Corporate Hierarchies and International Trade:
Theory and Evidence *

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Abstract

Corporate organization varies within countries and between countries. We develop a theory which explains the variation in levels of decentralization across firms and links it to the trade environment that firms face. We introduce firms with internal hierarchies in a Melitz and Ottaviano (2007) model of international trade. We show that international trade increases the conflicts of interest between CEO/owners and middle managers within firms and these eventually lead to decentralized corporate hierarchies. We test the theory with original data on the internal organizations of 2200 Austrian and German firms and find that the empirical evidence is consistent with the model’s predictions.

JEL Classification: F12, F14, L22, D23

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1 Introduction

Corporate organization varies within countries and between countries. We document the pattern of corporate organization based on original data of 2200 corporations in Austria and Germany in 1998-1999 in Table 1.¹ About 2/3 of firms in both countries have an organization with at least partially decentralized decision-making between CEO/owners and middle managers inside the firms. Firms are ranked by their level of decentralization of decision-making for 16 (13) types of corporate decision such as decisions over acquisitions, finance, R&D, transfer prices, hiring more than 10 percent of current personnel, etc.² The numbers in Table 1 are averages of a ranking of corporate decision-making between 1 (centralized) and 5 (decentralized), depending on whether the CEO/owner or middle managers at the divisional level take the decisions.

¹For more details on the data, see the data section 5.3 and the Appendix.
²For a full list of the corporate decisions for which we have information on who takes the decision in the firm, see footnote 2 of Table 1 and Tables A1 and A2 of the Data Appendix.
Figure 1 illustrates the variation in the level of decentralization within the two countries. Within each of the two countries, the allocation of power inside the corporation appears to vary with firm size. Larger firms tend to have a more decentralized organization of decision-making compared to smaller firms.

<table>
<thead>
<tr>
<th>Level of Decentralization</th>
<th>Austria</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 - 2.50</td>
<td>39.2</td>
<td>24.3</td>
</tr>
<tr>
<td>2.51 - 3.50</td>
<td>41.3</td>
<td>50.4</td>
</tr>
<tr>
<td>3.51 - 5.00</td>
<td>19.6</td>
<td>25.2</td>
</tr>
</tbody>
</table>

Table 1  Level of Decision Making in Corporations

<table>
<thead>
<tr>
<th>Corporate decisions</th>
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<td>in percent of all firms</td>
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Source: University of Munich, firm survey of 2200 German and Austrian firms

1) The F-statistic is 8.67, which rejects the null of no difference in the level of decision among firms in Austria and Germany at the 0.004 significance level.

2) Corporate decisions include the decision over acquisitions, the financial decision, the decision over a new strategy, the decision over transfer prices, the decision to introduce a new product, the decision over R&D expenditures, the budget, the hiring of more than 10% of current personnel, the decision to hire two workers, to change a supplier, the decision over price increase and over product price, the decision over wage increase, the decision of firing of personnel and of hiring a secretary.

3) Level of decentralization: corporate decisions are ranked between 1 and 5 with 1 as the decision taken by the CEO at the top of the headquarters and 5 as the decision taken at the divisional level. Firms are ranked by their level of decentralization in decision making over 16 decisions (Germany) and 13 decisions (Austria), respectively. The numbers are averages over the 16 decisions (13 decisions) undertaken by firms. A firm with a mean of 1 is centralized and a firm with a mean of 5 is decentralized. For the ranking of each of these corporate decisions see Tables A1 and A2 of the Appendix.
Tables 2 and 3 unveil a third pattern in the data. Organizational change appears to vary with the trade exposure that firms face. Firms in the smaller, more open economy of Austria change their organizations faster than firms in the larger less open economy of Germany. In Austria, the proportion of firms with a new organization (less than 2 years of age) is almost twice as large as the proportion in Germany (Table 2). Moreover, over time, firms have been introducing less hierarchical organizations by delegating power to lower levels of the corporation. In 1999, 26.5 percent of German firms used the centralized U-form organizational structure compared to 45.5 percent before 1999. Table 3 shows a gradual decline during the period 1989-1999 in the importance of the U-form organization in which power is concentrated at the top of the corporate hierarchy. Firms have been shifting towards the decentralized M-form organization which introduces profit centres at the divisional level providing incentives for workers at lower levels of the corporate hierarchy. The importance of the M-form organization increased from 10.4 percent of firms using it before 1999 to 20.5 percent adopting it in 1999. A similar more pronounced trend towards less hierarchical organizations can be found in Austria (Table 3).
The features described raise several questions. First, can differences in the trade exposure of firms account for the observed corporate diversity across firms? Second, why are firms changing their mode of organization? Can increased integration into world markets explain this trend towards less hierarchical organizations?

In this paper, we offer a model that explains differences in corporate hierarchies across firms. We introduce firms with internal hierarchies (a CEO and a division manager) in a monopolistic competition model of trade. Our model simultaneously determines the organizational choices of firms and heterogeneity across firms in size and productivity. Moreover, in our model, firms choose their organizational structure in response to the trade environment that they face.

We develop an industry equilibrium model with a monopolistic competitive sector
with differentiated goods that combines the Aghion-Tirole (1997) (AT) theory of the firm with the Krugman (1980) theory of international trade. Rather than using constant elasticity of substitution (CES) utility as in Krugman (1980), we adopt the Melitz and Ottaviano (2007) framework with a linear demand across a continuum of varieties. In this way, the price elasticity of demand is no longer exogenously fixed but changes with the toughness of competition in the market. Consumers have preferences over varieties. Production of varieties in the monopolistic sector follows AT. A principal hires an agent to monitor projects and workers to produce goods. There are m potential methods of production of which one maximizes profits and another one maximizes a private benefit for the agent. Hence, there is a conflict of interest between the principal/owner and her agent as the payoffs of the parties depend on who’s project is implemented. The principal and the agent gather information to understand which of the m ways of running the firm maximizes profits and the private benefit of the agent, respectively. If both parties find out which are their preferred projects, the decision rights reside in the party with formal power. If only one of the parties learns which is his/her preferred project, the uninformed party always rubber-stamps this project. In this case, the informed party has real power. In choosing between retaining formal power or delegating power to the agent, the principal trades off the benefit from control against the manager’s loss of initiative.

The first result of the paper states that the conflict of interest between the principal and her agent (the power struggle in the firm) increases with the intensity of competition in the market. When competition becomes tougher (with an increase in the number of firms and/or with an increase in the proportion of low cost firms in the market) relative profits decline between a firm in which the agent has power (an A-firm) and a firm in which the principal decides over the project (a P-firm). Hence, it becomes more costly to delegate power to the agent. It matters more who runs the firm because, as competition increases, the revenues of high-cost A-firms go down by more than those of low-cost P-firms and they try to fight the loss in revenues by lowering markups more than P-firms.

We then solve for industry equilibrium (imposing free entry). We find that the power struggle within firms increases the stakes of firms and thus increases the free entry profit level that firms require to enter the market. We find further, that the power struggle within firms affects the corporate equilibrium that emerges in the economy. When
the conflict of interest between the principal and her agent is small, preferences over projects between the principal and agent are fairly congruent and the principal invests little in information collection. Under these circumstances, the initiative of the agent can be kept alive and there are no costs of control. Hence, principals find it optimal to keep control. On the other hand, when the conflict of interest is large, the principal’s investment in information collection will also tend to be large, and the agent’s initiative will be killed even when he/she is given formal power. Hence, there is no gain in assigning formal power to the agent and principals keep control. Finally, there may exist intermediate levels of conflict in the firm for which principals find it optimal to delegate formal power to their agents to induce them to invest in information collection.

Next, we open the economy up to trade by examining changes in market size. Interestingly, we find that the size of nations is an important determinant of the equilibrium mode of organizations. In small countries, competition tends to be weak and the conflict of interest between principals and middle managers will also tend to be small and principals tend to monitor little. On the other hand, in large countries, competition and the power struggle in firms are both intense and principals tend to monitor a lot. It follows that small and large countries will tend to have firms in which principals keep formal control, while in medium-sized countries organizations of firms may prevail in which power is delegated to middle managers.

Finally, we derive predictions from our model and expose them to the data. We predict that in a cross-section of firms, firms will have more decentralized corporate hierarchies when they face tougher competition and more exposure to trade. We predict further that organizational change towards less hierarchical firms is more likely to happen in firms more exposed to international trade. We test these predictions for a cross-section of firms with the original data of 2200 corporations in Austria and Germany in 1998-1999. We find that these predictions are not rejected by the data.6

The paper contributes to a new body of literature on organizations in general equilib-
In their theory of the firm, Aghion and Tirole (1997) assume an exogenous degree of conflict between CEOs/owners and middle managers in the firm. We endogenize the power struggle inside firms with the trade environment that firms face. Trade liberalization increases the costs of delegating power to a manager, since it matters more for profits who runs the firm. In earlier work (Marin and Verdier (2008a)) we introduce firms’ organizational choices in a Dixit and Stiglitz model of monopolistic competition. However, in this model, market size and trade have no effect on corporate organization. As is typical for a model of monopolistic competition of the Dixit and Stiglitz (1977) type, an increase in market size leads to an increase in the number of varieties produced without affecting the size of firms, markups and firm organization. In this paper, we incorporate endogenous markups using the linear demand system as in Melitz and Ottaviano (2008). Markups across firms respond now to the toughness of competition in a market. In this way, our model exhibits a link between trade liberalization, firm size and the mode of organization that firms choose.

