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**Corporate Hierarchies and the
Size of Nations:
Theory and Evidence**

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Corporate Hierarchies and the Size of Nations: Theory and Evidence *

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Abstract

Corporate organization varies within a country and across countries with country size. The paper starts by establishing some facts about corporate organization based on unique data of 660 Austrian and German corporations. The larger country (Germany) has larger firms with flatter and more decentralized corporate hierarchies compared to the smaller country (Austria). Firms in the larger country change their organization less fast than firms in the smaller country. Over time firms have been introducing less hierarchical organizations by delegating power to lower levels of the corporation. We develop a theory which explains these facts and which links these features to the trade environment that countries and firms face. We introduce firms with internal hierarchies in a Krugman (1980) cum Melitz and Ottaviano (2007) model of trade. We show that international trade and the toughness of competition in international markets induce a power struggle in firms which eventually leads to decentralized corporate hierarchies. We offer empirical evidence which is consistent with the models predictions.

JEL Classification: F12, F14, L22, D23

Keywords: international trade with endogenous firm organizations, endogenous congruence in the firm, corporate organization in similar countries, empirical test of the theory of the firm

1 Introduction

Corporate organization varies within a country and across countries with country size. We establish some stylized facts about corporate organization for two countries which are similar in many dimensions like factor endowments, geography, institutions, culture, language, but market size. With a population of 8 million Austria is one tenth the size of Germany with a population of 82 million people.¹ We document the pattern of corporate organization based on unique data of 460 German and 200 Austrian corporations in 1998-1999.²

Corporate organization appears to vary with country size. The larger country (Germany) has firms with more decentralized corporate decision making compared to the smaller country (Austria). Table 1 provides an illustration of this fact. In Austria, almost 40 percent of firms organize corporate decisions centrally at the top of the organization (at the CEO level) compared to 24.4 percent of German corporations. German corporations tend to have an internal power allocation which is shared between the CEOs/owners at the top of the organization and middle managers at the divisional level (50.4 percent of firms in Germany compared to 41.3 percent in Austria). Firms are ranked by their level of centralization of decision making for several corporate decisions. The numbers in Table 1 are means 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 decision (see footnotes of Table 1 and Tables A1 and A2 of the the Data Appendix for a more detailed description).

¹In 1998 Austria had an export ratio of 44.9 percent of GDP and Germany of 28.7 percent.

²For more details on the data see the Appendix and Marin (2006).

Table 1 Level of Decision Making in Corporations¹⁾

	Austria	Germany
	corporate decisions ²⁾	
level of decentralization ³⁾	in percent of all firms	
1.00 - 2.50	39.2	24.3
2.51 - 3.50	41.3	50.4
3.51 - 5.00	19.6	25.2

Source: University of Munich, firm survey of 660 German and Austrian firms

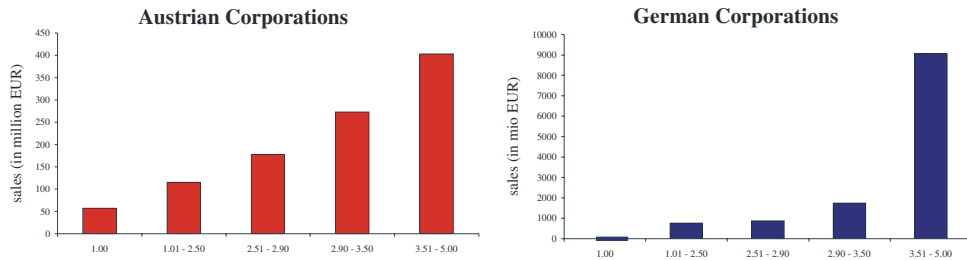
¹⁾The F-statistics = 8.67 rejects the null of no difference in the level of decision among firms in Austria and Germany at the 0.004 significance level.

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.

Figure 1 illustrates a second fact about corporate organization across firms and countries. Across the two countries, the larger country Germany has larger firms compared to Austria when measured by firms' sales. 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.

Figure 1 Level of Decentralization and Firm Size



horizontal axis: level of decentralization of corporate decisions, see footnotes 2 and 3 of Table 1 for definition.

