022)		
Contiguity			-0.0390***				-0.0402***	
			(0.0069)				(0.0062)	
Colonial Relat.			0.00202				-0.00106	
			(0.0115)				(0.0112)	
Common Language			-0.00703*				-0.0156***	
			(0.0041)				(0.0041)	
log (Distance)			0.0105362***				0.0123***	
			(0.0025)				(0.0026)	
log (diff. Legal qual.)			0.292***				0.298***	
			(0.0226)				(0.0251)	
log (diff. Fin. dev.)			-0.0403***				-0.0440***	
			(0.0090)				(0.0084)	
log (diff GDP)			0.0116***				0.00998***	
			(0.0019)				(0.0015)	
log (diff GNI per capita)			0.00938***				0.00968***	
			(0.0016)				(0.0014)	
Free Trade Agreements				-0.0490***				-0.0555***
				(0.0057)				(0.0053)
R2	0.057	0.057	0.059	0.056	0.051	0.051	0.057	0.050
# Observations	362523	362523	288654	362523	362523	362523	288654	362523
# Sectors	459	459	459	459	459	459	459	459
Sector Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	Sector	Sector	Sector	Sector	Sector	Sector	Sector	Sector

Notes: Robust standard errors are in parentheses denoting *** 1%, **5%, and *10% significance. Dependent variable is the log of the vertical integration index of firm f located in country c with primary sector k. In columns (1)-(3), the vertical integration index considers only the primary sector; in columns (4)-(6), all manufacturing sectors in which the firm is involved. Sample includes firms $\geq$ 20 empl., MNCs, tariff data.