In contrast to the present paper, we examine in Marin and Verdier (2010) how trade between dissimilar countries is affecting the corporate equilibrium organization of the world economy. We introduce organizational choices in a 2x2x2 Helpman and Krugman model of international trade in which countries differ in factor endowments. We find that relative factor endowments are important determinants of the equilibrium mode of organization. We find further that when two countries with different relative factor endowments open up to trade, their factor prices will tend to converge and this could induce a convergence in corporate cultures leading all principals in both countries to delegate power (even when no principal in any of the two countries was delegating in autarky). Surprisingly, as in Marin and Verdier (2010) with North-South trade between dissimilar countries, we find in the present paper that manager empowerment and the move to flatter corporate hierarchies emerge as an equilibrium when the world economy is governed by North-North trade as well.

In Marin and Verdier (2008b), we develop a theory in which organizational choices determine productivity differences between business firms. Rather than employing the customary assumption of an exogenous distribution of productivity as in Melitz (2003),

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7For a survey of this literature, see Marin and Verdier (2003), Helpman (2006), Spencer (2005) and Helpman, Marin and Verdier (2008).
heterogeneity in productivity arises as a result of the endogenous allocation of power inside the corporation. The model delivers new margins of trade adjustment: the monitoring margin and the organizational margin. Depending on which of these margins dominates, trade liberalization may lead to higher or lower productivity.

The paper is organized into the following sections. Section 2 describes the closed economy version of the model and studies the optimal choice of firm organization. Section 3 derives the conflict of interest between the CEO/owners and middle managers inside firms (the power struggle) as a function of the toughness of competition in the market. The section then discusses the industry equilibrium with free entry and derives the interaction between the power struggle in firms and the equilibrium mode of organization. Section 4 opens the economy up to trade and studies the role of international trade in determining corporate equilibrium. Section 5 describes the dataset and presents empirical evidence that supports the view that trade and competition can explain the allocation of power in firms as well as the speed of organizational change. Section 6 concludes. The proof of the main results and the description of the data are relegated to the Appendix.

2 The closed economy

2.1 Demand

Consider an economy with \( L \) consumers. Consumer preferences are defined over a continuum of differentiated varieties indexed by \( i \in \Omega \) and a homogenous good chosen as the numéraire. They are given by:

\[
U = q_0 + \beta \int_{i \in \Omega} q_i di - \frac{1}{2} \gamma \int_{i \in \Omega} q_i^2 di - \frac{1}{2} \eta \left[ \int_{i \in \Omega} q_i di \right]^2
\]

where \( q_0 \) and \( q_i \) are respectively the consumptions of the numéraire good and of variety \( i \) of the differentiated good. The demand parameters \( \beta \), \( \gamma \), and \( \eta \) are positive, with \( \beta \) and \( \eta \) giving the substitution between the differentiated varieties and the numéraire good and \( \gamma \) giving the degree of product differentiation between varieties \( i \).
The total demand for variety \( i \) can be expressed as

\[
q_i = Lq_i = \frac{\beta L}{\gamma + N\eta} - \frac{L}{\gamma} p_i + \frac{N\eta}{\gamma + N\eta} \frac{L}{\bar{p}}
\]

where \( q_i \) is the market demand for variety \( i \) and \( p_i \) is the price of variety \( i \). The average price index \( \bar{p} \) is given by \( \bar{p} = \frac{1}{N} \sum_{i \in \Omega} p_i d_i \). Note that in this linear demand system for varieties, the price elasticity of demand is driven by the 'toughness' of competition in the market induced either by a lower average price for varieties \( \bar{p} \) or more product varieties \( N \). The price elasticity of demand increases with lower \( \bar{p} \) and larger \( N \).  

### 2.2 Production

The numéraire good 0 is produced with constant returns of scale (one unit of good 0 requires one unit of labour) under perfect competitive conditions. Each variety of the differentiated good is produced under monopolistically competitive conditions. Suppose that a given variety \( i \) is produced with marginal cost \( c_i \), the profit maximizing output level \( q_i = q(c_i) \) and price level \( p_i = p(c_i) \) are given by:

\[
q_i = q(c_i) = \frac{L}{\gamma} \left[ p(c_i) - c_i \right]
\]

\[
p(c_i) = \frac{1}{2} \left[ c_i + \frac{\beta \gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta} \bar{p} \right]
\]

with the (absolute) markup over price as

\[
m(c_i) = p(c_i) - c_i = \frac{1}{2} \left[ \frac{\beta \gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta} \bar{p} - c_i \right]
\]

Note that in addition to the taste for variety parameter \( \gamma \), the markup is now also determined by the toughness of competition in the market induced either by a lower average price for varieties \( \bar{p} \) or a larger number of varieties \( N \).  

\[8\] For more details on the model see Melitz and Ottaviano 2008.  
\[9\] This is in contrast to CES utility used in the Dixit and Stiglitz 1977 model in which markups are fixed and exclusively determined by the taste for the variety parameter \( \gamma \).
Equilibrium profits of a firm with cost $c_i$ are given by

$$
\pi(c_i) = \frac{L}{4\gamma} [c_D - c_i]^2
$$

(5)

where $c_D$ is the cutoff cost level

$$
c_D = \frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta} \bar{\sigma}
$$

(6)

which is the cost level of a firm which is indifferent between remaining or leaving the industry with $p(c_D) = c_D$ and $\bar{\sigma} = \frac{1}{N} \sum_{i \in \Omega} c_i d_i$. Firms with cost $c_i < c_D$ earn positive profits. The cutoff cost level $c_D$ captures the ‘toughness’ of competition in an industry. 10

2.3 Power in the Firm

In this section, we determine the optimal choice of firm organization. We consider a firm with a simple hierarchy consisting of a CEO (the principal P) hiring a division manager (the agent A) to implement a project. There are $ex \ ante$ $m$ potential and $a \ priory$ identical projects (or ways to produce a good). Payoffs are $ex \ ante$ unknown to both parties. To make things interesting, we assume that there is a conflict of interest between the principal and the agent. Among the $m$ projects, there is one which yields the highest possible benefit $B$ for the principal and one which yields the highest possible benefit $b$ for the agent.11 Let $\alpha B$ be the principal’s expected benefit when the agent’s best project is implemented with ($0 \leq \alpha \leq 1$). We assume, for simplicity, that the agent’s expected benefit when the principal’s best project is implemented is 0.12 $\alpha$ is a congruence parameter capturing the degree of conflict between the principal and her agent. The lower $\alpha$, the more the principal’s payoff is reduced when the agent’s best project is implemented and hence the larger the conflict of interest between the principal and agent.

We turn now to the distinction between "formal" and "real power" in the firm. B

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10 see Melitz and Ottaviano (2008) for more details.
11 In the next section $B$ is endogenized by the intensity of competition in product markets.
12 Alternatively, one can assume that the agent receives a benefit of $\beta b$ when the principal’s preferred project is implemented with ($0 \leq \beta \leq 1$). Here, to simplify the exposition, we simply set $\beta = 0$. 

10
and $b$ are supposed to be known *ex ante* although the parties do not know *ex ante* which project yields such a payoff. We assume also that, among the $m$ projects, there are some with very high negative payoffs to both parties, implying that choosing a project randomly without being informed is not profitable to both agents who instead prefer to do nothing (project 0). This aspect, together with the fact that each uninformed party prefers to rubber-stamp the other informed party’s suggestion rather than do nothing, implies that private information about payoffs gives decision control to the informed party. In this case, the informed party has “real power” in the firm. There are two sources of power in the firm: "formal power" which is allocated to the manager by contract and "real power" which parties may obtain by being better informed.

Both parties may acquire information on possible ways to run the firm. However, we assume that the CEO has managerial overload. By spending some resource costs the principal learns the payoffs of all projects with probability $E$ and remains uninformed with probability $1 - E$. This generates costs of information collection of $g_P(E) = g \frac{E^2}{2}$. Similarly, by exerting some effort $g_A(e) = ke$ with $e \in [0, \bar{e}]$, $k < b$ the agent learns the payoff of all projects with probability $e$ and remains uninformed with probability $1 - e$. We assume that the principal is risk-neutral and that the agent is infinitely risk-averse with respect to income. Therefore, the agent is not responsive to monetary incentives and he agrees to receive a fixed wage $w$ equal to his opportunity cost. His incentives to gather information on projects will be directly related to the private non pecuniary benefit $b$ he gets from his “best” project.