Table 2 unveils a third pattern of the data. Organizational change appears to vary with country size. Firms in the smaller more open economy change their organization faster than firms in the larger less open country. In Austria, the share of firms with a new organization (less than two years of age) is almost twice as large compared to Germany.

Table 2 Age of Organization in Corporations

	Austria	Germany
less than two years	26.2	15.6
two to eight years	21.4	27.1
more than nine years	52.4	57.2

Source: University of Munich, firm survey of 660 German and Austrian firms

Table 3 illustrates the fourth fact. Over time, firms have been introducing less hierarchical organizations by delegating power to lower levels of the corporation. In 1999 (today), 26.5 percent of German firms use the centralized U-form organization compared to 45.5 percent before. Table 3 shows a gradual decline since 1989 (over the last 10 years) 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 centers at the divisional level providing incentives for workers at lower levels of the corporate hierarchy. The importance of the M-form organization increased from 10.5 percent of firms using it before to 20.5 percent adopting it in 1999. A similar more pronounced trend towards less hierarchical organizations can be found for Austria.^{3 4}

Table 3 **Organizational Change**

in percent of all firms with a change in organization ¹⁾								
	Austrian Corporations				German Corporations			
	today ²⁾	before	5 years before	10 years before	today ²⁾	before	5 years before	10 years before
Functional (U-form)	24.2	51.1	34.5	43.2	26.5	45.5	33.5	40.4
Holding (H-form)	31.6	11.9	23.7	16.4	25.5	7.5	19.4	14.1
Divisional with groups and/or sectors (M-form)	19.7	6.7	10.1	9.6	20.5	10.4	20.0	18.6
other	24.7	30.4	31.8	30.8	27.5	36.6	27.1	26.9

Source: University of Munich, firm survey of 660 German and Austrian firms

¹⁾ In Germany 58.1 percent of firms and in Austria 86.3 percent of firms reported a change in organization. The M-form organization is a multi-divisional organization of "self-contained units" which are organized in profit centers. The U-form organization consists of specialized units which groups together similar tasks.

²⁾ In Germany today is 1998 and 1999, in Austria it is 2000 and 2001.

The described features raise several questions. First, can differences in countries' trade exposure account for the observed corporate diversity across countries and firms? Second, why are firms changing their mode of organization? Can an increased integration into world markets explain this trend towards less hierarchical organizations?

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

We develop an industry equilibrium model with a monopolistic competitive sector with differentiated goods that combines the Aghion-Tirole (1997)

³For the distinction between the M- and the U-form organization see Williamson (1975).

⁴Empirical evidence on the changing nature of corporate hierarchies is scarce. Besides anecdotal evidence in the business press there are a few studies which document these corporate changes for US corporations see Ostermann (1996), Holmstrom and Kaplan (2001), Rajan and Wulf (2006).

(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 linear demand across a continuum of varieties. This way the price elasticity of demand is no longer exogenously fixed and changes with the toughness of competition in the market. Consumers have preferences over varieties. Production of the varieties in the monopolistic sector is as in AT. A principal hires an agent to monitor projects and workers to produce. 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 which of the m ways to run 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 her preferred project is, the uninformed party always rubber-stamps this project. In this case, the informed party has *real power*. In choosing between keeping 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 share 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 high-cost A-firms' revenues go down by more than those of low-cost P-firms and they try to fight the loss in revenues by lowering mark-ups by more than P-firms.

We then solve for the industry equilibrium (imposing free entry). We find that the power struggle in 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 in 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 her 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 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 organization. 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 firm organizations 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 in larger countries. Organizational change towards less hierarchical firms is, however, more likely to happen in smaller countries. We predict further, that in a cross section of firms, the power struggle between CEOs/owners and middle managers will be more intense in larger more competitive countries. We test these predictions for a cross section of firms with unique data of 660 corporations in Austria and Germany in 1998-1999. We find that these predictions are not rejected by the data.⁵

The paper contributes to a new body of literature on organizations in general equilibrium models of international trade.⁶ 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

⁵Recently, a new empirical literature has emerged which investigates the determinants of how firms are organized. Acemoglu et al (2005, 2007) examine the role of technology for vertical integration and the decentralization of firms, Bloom and Van Reenen (2007) investigate the role of competition for management practices in four OECD countries, and Marin (2006) and Nunn and Trefler (2008) analyse the boundaries of multinational corporations.