Firms can choose between three types of organizations, a P-organization in which the CEO/owner has formal power, an A-organization in which the CEO delegates formal power to the agent, and an O-organization in which the principal has formal power and in which the agent exerts minimum effort. The O-organization can be thought of as a single managed firm (run by the principal) without an internal hierarchy. The agent is employed but is not doing anything useful, since it is assumed that the agent’s effort is assumed to be not contractible.

We first compute the Nash equilibria in information collection and the resulting payoffs under the three types of organization. Then we examine which of these organizations yields higher utility to the principal and is preferred by him/her.
**P-Organization**

Consider first the P-organization. Under the P-organization, the principal has formal power in the firm. The principal’s and agent’s expected payoffs are

\[
U_P(E, e) = EB + (1 - E)e\alpha B - g_P(E) - w
\]

\[
v_P(E, e) = (1 - E)eb - g_A(e)
\]

With probability \(E\), the principal becomes fully informed about her payoffs and picks her preferred project with monetary payoff \(B\), while the agent receives 0. With probability \(1 - E\), the principal remains uninformed about payoffs. The agent may then learn with probability \(e\) and suggest his best project to the principal (who accepts it). The principal receives a monetary payoff \(\alpha B\) while the agent gets his best private benefit \(b\). In this case the informed agent has real power in the firm. If none of the two agents find out which is their preferred project, production does not take place (the other \(m - 2\) projects yield large negative payoffs). If both agents engage in information collection, the decision rights reside with the principal (who has formal power).

The first order conditions of the two parties with respect to efforts \(E\) and \(e\) are

\[\begin{align*}
\text{Principal} & : \quad B(1 - e\alpha) = gE \\
\text{Agent} & : \quad e = \overline{e} \text{ if } k \leq b(1 - E) \\
& \quad = 0 \text{ if } k > b(1 - E)
\end{align*}\]

The conditions highlight the trade-off between the principal’s control and the agent’s initiative. The principal supervises more, the higher her stake in the project (the larger \(B\)), the larger the conflict of interest between the principal and agent (the lower \(\alpha\)) and the lower the agent’s effort \(e\). The agent, in turn, has more initiative the higher his stake (the larger \(b\)) and the lower the principal’s interference (the lower \(E\)). Thus, control comes with the cost of losing the agent’s initiative.

The Nash equilibrium level of efforts under the P-organization are\(^{13}\):

\(^{13}\)There are three possible Nash equilibria in effort levels. We select the equilibrium with the highest agent’s effort which is also the one preferred by the principal. For a discussion of the three Nash equilibria see Aghion and Tirole 1997.
\[ e_p^* = \bar{e}, \quad \text{and} \quad E_p^* = \frac{B(1 - \bar{e} \alpha)}{g} \quad \text{when} \quad B \leq \tilde{B}_P(\alpha) \]

\[ e_p^* = 0, \quad \text{and} \quad E_p^* = \frac{B}{g} \quad \text{when} \quad B > \tilde{B}_P(\alpha) \]

with

\[ \tilde{B}_P(\alpha) = \frac{g(1 - k/b)}{1 - \bar{e} \alpha} \]

\( \tilde{B}_P(\alpha) \) is the threshold level of profits at which the agent’s initiative is killed under the P-organization. For \( B \) above the level \( \tilde{B}_P(\alpha) \), the principal exerts the effort \( E_p^* \) and kills the initiative of the agent. The equilibrium expected utility of the principal under this organization is then:

\[ u_P(B) = U_P\left(\frac{B(1 - \bar{e} \alpha)}{g}, \bar{e}\right) \]

or

\[ u_P(B) = \frac{B^2(1 - \alpha \bar{e})^2}{2g} + \bar{e} \alpha B - w \quad (9) \]

**O-Organization**

Alternatively, whenever profits are sufficiently large \((B > \tilde{B}_P(\alpha))\), the Nash equilibrium level of efforts implies \( e_p^* = 0 \) and the agent does not actively engage in the firm under the P-organization. We denote such an organization an ‘O-organization’. The equilibrium expected utility of the principal in the O-organization is

\[ u_O(B) = U_P\left(\frac{B}{g}, 0\right) = \frac{B^2}{2g} - w \quad (10) \]

**A-Organization**

Consider now the A-organization. In this organization, the principal delegates formal power to the agent. Now the principal is prevented from overruling the agent’s decision when both have acquired information. The two parties’ expected payoffs are
then

\[ U_A(E, e) = eaB + (1 - e)EB - g_P(E) - w \]
\[ v_A(E, e) = eb - g_A(e) \]

Now the agent chooses his preferred project when informed. Under this organization, the principal is prevented from overruling the agent’s decision when both have acquired information. When the principal is informed and the agent is uninformed, the principal suggests her best project, which is then implemented by the agent. In this case the principal has real power in the firm. With \( b > k \), the Nash equilibrium effort levels under the A-organization are\(^{14}\):

\[ e^*_A = \bar{e} \quad \text{and} \quad E^*_A = B(1 - \bar{e}) \]

\[ (11) \]

The advantage of delegating formal power to the agent is that the agent has more initiative to become informed. In our specification, the agent will always give maximum effort under the A-organization while his initiative will be killed under the P-organization when the profits of the principal are large enough. The equilibrium expected utility of the principal under the A-organization is

\[ u_A(B) = U_A\left( \frac{B(1 - \bar{e})}{g}, \bar{e} \right) = \frac{B^2(1 - \bar{e})^2}{2g} + \bar{e}aB - w \]

\[ (12) \]

2.4 The Choice of Firm Organization

We turn now to the problem of determining the optimal organization of the firm. We ask how the parties’ informational efforts respond to exogenous changes in payoff \( B \) under the P-organization and A-organization, respectively.\(^{15}\) We solve for the subgame

\(^{14}\)When \( \beta > 0 \), we can show that there exists a threshold \( B_A \) given by

\[ B_A = \frac{g(1 - k/b)}{\beta(1 - \bar{e})} \]

such that the agent’s initiative is killed under the A-organization when \( B > B_A \). Intuitively, above the threshold level \( B_A \), the principal’s stakes are so high that she acquires information \( E^*_A \) leading to a high probability of intervention which, in equilibrium, leads to the agent’s minimum effort \( e^*_A = 0 \).

\(^{15}\)We endogenize \( B \) with product market competition in the next section.
perfect equilibrium in effort levels $E^*, e^*$ under each mode of organization when profits gradually increase. We summarize the results in the following proposition. The proof is given in the appendix.

**Proposition 1** For $\bar{B}(\alpha) < \bar{B}_P(\alpha)$, the P-organization yields higher utility to the principal than the A-organization for all values of $B$.

For $\tilde{B}_P(\alpha) < \bar{B}(\alpha)$, three organizations may emerge as profits gradually increase.

- For $B \leq \tilde{B}_P(\alpha)$, the principal prefers the P-firm over the A-firm with $e^*_P = \underline{e}$ and $E^*_P = \frac{B(1-a\underline{e})}{g}$;
- For $\tilde{B}_P(\alpha) < B < \bar{B}(\alpha)$, the A-firm yields higher utility to the principal than the P-firm with $e^*_A = \underline{e}$ and $E^*_A = \frac{B(1-a\underline{e})}{g}$;
- For $\bar{B}(\alpha) \leq B$, the O-firm yields higher utility to the principal than the A-firm with $e^*_P = 0$ and $E^*_P = \frac{B}{g}$.

Intuitively, the mode of organization matters for incentives inside the firm at intermediate levels of profits only. At low and high profit levels, there is no trade-off between control and initiative. At low profit levels, the principal monitors and intervenes little because her stakes are small and she cares little. Therefore, the P-organization gives sufficient initiative to the agent. At high profit levels, the principal’s stakes are so large that she intervenes even under the A-organization, leading to minimum effort by the agent even when he is given formal power in the firm. Therefore, the principal may as well keep control by choosing the O-organization. At intermediate levels of profits, there is a trade-off between control and initiative and the principal delegates formal power to her agent to keep his initiative and the A-organization emerges as the optimal mode of organization.

The firm’s optimal choice of organization is illustrated in Figure 2. The $\tilde{B}_P(\alpha)$ curve captures the cost of having control in the firm in terms of the loss of agent initiative. The $\tilde{B}(\alpha)$ curve captures the gain of having control in terms of the firm’s/principal’s profits. From Proposition 1, we know that for profit levels below the $\tilde{B}_P(\alpha)$ curve, the benefit of control outweighs its costs and the firm chooses the P-organization. In fact, at these levels of profits, there are no costs of control, since the agent’s initiative can be kept alive under the P-organization. For profit levels in between the $\tilde{B}_P(\alpha)$ and the $\tilde{B}(\alpha)$ curves,
the cost of control outweighs the benefit and the firm opts for the A-organization. For profit levels above the $\tilde{B}(\alpha)$ curve, the benefit of control again outweighs its costs and the firm chooses the O-organization.

3 Organization, the Power Struggle and Competition

3.1 Endogenous Power Struggle

We incorporate now the choice of firm organization into the production side described in section 2. We endogenize profits $B$ and the power struggle within firms $\alpha$ in this section. Recall the distinction between formal and real power in the firm. Consider two types of firm depending on who has real (as opposed to formal) power in the organization. Firms in which the principals’ preferred project is implemented produce the good with production cost $c_i = c_B$. Call these firms "real P-firms”. Similarly firms in which the agent’s preferred project is implemented produce the good with production cost $c_i = c_h = \phi c_B$ and $\phi > 1$. Call these firms "real A-firms”. The idea here is that the agent does not always choose the cost minimizing project but rather one that is best for him and maximizes his perks. Thus, even in a ‘formal P-firm’ in which the principal keeps formal control, the agent’s preferred high cost project may get implemented. This will happen when the principal decides not to become informed but to rubber stamp the agent’s suggestion. This is a ‘real A-firm’ in a formal P-firm equilibrium.
From (5) we can rewrite the principal’s profits when her best project is implemented as:

\[ B = \pi(c_B) = \frac{L}{4\gamma} [c_D - c_B]^2 = \frac{Lc_B^2}{4\gamma} [\tilde{c}_D - 1]^2 \quad \text{with} \quad \tilde{c}_D = \frac{c_D}{c_B} \quad (13) \]

\( \tilde{c}_D \) is the cost gap between firms with zero profits \( c_D \) and the low cost P-firms \( c_B \). The smaller this gap, the harder it is to earn positive profits in the market. Thus, \( \tilde{c}_D \) reflects the toughness of competition faced by a firm.

The conflict of interest between the principal and her agent \( \alpha \) can also be expressed as a function of the cost gap \( \tilde{c}_D \)

\[ \alpha = \frac{\pi(c_b)}{\pi(c_B)} = \left[ \frac{\tilde{c}_D - \varphi}{\tilde{c}_D - 1} \right]^2 \quad (14) \]

The power struggle in firms becomes more intense (\( \alpha \) becomes smaller) with a decline in relative profits between an A-firm \( \pi(c_b) \) in which the agent runs the firm and a P-firm \( \pi(c_B) \) in which the principal has power in the firm. Relative profits between these two types of firm decline with tougher competition (with smaller \( \tilde{c}_D \)), because the revenues of high-cost A-firms go down by more than the revenues of low-cost P-firms. A-firms try to fight the loss in revenues by lowering markups more than P-firms. With more intense competition, it matters more who runs the firm and delegation of power to the agent becomes more costly to firms.

The two relationships (13) and (14) describe how \( \tilde{c}_D \), jointly affects profits and the power struggle in firms. Eliminating \( \tilde{c}_D \), they define a relationship between \( B \) and \( \alpha \) that has to be satisfied by any firm. From (13) we get

\[ \tilde{c}_D = 1 + \frac{2}{c_B} \sqrt{\frac{\gamma}{L}} \sqrt{B} \]

and from (14) we have

\[ \tilde{c}_D = \frac{\varphi - \sqrt{\alpha}}{1 - \sqrt{\alpha}} \]
Therefore, the relationship between \( B \) and \( \alpha \) is given by

\[
B = \tilde{B}(\alpha) = \left[ \frac{\varphi - 1}{1 - \sqrt{\alpha}} \right]^2 \frac{L c_B^2}{\gamma} \frac{1}{4}
\]  

The construction of the \( \tilde{B}(\cdot) \) curve is described in Figure 3. The curve \((PP)\) in quadrant I plots equation (11) and shows how the firm’s profits \( B \) vary with \( \zeta_D \) (relationship 13)). The curve has a positive slope, because when \( \zeta_D \) declines and competition becomes tougher, profits decline as revenues and markups become smaller. The curve \((\alpha\alpha)\) in quadrant II plots equation (12) and shows how \( \zeta_D \) affects the conflict of interest inside firms \( \alpha \) (relationship (14)). The curve has a positive slope because, when \( \zeta_D \) declines and competition becomes tougher, delegating power to the agent becomes more costly to firms and hence the conflict of interest in firms rises (\( \alpha \) becomes smaller). Quadrant III plots the 45° line making sure that the two curves \((\alpha\alpha)\) and \((PP)\) are drawn for the same value of \( \zeta_D \). Then the \( \tilde{B}(\cdot) \) curve is obtained in quadrant IV which shows how \( \alpha \) affects profits \( B \). The curve has a positive slope because, with an increase in \( \zeta_D \) and \( \alpha \), competition and the power struggle in firms decline and firms earn higher profits. A given value of \( \alpha \) in quadrant IV is associated with a value of \( \zeta_D \) in quadrant II which results in a level of profits \( B \) in quadrant I, generating a point \( M \) on curve \( \tilde{B}(\cdot) \) in quadrant IV.

The appendix shows that \( \tilde{B}(\cdot) \) satisfies \( \tilde{B}(0) > 0 \) and \( \tilde{B}(1) = +\infty \) and has a positive slope in the space \((B, \alpha)\). A downward move along \( \tilde{B}(\cdot) \) is associated with an increase in market competition (a decrease in \( \zeta_D \)).
3.2 Organizational Equilibria and Free Entry

We derive now the industry equilibrium in which the free entry conditions have to be fulfilled for a given choice of firm organization. The timing of events is as follows. In a first stage, firms decide whether or not to enter the market and to hire an agent to monitor projects. At this stage, there is free entry. In a second stage, firms decide who has formal power in the organization by choosing between the formal P-firm and the formal A-firm. In a third stage, information collection efforts are realized by the two parties and a project is selected. This, in turn, determines who has real power in the organization. Finally there is production, consumption and factor market clearing.

The free entry conditions for a given choice of firm organization can be written as $\max\{u_P(B), u_A(B), u_O(B)\} = 0$. The ”Max” argument in free entry conditions reflects the fact that each firm decides its optimal type after market entry. For simplicity, we normalize $\omega = 1$. Three types of free entry equilibria are possible:

i) Equilibrium with P-organization and $e_P^* = \bar{e}$

The free entry condition in such a regime is

$$u_P(B) = \frac{B^2(1 - a\bar{e})^2}{2g} + \bar{e}aB - 1 = 0 \quad (16)$$
This gives a unique positive solution \( B_P = B_P^*(\alpha) \) which is the free entry profit level that firms require to enter the market with a formal P-organization. Obviously, an equilibrium in this regime exists if and only if \( B_P^*(\alpha) \leq \overline{B}_P(\alpha) \)

\[ \text{ii) Equilibrium with A-organization and } e^*_A = \overline{e}. \]

The free entry condition in such a regime is

\[
u_A(B) = \frac{B^2(1 - \overline{e})^2}{2g} + \overline{e} \alpha B - 1 = 0 \quad (17)\]

The free entry condition gives a unique positive solution \( B_A = B_A^*(\alpha) \). An equilibrium in this regime exists if and only if \( \overline{B}_P(\alpha) \leq B_A^*(\alpha) < \overline{B}(\alpha) \).

\[ \text{iii) Equilibrium with O-organization and } e^*_P = 0 \]

Finally the free entry condition in this regime is

\[
u_O(B) = g \frac{B^2}{2} - 1 = 0 \quad (18)\]

which gives the solution \( B_P = \sqrt{2g} \). Such an equilibrium exists when \( \sqrt{2g} > \overline{B}(\alpha) \).

Next, we analyze how the incentives of firms to enter the market are affected by the anticipated power struggle in firms. In terms of the model, we look at how the equilibrium conditions for free entry for P-firms, A-firms, and O-firms, respectively, are affected by changes in \( \alpha \). We do this with the help of Figure 4. Recall that the curves \( B_P^*(\alpha) \) and \( B_A^*(\alpha) \) are the free entry profit levels that a firm requires to enter the market as a P-firm and as an A-firm, respectively. Both curves slope down at rate \( \alpha \), since the revenues of both firms increase with \( \alpha \) and thus firms require a lower profit to enter the market. The \( B_A^*(\alpha) \) curve lies above the \( B_P^*(\alpha) \) curve since, for any given \( \alpha \), firms with an A-organization anticipate that their profits will be reduced when the agent has power in the firm. Hence, A-firms require a larger profit to enter the market. When preferences between principals and agents are perfectly congruent (when \( \alpha = 1 \)), there is no conflict of interest and the organization of the firm stops mattering for market entry. Both types of firm will choose the same cost minimizing project (at \( \alpha = 1 \), the two curves collapse to the same required profit value \( B_A^*(\alpha) = B_P^*(\alpha) \)).
3.3 Free Entry Corporate Equilibrium

Consider now the structure of organizational equilibria with free entry which are determined in Figure 5. The figure combines the profit maximizing choice of organization of Figure 2 and the free entry conditions of Figure 4, to analyze the equilibrium mode of organization under free entry. The two curves $\tilde{B}_P(\alpha)$ and $\tilde{B}(\alpha)$ from Figure 2 determining the optimal organization are plotted as well as the two curves $B_P^*(\alpha)$ and $B_A^*(\alpha)$ from Figure 4 describing the free entry profit levels for P-firms with agent effort (i.e. $e = \bar{e}$) and for A-firms. In addition, the horizontal line $B_0^* = \sqrt{2g}$ gives the free entry profit level for O-firms. The bold line in Figure 5 describes the nature of free entry corporate equilibria as a function of the power struggle within firms.