⁶For a survey of this literature, see Marin and Verdier (2003a), Helpman (2006), Spencer (2005) and Helpman, Marin, Verdier (2008).

struggle inside firms by the trade environment firms face. Trade liberalization increases the costs of delegating power to the manager, since it matters more for profits who runs the firm. In earlier work (Marin and Verdier (2007)) 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 (2007). Markups across firms respond now to the toughness of competition in a market. This way our model exhibits a link between trade liberalization, firm size and the mode of organizations firms choose.

In contrast to the present paper, we examine in Marin and Verdier (2003b) 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 MV (2003b) with North-South trade between dissimilar countries, we find in the present paper that managers' 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 (2008) we are reversing the question of this paper by asking how corporate organization is affecting the nature of competition rather than the other way around. We develop a theory in which organizational choices determine productivity differences across business firms. Rather than employing the customary assumption of an exogenous distribution of productivity as in Melitz (2003), heterogeneity in productivity arises as a result of the endogenous allocation of power inside the corporation. The model has several novel features. First, the intensity of competition depends on whether headquarters or middle managers have power inside the corporation. Second, 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 in 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 power struggle in firms 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 the size of nations in determining the corporate equilibrium. Section 5 presents empirical evidence supporting the view that trade and competition are explaining the allocation of power in firms as well as the conflict of interests between principals/owners and managers. 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 homogeneous good chosen as the numeraire. 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 consumption of the numeraire good and of variety i of the differentiated good. The demand parameters β , γ and η are positive with β and η giving the substitution between the differentiated varieties and the numeraire good and γ as the degree of product differentiation between varieties i . When $\gamma = 0$, varieties are perfect substitutes and consumers care only about the total consumption level over all varieties given by

$$Q^c = \int_{i \in \Omega} q_i di$$

Let p_i be the price of variety i . We assume that consumers have positive demand for the numeraire good. Then standard utility maximization gives

the individual inverse demand function

$$p_i = \beta - \gamma q_i - \eta Q^c$$

whenever $q_i > 0$. This will be the case when

$$p_i \leq \frac{1}{\gamma + \eta N} (\gamma \beta + \eta N \bar{p})$$

where N is the measure of the set of varieties Ω with positive demand and \bar{p} the average price index given by

$$\bar{p} = \frac{1}{N} \int_{i \in \Omega} p_i di$$

It follows that

$$\bar{p} = \beta - \frac{\gamma}{N} Q^c - \eta Q^c = \beta - \frac{\gamma + N\eta}{N} Q^c$$

Total demand for variety i can be expressed as

$$q_i = Lq_i = \frac{\beta L}{\gamma + N\eta} - \frac{L}{\gamma} p_i + \frac{N\eta}{\gamma + N\eta} \frac{L}{\gamma} \bar{p} \quad (1)$$

where q_i is the market demand for variety 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 .

2.1.1 Production

The numeraire good 0 is produced with constant returns to scale (one unit of good 0 requires one unit of labor) 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 , then profits for that variety can be written as

$$\pi_i = q_i(p_i - c_i)$$

The profit maximizing output level $q_i = q(c_i)$ and price level $p_i = p(c_i)$ are related to each other by:

$$q_i = q(c_i) = \frac{L}{\gamma} [p(c_i) - c_i] \quad (2)$$

Note, that output per firm increases with the size of the market L .⁷

The profit maximizing price can be written as

$$p(c_i) = \frac{1}{2} \left[c_i + \frac{\beta\gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta} \bar{p} \right] \quad (3)$$

with the (absolute) markup over price as

$$m(c_i) = p(c_i) - c_i = \frac{1}{2} \left[\frac{\beta\gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta} \bar{p} - c_i \right] \quad (4)$$

Note, that in addition to the taste for variety parameter γ 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