Statement 1: When the power struggle in firms increases, the corporate equilibrium organization moves from the central P-organization to the decentralized A-organization to the singly managed O-organization.
3.4 Corporate Equilibrium and Competition

We are finally ready to describe the corporate equilibrium organization. This is done in Figure 6 which explores how the free entry organizational equilibria we have just derived in the previous section interact with the toughness of competition and the power struggle within firms. The $B^* B^*$ curve (derived in Figure 5) determines free entry profits and the profit maximizing choice of firm organization. The $B = \hat{B}(\alpha)$ curve (derived in Figure 4) determines profits, the toughness of competition in the market as well as the power struggle within firms. An equilibrium $E = (B^e, \alpha^e)$ is defined by the intersection point of the two curves. Since $B^* B^*$ is downward sloping in $\alpha$ and $\hat{B}(\alpha)$ is increasing in $\alpha$, we show in the appendix that such an organizational equilibrium $(B^e, \alpha^e)$ always exists. The model is then solved recursively. Once the equilibrium values of $B^e$ and $\alpha^e$ and an equilibrium organizational regime $i \in \{P, A, O\}$ are obtained, one can derive the corresponding threshold cost $\tilde{c}_i^d$ in quadrant II of Figure 6. Similarly, the equilibrium level of monitoring by firms $E_i$ is obtained, from which we then compute the equilibrium average costs $\bar{c}_i^d$, the equilibrium number of effective firms $N_i$, the number of firms entering $M_i = N_i / (1 - E_i + (1 - E_i) \epsilon)$ and output, revenues and markup levels of low cost P-firms and high cost A-firms. Finally, the labour market equilibrium gives the output level of the numéraire good $0$. 

22
Consider now the comparative statics associated with a change in market size $L$. A change in market size affects profits and the toughness of competition between firms. This, in turn, affects the power struggle within firms and the optimal firm organization.

The effect of a change in market size $L$ is illustrated in Figure 7. We know from (13) that a larger market increases firms’ profits as output per firm and revenues increase. This is reflected by an upward shift of the (PP) curve in quadrant I of Figure 7. At the same time, a change in $L$ does not affect the conflict curve $(aa)$ in quadrant II. Given that the profits of high cost and low cost firms are both directly proportional to market size, a change in $L$ has no direct effect on the conflict of interest $\alpha$, everything else being equal. Thus, an increase in $L$ shifts up the curve $\hat{B}(\alpha)$ in quadrant IV of Figure 7. Note also that the free entry curve $B^*B^*$ is not affected by a change in $L$.

As a consequence, market size affects the equilibrium organization of firms. An increase in $L$ makes the equilibrium point $E$ (intersection of $\hat{B}(\alpha)$ and $B^*B^*$) move along $B^*B^*$ upward from a P-equilibrium with power at the top of the organization to an A-equilibrium with power delegated to the divisional level, to finally a singly managed
O-equilibrium regime without internal hierarchies. Note also that with an increase in market size, $\alpha$ moves leftward along the $B^* B^*$ curve. Hence, the conflict of interest within the firm increases with an increase in $L$. Finally, in quadrant II of Figure 7, an increase in $L$ increases the toughness of competition in the market (decreases $\tilde{c}_D$).

Intuitively, an increase in market size increases the firms’ outputs and profits, encouraging the entry of other firms, tougher competition and smaller markups. With increased competition, delegation of power becomes more costly which tends to increase the power struggle between principals and middle managers (lower $\alpha$). A larger conflict of interest in firms and larger profits in turn stimulate monitoring by principals (increased effort $E$), making it more likely that the initiative of agents is crowded out under a central P-organization. Initially, when the market is small, the profits and the conflict of interest in firms is small. Therefore, principals of firms monitor little and do not kill the initiative of agents under the P-organization. There is no trade-off between control and initiative. Hence, firms choose the latter. However, when market size keeps increasing and reaches intermediate levels, profits, competition and the conflict within firms become sufficiently large to kill the initiative of agents under the P-organization.
There is a trade-off between control and initiative. Principals delegate power to agents to keep the initiative alive and the A-organization emerges as a free entry corporate equilibrium. When market size keeps increasing further, profits, competition, and the power struggle within firms become so large that the principals of firms prefer control no matter what. There is again no trade-off between control and initiative and the singly managed O-firm without effort from agents emerges as the equilibrium organization. This discussion can be summarized in the following statement

Statement 2: When the size of the market increases, the corporate equilibrium moves from the central P-organization to the decentralized A-organization and finally to the singly managed O-firm. Within each organizational regime (P, A or O), the conflict of interest between principals and managers increases with market size.

5 Empirical Evidence

In this section, we test the predictions of our theory against original data of 2200 global corporations in Austria and Germany. We first derive predictions from the theory. We then examine the relationship between the allocation of power in firms and international trade. Finally, we analyse how the trade environment affects the speed of organizational change. As predicted by the theory, we show that the level of decision-making inside firms as well as the speed of organizational change in Austrian and German corporations can be explained by the trade environment that they face.

5.1 Predictions

We start by examining the relationship between international trade and the mode of organization of firms. An increase in trade is captured in our model by an increase in market size $L$. From Figure 7, we can derive this relationship. Recall that an increase in market size $L$ shifts up the $\hat{B}(\alpha)$ curve along the $B^*B^*$ curve in quadrant IV. Hence, with an increase in $L$, competition becomes more intense ($\bar{c}_D$ declines) and the economy moves from a P-equilibrium with power at the CEO level to an A-equilibrium with power delegated to middle managers, to finally a singly managed O-firm. Thus, we have:
Prediction 1: In a cross-section of firms, firms will have more decentralized corporate hierarchies when they are facing tougher competition and a stronger exposure to international trade.

Next, we study the relationship between the exposure to trade and the speed of organizational change. Smaller economies will import more varieties from the larger foreign economy as home consumers want to consume all varieties produced in the world economy. Hence, firms in smaller countries will have larger trade shares than in larger economies. As the number of varieties supplied by foreign firms increases in response to trade liberalizations, smaller countries will experience a larger movement down along the $\tilde{B}(\alpha)$ curve in Figure 7 compared to larger countries. This corresponds to an increase in the toughness of competition (along $\tilde{B}(\alpha)$ $\tilde{c}_D$ declines). Hence, firms in smaller economies are more likely to shift the corporate equilibrium from a centralized O-organization to a decentralized A-organization in response to a liberalization of international trade. Thus, we have:

Prediction 2: In a cross-section of firms, organizational change towards less hierarchical organizations is more likely to happen in firms more exposed to international trade.

5.2 Specification

In order to test Prediction 1, we consider the following econometric model for decentralization:

$$\ln power_{ij} = \theta_1 + \theta_2comp_{ij} + \theta_3trade_{ij} + \theta_4nation_j + \theta_5w_{ij}^j + \epsilon_{ij} \quad (19)$$

where $i$ denotes firm and $j$ denotes country. $power_{ij}$ indicates whether headquarters or middle managers have power in the corporation. $power_{ij}$ is the mean of a ranking between 1 (centralized) and 5 (decentralized) of corporate decisions depending on whether the CEO/owner or the divisional manager in the firm take the decision. $comp_{ij}$ and $trade_{ij}$ are measures of domestic and foreign competition with very many, many, many, many, many.
or few when firms face very many, many or few competitors, respectively, rather than no competitors (the omitted category). nation is a dummy variable taking the value 1 for the large country Germany and zero for Austria. \( w_{ij}' \) is a vector of controls and \( \varepsilon_{ij} \) is an error term. In light of Prediction 1, we test for the hypotheses \( \theta_2 > 0 \) and \( \theta_3 > 0 \).

Next, we examine organizational change as stated in Prediction 2. We estimate an equation with the following specification:

\[
\text{age}_{ij} = \partial_1 + \partial_2 \text{trade}_{ij} + \partial_3 \text{nation}_j + \partial_4 (\text{nation}_j \ast \text{trade}_{ij}) + \partial_5 w_{ij}' + v_{ij} \tag{20}
\]

where \( \text{age}_{ij} \) is an indicator for organizational change. It is a dummy variable taking the value 1 and zero otherwise when firms have been structured according to the current type of organization for less than four years. \( \text{trade}_{ij} \) is a measure of competition with very many, many, or few when firms face very many, many or few foreign competitors, respectively. In light of Prediction 2, we test for \( \partial_2 > 0 \), \( \partial_3 < 0 \). In particular we test for \( \partial_4 < 0 \) that firms exposed to more foreign competition in the smaller country are more likely to introduce organizational change. \( w_{ij}' \) is a vector of controls and \( v_{ij} \) is an error term.

\section*{5.3 The Data}

We conducted a survey of 2200 global corporations in Austria and in Germany in the period 1998-2001. Due to the length of the questionnaire, we personally visited the firms in Austria or Germany, or conducted the interviews by phone. The data include all publicly traded German DAX firms. The data consist of the organizational part of a full population survey of global corporations in Austria and Germany investing in Eastern Europe. The firms included in the sample are global corporations in the sense that they at least have two subsidiaries outside Austria and Germany, respectively. The sample covers 1200 German and 1000 Austrian firms. In 1998-1999, about 90 percent of the total outgoing foreign direct investment in Austria has been reoriented to Eastern Europe including the former Soviet Union, while in Germany, Eastern Europe accounted for only about 5 percent of total outgoing foreign direct investment. This explains why the sample consists of relatively more Austrian firms in spite of Austria being much...
smaller country than Germany (with 8 Mio people, Austria’s population is 10 percent of Germany’s).

The organizational data of the sample are unique in several dimensions. They include detailed information on the internal organization of the corporations such as power relations between the CEO/owner and middle managers at the divisional level, organizational form, incentive system used for its workers, wages and educational qualifications of the firms’ work force, detailed data on the financial structure as well as balance sheet information. Table A3 of the data appendix gives summary statistics of all the variables used in this paper.\textsuperscript{17}

The left-hand side variable $power_{ij}$ of equation (21) is obtained from the question 'Who decides over the following issues concerning your corporation, headquarters or the divisional manager, please rank between 1 (centralized decision taken at the headquarters) and 5 (decentralized decision taken at the divisional level)?' The survey then lists 16 (Germany) and 13 (Austria) corporate decisions which are ranked by headquarters of the corporation including the decisions over acquisitions, financial decisions, the decision over a new strategy, transfer pricing, the decision to introduce a new product, the decision over R&D expenditures, the decision over the budget, the decision over product price, over a wage increase, the decision to fire personnel, and the decision to hire a secretary.\textsuperscript{18} Tables A1 and A2 of the Appendix give a complete list of the ranking of these decisions in the corporate hierarchy. The variable $power$ is the mean over the 16 (13) corporate decisions ranking for an individual firm ranging between 1 and 5. A firm with a mean of 1 has all 16 (13) decisions centrally organized with power at the top of the organization and a firm with a mean of 5 has these decisions decentralized to middle managers at the divisional level. As can be seen from Tables A1 and A2 the corporate decisions exhibit a robust ranking in the two countries. The decision over acquisitions and the financial decision tend to be taken at the top of the corporation in both countries, while the decision over R&D expenditures and the decision to introduce a new product tend to be taken together between headquarters and middle managers.

\textsuperscript{17}For more information on the data see Marin (2010).

\textsuperscript{18}In some cases these decisions in the corporation were ranked by the divisional manager, when the firm is a very large conglomerate. In this case, the interview was conducted at the divisional level.
The left-hand side variable $age_{ij}$ of equation (22) is obtained from the question 'How many years have you been using the current organization?' $age_{ij}$ is transformed to a dummy variable with value 1 when firms have been using the current organization for less than four years.

We use several measures to proxy for the right-hand variables competition and international trade. The variables $comp_{ij}$ and $trade_{ij}$ are subjective measures of domestic and foreign competition as perceived by firms. They are obtained from the question 'How many competitors do you face on your local (Austrian or German) market and worldwide, respectively?' Firms tend to face many (940) or few (808) competitors (out of 2058 firms) in local markets, while they face many (1463) and few (347) foreign competitors. 67 firms are a monopoly locally and 6 firms worldwide, while some firms did not find it profitable to enter the local market (243 firms) or world markets (194 firms). Since many of these firms are multi-product firms, the subjective measure of competition is an average description over the firms’ product range.

As an alternative to the firm-level measure we use the sectoral-level Lerner index (at the 3-digit ISIC level) obtained from the AMADEUS database of the Bureau van Dijk defined by $(1 - \text{average profits/sales})$ as a proxy for domestic competition. The average of the profit margins is taken first across all firms available in a three-digit industry in Austria and Germany, respectively, and secondly, over the years 1998-2000. Besides the firm specific measure of $trade_{ij}$ we use the import share, the export share and the average effective tariff rates on imports at the 3-digit sectoral level obtained from the WITS-TRAiNS database of the World Bank. We include several controls in the estimation such as firm size proxied by sales and the number of business segments $\#\text{segm}$. We obtained the latter from the question 'How many business segments do you have in the corporation?' In the survey, we followed the firms’ own definition of a business segment. This implies that the level of aggregation of what constitutes a business segment varies across firms. In the sample, the number of business segments varied between 0 (e.g. for a holding company without a production unit) and 14 segments. Moreover, we control for sales per worker as well as how capital intensive the firm is, as given by the physical capital to output ratio.
5.4 Results

5.4.1 The Allocation of Power

Our main findings are given in Table 4 which presents ordinary least squares estimates of equation (21). All p-values are computed allowing for heteroskedasticity at the firm level. Furthermore, all regressions include a set of industry dummies. The omitted category for domestic and foreign competition is ‘no competitor’. We include the variable domestic competition and the country dummy nation in column 1 as well as a range of additional firm-level controls to avoid reported correlations being driven by omitted variables. The additional firm-level covariates are log sales and log segments as well as log output per worker. Larger, more diversified and more productive firms appear to be significantly more likely to be decentralized. The estimated coefficient on local competition and on the country dummy nation are positive and are all highly significant at conventional levels, suggesting that firms exposed to tougher domestic competition in the larger country Germany tend to be more decentralized.

In column 2, we replace the firm specific measure of local competition with the more exogenous measure of competition given by the Lerner index at the sectoral 3-digit level. One problem with the firm level measure of competition is that it may suffer from reverse causality. To prevent the possibility of a single firm influencing the market outcome, we introduce the more exogenous measure of competition at the sectoral level given by the Lerner index. As shown in column 2, the results are robust to the measure of domestic competition as an increase in the Lerner leads to more decentralization.

In column 3, we turn to the firm specific measure of trade. Here we find that firms first centralize when faced with few foreign competitors and then decentralize when the number of foreign competitors increase. The relationship is significant at the 5 percent level. This finding is consistent with the theory’s prediction shown in Figure 7 and in Statement 2 of section 4. As predicted by the theory, firms have to reach a critical level of competition before they start to decentralize. We then include both measures of competition and trade together in the estimation in columns 4 and 5 with very similar results. A priori we do not expect that domestic or foreign competition affect the level of decentralization differently and the results indeed support this. Both measures are
significant and the size of the coefficients remain about the same when both measures are included.

In columns 6 and 7, we replace the firm specific measure of trade with the sectoral import share as an alternative measure of trade exposure. In specification 6, the estimated coefficient on the import share turns negative and the Lerner index becomes insignificant. There are several caveats to bear in mind when interpreting the results of specification 6. First, the data sample drops almost in half when we use the import share, since data on the import share are not available for several 3 digit industries. Moreover, the sectoral import share is a poor measure of firms’ true exposure to trade when only a small number of firms in a sector engage in trading activities.\(^{19}\) An increase in the average trade ratio in a sector does not expose the mass of firms in a sector to the critical level of international competition suggested by our theory, when the distribution of firms’ trade exposure in a sector is particularly skewed. As a result, the statistical association of the import ratio with the firms’ level of decentralization may turn out not to be statistically different from zero or the estimated coefficient on the import ratio may have a positive sign as firms stay centralized when the average import ratio of the sector is not large enough to induce a change in the organization of firms.

Alternatively, the negative association between the level of decentralization and the import ratio may also be caused by the endogeneity of the import ratio. The endogeneity bias here is that we may underestimate the importance of import competition because more decentralized firms may be more productive and may have lower import ratios and drive out foreign rivals. We address the problem of endogeneity in column 7. We introduce the effective tariff rates on imports as an instrument for imports which are supposed to be truly exogenous to firms. We find that tariffs are a relevant instrument as larger tariffs are estimated to significantly reduce the import ratio in the first stage regression. We indeed find that the influence of imports on the level of decentralization has been underestimated as the estimated coefficient on the import ratio turns positive but is not significant. Overall, we take the findings given in Table 4 as supporting Prediction 1 that firms exposed to tougher competition and more trade introduce more

\(^{19}\)That the mass of firms do not engage in trading activities is suggested by recent theoretical and empirical literature on trade, see Melitz (2003) and Bernard et al. (2007).
decentralized corporate hierarchies. 20

Delegation of power may be more beneficial for some decisions than others. In Table 5 we focus on two corporate decisions for which empowerment of middle managers may matter most, the decision over R&D and the decision to introduce a new product. These two decisions tend to be typically shared between the CEO and middle managers (see Tables A1 and A2) and they tend to be delegated to middle managers when domestic competition increases (see columns 1, 2, 6 and 7 of Table 5). The results for foreign competition are more ambiguous. The firm specific measure of trade suggests that firms centralize R&D with more foreign competitors, while all other measures of trade exposure such as import and export ratios as well as the tariff rates on imports indicate that firms decentralize R&D with a stronger exposure to trade.