The average price \bar{p} and average cost of firms \bar{c} can be expressed as

$$\bar{p} = \frac{\bar{c} + \frac{\beta\gamma}{\gamma + N\eta}}{\frac{2\gamma + N\eta}{\gamma + N\eta}} \quad (5)$$

$$\bar{c} = \frac{1}{N} \int_{i \in \Omega} c_i di \quad (6)$$

and equilibrium profits of a firm with cost c_i are given by

$$\pi(c_i) = \frac{L}{4\gamma} [c_D - c_i]^2 \quad (7)$$

where c_D is the cutoff cost level

$$c_D = \frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta} \bar{c} \quad (8)$$

which is the cost level of a firm who is indifferent between remaining or leaving the industry. This firm earns zero profits as its price is driven down to its marginal costs, $p(c_D) = c_D$. Firms with cost $c_i < c_D$ earn positive profits. The cut off cost level c_D captures the 'toughness' of competition in an industry. The cut off cost level c_D declines and competition is tougher with more firms around (with larger N), with more low cost firms in the market (with lower \bar{c}), and when varieties are closer substitutes (with smaller γ).⁹

⁷In the the Dixit and Stiglitz (DS) model output per firm does not depend on market size. In the DS model a larger market increases the number of varieties without changing firm size.

⁸This stands in contrast to CES utility used in the DS model in which markups are fixed and exclusively determined by the taste for variety parameter γ .

⁹see Melitz and Ottaviano (2007) for more details.

2.1.2 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 priori 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.¹⁰ Let αB 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 0.¹¹ α is a congruence parameter capturing the degree of conflict between the principal and her agent. The lower α , the more is the principal's payoff reduced when the agent's best project is implemented and hence the larger the conflict of interest between the principal and her agent.

We turn now to the distinction between "*formal*" and "*real power*" in the firm. B and b are supposed to be known ex ante though the parties do not know ex ante which project yields such payoff. We assume also that, among the m projects, there are some with very high negative payoffs to both parties, implying that choosing randomly a project 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's party suggestion to 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

¹⁰In the next section B is endogenized by the intensity of competition in product markets.

¹¹Alternatively, one can assume that the agent receives a benefit of βb when the principal's preferred project is implemented with ($0 \leq \beta \leq 1$). Here, to simplify exposition we simply set $\beta = 0$.

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 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 yield higher utility to the principal and is preferred by her.

P-Organization

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

$$\begin{aligned} U_P(E, e) &= EB + (1 - E)e\alpha B - g_P(E) - w \\ \nu_P(E, e) &= (1 - E)eb - g_A(e) \end{aligned}$$

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 αB 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 in the principal (who has formal power).

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

$$\text{Principal} : B(1 - e\alpha) = gE \quad (9)$$

$$\text{Agent} : \begin{aligned} e &= \bar{e} \text{ if } k \leq b(1 - E) \\ &= 0 \text{ if } k > b(1 - E) \end{aligned} \quad (10)$$

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 the agent (the lower α) and the lower the agent's effort e . The agent, in turn, has more initiative the higher her stake (the larger b) and the lower the principal's interference (the lower E). Thus, control comes with the cost of loosing the agent's initiative.

The Nash equilibrium level of efforts under the P-organization are ¹²

$$\begin{aligned} e_P^* = \bar{e}, \text{ and } E_P^* &= \frac{B(1 - \bar{e}\alpha)}{g} && \text{when } B \leq \tilde{B}_P(\alpha) \\ e_P^* = 0, \text{ and } E_P^* &= \frac{B}{g} && \text{when } B > \tilde{B}_P(\alpha) \end{aligned}$$

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 's 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:

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

¹²There 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.

or

$$u_P(B) = \frac{B^2(1 - \alpha\bar{e})^2}{2g} + \bar{e}\alpha B - w \quad (11)$$

O-Organization

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

$$u_O(B) = U_P\left(\frac{B}{g}, 0\right) = \frac{B^2}{2g} - w \quad (12)$$

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

$$\begin{aligned} U_A(E, e) &= e\alpha B + (1 - e)EB - g_P(E) - w \\ v_A(E, e) &= eb - g_A(e) \end{aligned}$$

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 are¹³

$$e_A^* = \bar{e} \text{ and } E_A^* = \frac{B(1 - \bar{e})}{g} \quad (13)$$

¹³When $\beta > 0$, we can show that there exists a threshold \tilde{B}_A given by

$$\tilde{B}_A = \frac{g(1 - k/b)}{\beta(1 - \bar{e})}$$

such that the agent's initiative is killed under the A-organization when $B > \tilde{B}_A$. Intuitively, above the threshold level \tilde{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 minimum agent's effort $e_A^* = 0$.