As suggested before the differences in the results between the two measures of trade may be caused by the fact that only a small number of firms in a sector engage in trade. Our theory suggest a non monoton relationship between international trade and the level of decentralization. The firm specific measure of trade is a strong measure of trade as it captures firms’ true exposure to foreign competition. The sectoral measure of trade is a weak measure when firms are heterogenous in trading activities. The data in Table A3 of the Appendix indeed suggest that the firm level measure of trade indicates a much stronger exposure to trade compared to the sectoral trade ratios. Firms in our data sample have more foreign than domestic competitors when they are facing very many and many competitors (the ratio is 1.4). As predicted by the theory, we find that with the weak measure of trade firms tend to decentralize and with the strong measure of trade they centralize R&D when trade increases. Note the difference in the organizational response of R&D decisions compared to the other corporate decisions. Apparently, firms respond earlier with changing who in the firm decides over R&D when the trading environment changes compared to all other corporate decisions. All corporate decisions at first remain centralized and are then decentralized when trade increases (see the results of Table 4).

20Using an elaborate measure of management practices for the US, UK, GER, and FRA, Bloom and Van Reenen (2007) also find that competition is a driving force behind the quality of management in corporations. Poor management practices tend to be more prevalent when product market competition is weak.
### Table 4: Determinants of the Level of Power in Corporations

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<tr>
<th>Dependent Variable</th>
<th>Level of Decentralization</th>
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<tr>
<td></td>
<td>All corporate decisions</td>
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</table>

#### A. Local Competition
- Few competitors: 0.427*** [0.009] 0.352*** [0.016] 0.352*** [0.016] 0.281*** [0.013] 0.206** [0.009] 0.125*** [0.009]
- Many competitors: 0.379*** [0.009] 0.257*** [0.009] 0.122*** [0.009] 0.055** [0.009] 0.039*** [0.009] 0.028*** [0.009]
- Very many competitors: 0.098** [0.009] 0.0776 [0.009] 0.125*** [0.009]

#### B. Foreign Competition
- Few competitors: 0.060*** [0.003] 0.056** [0.003] 0.039*** [0.003] 0.028*** [0.003] 0.015*** [0.003] 0.011*** [0.003] 0.007*** [0.003]
- Many competitors: 0.110** [0.004] 0.122*** [0.004] 0.095** [0.004] 0.080** [0.004] 0.067** [0.004] 0.053** [0.004] 0.035** [0.004]
- Very many competitors: 0.008 [0.005] 0.006 [0.005] 0.006 [0.005] 0.006 [0.005] 0.006 [0.005] 0.006 [0.005] 0.006 [0.005]

### Notes
- All coefficients are marginal effects from ordinary least squares estimations. Robust standard errors corrected for arbitrary variance-covariance matrix of the firm level in parentheses. The dependent variable is transformed in logs and indicates whether corporate decisions are taken at the CEO level in the top of the organization (5="controlled decisions") or by middle managers at the divisional level (5="decentralized decisions"). All corporate decisions include all decisions listed in Tables A1 and A2. The omitted category for local and foreign competition is "no competition". The instrument for the import share is the variable tariffs. All regressions include controls for output per worker and the number of business segments in the corporation. See text and Tables A3, A2, and A3 of the Appendix for variable definitions.

* ** significant at 10% ** significant at 5% *** significant at 1%
5.4.2 Organizational Change

Table 6 reports probit maximum likelihood estimates of equation (22). All p-values are computed allowing for heteroskedasticity at the firm level. Furthermore, all regressions include a set of industry dummies. We also include additional firm-level controls to avoid omitted variable bias. The additional firm-level covariates are the log of output per worker, the log of physical capital stock divided by sales and the log of firm sales as a measure of firm size. In light of prediction 2, we examine in column 1 whether \( \partial_2 > 0, \partial_4 < 0 \). With the firm specific measure of trade we do indeed find that firms are more likely to introduce organizational change when they are exposed to many and very many foreign competitors. The interaction of trade with nation turns negative.
for very many foreign competitors suggesting that in the smaller country, firms opted for organizational change when faced with very many foreign competitors as opposed to firms in the larger economy with few foreign competitors.

In column 2, we re-run the specification with the firm specific measure of domestic competition with similar albeit stronger results. In column 3, we include both the firm specific measures of domestic and foreign competition supporting the view that it is foreign rather than domestic competition which acts as the driving force behind organizational change. This is also supported by column 4 when we replace the firm specific measure of domestic competition by the Lerner index and use as an alternative measure of trade the import ratio at the sectoral level. We find that the Lerner index has no significant effect on the probability of introducing organizational change, while a stronger exposure to import competition increases the probability of changing the organization. The interaction of the importshare with nation is again negative, supporting the prediction that foreign competition acts as a driver for change, particularly in the smaller economy. In column 5, we use import tariffs as an instrument for the import share to account for the possibility that imports may be endogenous. We indeed find that tariffs are a relevant instrument in the first stage regression and the results become stronger in the instrumental variable regression. Overall, the findings of Table 5 give support to Prediction 2 that firms more exposed to international trade, in particular in the smaller more open economy, are more likely to introduce organizational change.
<table>
<thead>
<tr>
<th>Table 6</th>
<th>Determinants of Organizational Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dependent Variable (mean=0.39)</td>
</tr>
<tr>
<td></td>
<td>Age of Organization less than 4 years</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>Probit</td>
</tr>
<tr>
<td>A. Foreign Competition</td>
<td></td>
</tr>
<tr>
<td>few competitors</td>
<td></td>
</tr>
<tr>
<td>many competitors</td>
<td>0.26</td>
</tr>
<tr>
<td>[0.185]</td>
<td>[0.203]</td>
</tr>
<tr>
<td>very many competitors</td>
<td>0.824***</td>
</tr>
<tr>
<td>[0.804]</td>
<td>[0.291]</td>
</tr>
<tr>
<td>competition*nation</td>
<td></td>
</tr>
<tr>
<td>few competitors</td>
<td>1.255***</td>
</tr>
<tr>
<td>[0.275]</td>
<td>[0.292]</td>
</tr>
<tr>
<td>many competitors</td>
<td></td>
</tr>
<tr>
<td>very many competitors</td>
<td>-1.361***</td>
</tr>
<tr>
<td>[0.479]</td>
<td>[0.484]</td>
</tr>
<tr>
<td>B. Local Competition</td>
<td></td>
</tr>
<tr>
<td>few competitors</td>
<td></td>
</tr>
<tr>
<td>many competitors</td>
<td>12.60***</td>
</tr>
<tr>
<td>[0.903]</td>
<td>[0.414]</td>
</tr>
<tr>
<td>very many competitors</td>
<td>11.80***</td>
</tr>
<tr>
<td>[0.517]</td>
<td>[0.419]</td>
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<tr>
<td>competition*nation</td>
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<tr>
<td>few competitors</td>
<td>-12.50***</td>
</tr>
<tr>
<td>[0.629]</td>
<td>[0.419]</td>
</tr>
<tr>
<td>many competitors</td>
<td>-12.28***</td>
</tr>
<tr>
<td>[0.614]</td>
<td></td>
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<tr>
<td>very many competitors</td>
<td>-7.394***</td>
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<tr>
<td>[0.419]</td>
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<tr>
<td>Lerner</td>
<td></td>
</tr>
<tr>
<td>-0.0148</td>
<td>-0.0442***</td>
</tr>
<tr>
<td>[0.019]</td>
<td>[0.013]</td>
</tr>
<tr>
<td>import share</td>
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</tr>
<tr>
<td>0.715***</td>
<td>4.957***</td>
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<tr>
<td>[0.830]</td>
<td>[0.277]</td>
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<tr>
<td>import share*nation</td>
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</tr>
<tr>
<td>-2.029**</td>
<td>-5.062***</td>
</tr>
<tr>
<td>[0.799]</td>
<td>[0.347]</td>
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<td>Industry dummies: yes</td>
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<tr>
<td>Observations</td>
<td>707</td>
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<td>Pseudo R-squared</td>
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<tr>
<td>First stage:</td>
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</tr>
<tr>
<td>tariff</td>
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</tr>
<tr>
<td>P-value</td>
<td>0.0000***</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>* significant at 10%; ** significant at 5%; *** significant at 1%</td>
<td></td>
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</tbody>
</table>

Notes: Robust standard errors corrected for arbitrary variance-covariance matrix at the firm level in parentheses. The dependent variable is a dummy variable indicating whether "Firm has been using the current organization less than 4 years". The omitted category for local and foreign competition is "no competitor". The instrument for the import share is the variable tariff. All regressions include controls for the firm's size, for the considered country and for the ratio of physical capital to sales. See text and Table A3 of the Appendix for variable definitions.
6 Conclusion

Can differences in firms’ exposure to trade account for the observed differences in corporate organization across firms? Can an increased integration into the world economy explain the trend towards less hierarchical organizations in rich countries? We have developed a model which combines the Melitz and Ottaviano model of trade with the Aghion and Tirole theory of the firm to answer these questions. Our model traces a link between international trade, competition and corporate organization which can account for the facts identified in the introduction. We derive predictions from our model which we test with original firm level survey data of 2,200 firms in Austria and Germany.

References


# Appendix

## Definition of Variables and Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Description</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Stand. Dev.</th>
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<tbody>
<tr>
<td><strong>Organizational Information</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>power</td>
<td>1161</td>
<td>All corporate decisions: 16 corporate decision (Germany) and 13 corporate decision (Austria) ranked between 1 and 5 with 1 as the decision taken by the CEO at the top of organization (centralized decision) and 5 as the decision taken at the divisional level (decentralized decision). The numbers are means over the 16 (13) decisions. A firm with a mean of 1 is centralized and a firm with a mean of 5 is decentralized. Corporate decisions include the decision over acquisitions, the financial decision, the decision over a new strategy, the decision over transfer prices, the decision to introduce a new product, the decision over R&amp;D expenditures, the budget, the hiring of more than 10% of current personnel, the decision to hire two workers, to change a supplier, the decision over price increase and over product price, the decision over wage increase, the decision of firing of personnel and of hiring a secretary. For the ranking of these decisions see Tables A1 and A2.</td>
<td>2.83</td>
<td>1</td>
<td>5</td>
<td>0.87</td>
</tr>
<tr>
<td>power R&amp;D</td>
<td>836</td>
<td>R&amp;D decision: 2 corporate decision which are the decision over R&amp;D expenditures and the decision to introduce a new product.</td>
<td>2.71</td>
<td>1</td>
<td>5</td>
<td>1.22</td>
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<td># business segments</td>
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<td>number of business segments in the firm</td>
<td>3.76</td>
<td>0</td>
<td>14</td>
<td>2.03</td>
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<td>age</td>
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<tr>
<td>D = 1, 487 observations</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Measures of Competition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>local competition</td>
<td></td>
<td>local competition as perceived by firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>very many competitors</td>
<td>2598</td>
<td>dummy variable equal to 1 and 0 otherwise if firm does not enter the market</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>many competitors</td>
<td>2558</td>
<td>dummy variable equal to 1 and 0 otherwise if firm faces many competitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>few competitors</td>
<td>2058</td>
<td>dummy variable equal to 1 and 0 otherwise if firm faces few competitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no competitors</td>
<td>2058</td>
<td>dummy variable equal to 1 and 0 otherwise if firm faces no competitors</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D = 1, 487 observations</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

40
### Definition of Variables and Descriptive Statistics (continued)

For a three-digit ISIC Rev. 3 industry j of country k:

\[
\text{Lerner}_j = \frac{1}{100} \sum_{n=1}^{N} \frac{\text{profit before tax}_j}{\text{operating revenue}_j}
\]

Data source: AMADEUS database (Bureau van Dijk, 2009)

### Measures of Trade

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Description</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import share</td>
<td>1055</td>
<td>Total imports divided by domestic production at three-digit ISIC Rev. 3 level in host countries and averaged over the years 1996 to 2000, when the three-digit level information is missing, the two-digit ISIC level is used.</td>
<td>0.38 0.01 1.40 0.25</td>
</tr>
<tr>
<td>Export share</td>
<td>1053</td>
<td>Total exports divided by domestic production at the three-digit ISIC Rev. 3 level in host countries and averaged over the years 1996 to 2000, when the three-digit level information is missing, the two-digit ISIC level is used. Source of trade data: WITS-UN COMTRADE database (World Bank, 2009). Source of production data: INDISTAT 4 (three-digit), STAN (two-digit) databases (UNIDO, 2008, OECD, 2009)</td>
<td>0.40 0.01 1.05 0.26</td>
</tr>
<tr>
<td>Foreign competition</td>
<td>2010</td>
<td>Foreign competition as perceived by firms</td>
<td>D=1, 194 observations</td>
</tr>
<tr>
<td>Very many competitors</td>
<td>2010</td>
<td>Dummy variable equal to 1 and 0 otherwise when firm does not enter the market</td>
<td>D=1, 1,463 observations</td>
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<tr>
<td>Many competitors</td>
<td>2010</td>
<td>Dummy variable equal to 1 and 0 otherwise when firm faces many foreign competitors</td>
<td>D=1, 347 observations</td>
</tr>
<tr>
<td>Few competitors</td>
<td>2010</td>
<td>Dummy variable equal to 1 and 0 otherwise when firm faces few foreign competitors</td>
<td>D=1, 1,603 observations</td>
</tr>
<tr>
<td>No competitors</td>
<td>2010</td>
<td>Dummy variable equal to 1 and 0 otherwise when firm faces no foreign competitors</td>
<td>D=1, 6 observations</td>
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<tr>
<td>Tariff</td>
<td>1057</td>
<td>Average effective tariffs on imports in host countries over the years 1996 to 2000 at the three-digit ISIC Rev. 3 level, when the three-digit level information is missing, the two-digit ISIC level is used. Source of trade data: WITS-TRADE database (World Bank 2009)</td>
<td>2.43 0.00 35.28 4.12</td>
</tr>
</tbody>
</table>

### Other Firm Level Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Description</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>1855</td>
<td>Firm-level sales (in Mio. Euro)</td>
<td>1,770 0.562 58,000 5,920</td>
</tr>
<tr>
<td>Labour Productivity</td>
<td>1728</td>
<td>Sales per worker</td>
<td>477,540 17,384 968,971 10,032.43</td>
</tr>
<tr>
<td>Physical Capital to Output</td>
<td>1194</td>
<td>Physical capital to output ratio</td>
<td>1.93 0 130 12.64</td>
</tr>
<tr>
<td>Nation</td>
<td>2123</td>
<td>Dummy variable equal to 1 if the country is Germany and 0 if it is Austria</td>
<td>D=1, 1,186 observations</td>
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</tbody>
</table>
### Definition of Variables and Descriptive Statistics (continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Description</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>Lerner index</td>
<td>2055</td>
<td>for a three-digit ISIC Rev. 3 industry j of country k:</td>
<td>94</td>
<td>78</td>
<td>122</td>
<td>6</td>
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<tr>
<td>(Lerner_{ij} = \frac{1}{1 - \frac{\text{profit before tax}<em>{ij}}{\text{operating revenue}</em>{ij}}} \times 100%).</td>
<td></td>
<td>Data source: AMADEUS database (Bureau van Dijk, 2009)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measures of Trade</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Import share</td>
<td>1055</td>
<td>total imports divided by domestic production at three-digit ISIC Rev. 3 level in host countries and averaged over the years 1996 to 2000, when the three-digit level information is missing, the two-digit ISIC level is used.</td>
<td>0.38</td>
<td>0.01</td>
<td>1.89</td>
<td>0.35</td>
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<tr>
<td>Export share</td>
<td>1053</td>
<td>total exports divided by domestic production at the three-digit ISIC Rev 3 level in host countries and averaged over the years 1996 to 2000, when the three-digit level information is missing, the two-digit ISIC level is used. Source of trade data: WITS-UN COMTRADE database (World Bank, 2009). Source of production data: UN/DOTSTAT 4(Digit), STAS (two-digit) database (UNIDO, 2008, OECD, 2009)</td>
<td>0.40</td>
<td>0.01</td>
<td>1.05</td>
<td>0.26</td>
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<tr>
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<td></td>
<td>foreign competition as perceived by firms</td>
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<tr>
<td>Very many competitors</td>
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<td>Tariff</td>
<td>1067</td>
<td>average effective tariffs on imports in host countries over the years 1996 to 2000 at the three digit ISIC Rev. 3 level, when the three-digit level information is missing, the two-digit ISIC level is used. Data source: WITS-TRAFFS database (World Bank 2009)</td>
<td>2.43</td>
<td>0.00</td>
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<td>Sales</td>
<td>1855</td>
<td>firm-level sales (in Mio. Eur)</td>
<td>1.770</td>
<td>0.562</td>
<td>58,000</td>
<td>5,920</td>
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<td>Labour productivity</td>
<td>1728</td>
<td>sales per worker</td>
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<td>9689711</td>
<td>1033243</td>
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<td>Physical capital to output ratio</td>
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</tbody>
</table>

\(D = 1, 1188\) observations