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 provide maximum effort under the A-organization while his initiative will be killed under the P-organization for profits of the principal large enough. The equilibrium expected utility of the principal under the A-organization is

$$u_A(B) = U_A\left(\frac{B(1-\bar{e})}{g}, \bar{e}\right) = \frac{B^2(1-\bar{e})^2}{2g} + \bar{e}\alpha B - w \quad (14)$$

The Choice of Firm Organization

We turn now to determine the optimal firm organization. We now ask how the parties' informational efforts respond to exogenous changes in the payoff B under the P-organization and under the A-organization, respectively.¹⁴ We solve for the subgame perfect equilibrium in effort levels E^*, e^* under each mode of organization when profits gradually increase.

Two cases can be distinguished.

Case 1: $B \leq \tilde{B}_P(\alpha)$

At this profit level both firm organizations keep the agent's initiative alive.

The utility levels of the principal under the two forms of organization are simply

$$u_P(B) = \frac{B^2(1-\alpha\bar{e})^2}{2g} + \bar{e}\alpha B - w \quad \text{and} \quad u_A(B) = \frac{B^2(1-\bar{e})^2}{2g} + \bar{e}\alpha B - w$$

Given that $e_P^* = e_A^* = \bar{e}$, and that $E_P^* > E_A^*$ in this regime, it follows that $u_P(B) > u_A(B)$. Thus, the P-organization yields higher utility to the principal.

Case 2: $\tilde{B}_P(\alpha) < B$

At this profit level, the P-organization kills the agent's effort $e_P^* = 0$, while he exerts maximal effort $e_A^* = \bar{e}$ under the A-organization. The principal's expected utilities under the two organizations, respectively are given by

$$u_O(B) = \frac{B^2}{2g} - w \quad \text{and} \quad u_A(B) = \frac{(1-\bar{e})^2 B^2}{2g} + \bar{e}\alpha B - w$$

¹⁴We endogenize B by product market competition in the next section.

$u_O(B) > u_A(B)$ and thus the principal prefers the O-firm over the A-firm when

$$B > \bar{B}(\alpha) = \frac{2g\alpha}{2 - \bar{e}}$$

$\bar{B}(\alpha)$ is the threshold level of profits at which the principal is indifferent between loosing control while keeping the agent's initiative as in the A-organization and keeping control but loosing the agent's initiative as in the O-organization. When $B > \bar{B}(\alpha)$, the principal prefers to exert control and to loose the agent's initiative and she opts for the O-organization.

We summarize the preceding discussion in the following proposition.

Proposition 1 *For $\bar{B}(\alpha) < \tilde{B}_P(\alpha)$ 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 $e_P^* = \bar{e}$ and $E_P^* = \frac{B(1-\alpha\bar{e})}{g}$;*

- *For $\tilde{B}_P(\alpha) < B < \bar{B}(\alpha)$, the A-firm yields higher utility to the principal than the P-firm with $e_A^* = \bar{e}$ and $E_A^* = \frac{B(1-\bar{e})}{g}$;*

- *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 might 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 the agent's initiative. The $\bar{B}(\alpha)$ - 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 $\bar{B}(\alpha)$ - curve, the cost of control outweighs the benefit and the firm goes for the A-organization. For profit levels above the $\bar{B}(\alpha)$ - curve, the benefit of control again outweighs its costs and the firm chooses the O-organization.

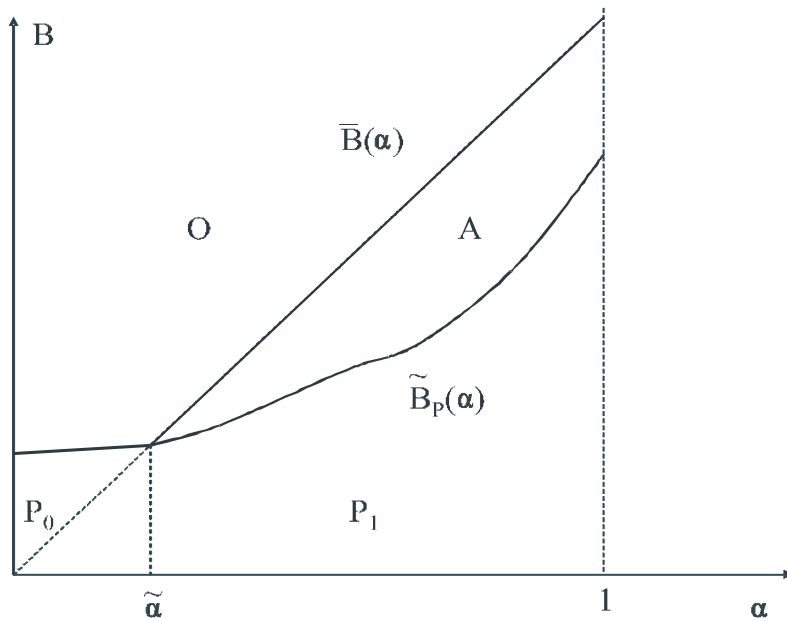


Figure 2: The Optimal Choice of Firm Organization

3 Market Competition and 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 in firms α in this section. Recall the distinction between formal and real power in the firm. Consider two types of firms 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 $c_i = c_b = \varphi c_B$ and $\varphi > 1$. 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 get informed and to rubber stamp the agent's suggestion. This is a 'real A-firm' in a formal P-firm equilibrium.

From (7) we can rewrite the principal's profits when her best project is implemented as

$$B = \pi(c_B) = \frac{L}{4\gamma} [c_D - c_B]^2 = \frac{Lc_B^2}{4\gamma} [\tilde{c}_D - 1]^2 \quad \text{with} \quad \tilde{c}_D = \frac{c_D}{c_B} \quad (15)$$

\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 that a firm faces.

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

$$\alpha = \frac{\pi(c_b)}{\pi(c_B)} = \left[\frac{\tilde{c}_D - \varphi}{\tilde{c}_D - 1} \right]^2 \quad (16)$$

The power struggle in firms becomes more intense (α 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 firms decline with tougher competition (with smaller \tilde{c}_D), because high-cost A-firms' revenues go down by more than revenues of low-cost P-firms. A-firms try to fight the loss in revenues by lowering mark-ups by 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.

To see this we express prices, output, mark-ups, and revenues of P-firms and A-firms, respectively as a function of \tilde{c}_D .

$$q_B = q(c_B) = L c_B \frac{\tilde{c}_D - 1}{2\gamma} \quad \text{while} \quad q_b = q(c_b) = L c_B \frac{\tilde{c}_D - \varphi}{2\gamma}$$

$$\begin{aligned}
p_B = p(c_B) &= c_B \frac{\tilde{c}_D + 1}{2} & \text{while } p_b = p(c_b) &= c_B \frac{\tilde{c}_D + \varphi}{2} \\
r_B = r(c_B) &= \frac{Lc_B^2}{4\gamma} (\tilde{c}_D^2 - 1) & \text{while } r_b = r(c_b) &= \frac{Lc_B^2}{4\gamma} (\tilde{c}_D^2 - \varphi^2) \\
\pi_B = \pi(c_B) &= \frac{Lc_B^2}{4\gamma} [\tilde{c}_D - 1]^2 & \text{while } \pi_b = \pi(c_b) &= \frac{Lc_B^2}{4\gamma} [\tilde{c}_D - \varphi]^2
\end{aligned}$$

$$\begin{aligned}
m_B = m(c_B) &= c_B \frac{\tilde{c}_D - 1}{2}, \\
m_b = m(c_b) &= c_B \frac{\tilde{c}_D - \varphi}{2}.
\end{aligned}$$

Low cost P-firms set lower prices p_B , produce larger outputs q_B , and earn larger revenues r_B , and profits π_B than high-cost A-firms (p_b, q_b, r_b, π_b). They also set larger mark-ups over price m_B compared to A-firms m_b .

The two relationships (15) and (16) 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 α that has to be satisfied by any firm. From (15) we get

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

and from (16) we have

$$\tilde{c}_D = \frac{\varphi - \sqrt{\alpha}}{1 - \sqrt{\alpha}}$$

Therefore, the relationship between B and α is given by

$$B = \hat{B}(\alpha) = \left[\frac{\varphi - 1}{1 - \sqrt{\alpha}} \right]^2 \frac{L c_B^2}{\gamma 4} \quad (17)$$

The construction of the $\hat{B}(\cdot)$ 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 \tilde{c}_D (relationship 15)). The curve is positively sloped, because when \tilde{c}_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 \tilde{c}_D affects the conflict of interest inside firms α (relationship 16)). The curve is positively sloped, because when \tilde{c}_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 (α becomes smaller). Quadrant III plots the 45⁰-line making sure that the two curves ($\alpha\alpha$) and

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 the free entry conditions reflects the fact that each firm decides about its optimal type after market entry. For simplicity, we normalize $w = 1$. 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

$$u_P(B) = \frac{B^2(1 - \alpha\bar{e})^2}{2g} + \bar{e}\alpha B - 1 = 0 \quad (18)$$

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 $B_P^*(\alpha) \leq \tilde{B}_P(\alpha)$

ii) Equilibrium with A-organization and $e_A^ = \bar{e}$.*

The free entry condition in such a regime is

$$u_A(B) = \frac{B^2(1 - \bar{e})^2}{2g} + \bar{e}\alpha B - 1 = 0 \quad (19)$$

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

iii) Equilibrium with O-organization and $e_P^ = 0$*

Finally the free entry condition in this regime is

$$u_O(B) = g\frac{B^2}{2} - 1 = 0 \quad (20)$$

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

Next, we analyze how firms' incentives 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 α . 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 with α , since both firms revenues increase with α 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 α , 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 to matter for market entry. Both types of firms will choose the same cost minimizing project (at $\alpha = 1$ the two curves collapse to the same required profit value $B_A^*(\alpha) = B_P^*(\alpha)$).

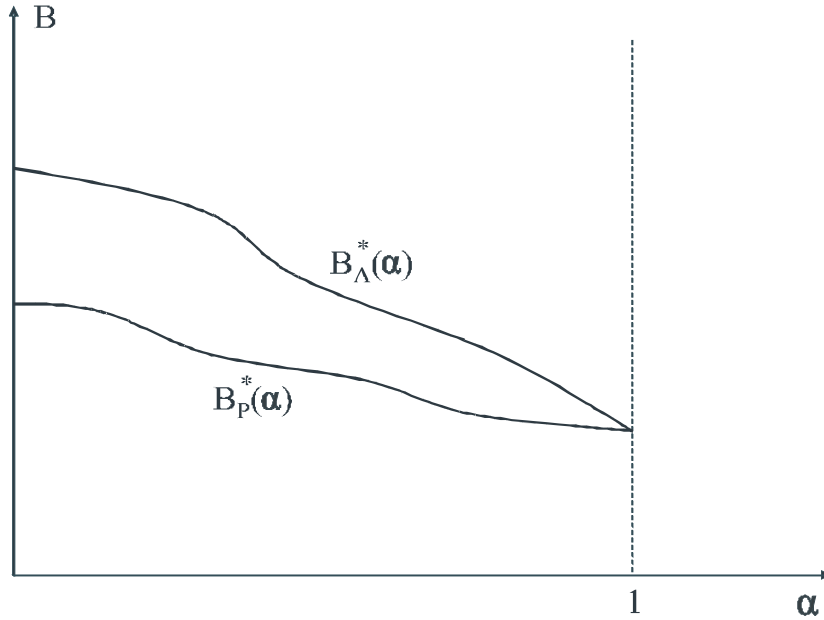


Figure 4: Equilibrium Entry

3.2 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 $\bar{B}(\alpha)$ from Figure 2 determining the optimal firm 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's effort (i.e. $e = \bar{e}$) and for A-firms. In addition, the horizontal line $B_0^* = \sqrt{2g}$ is giving the free entry profit level for O-firms.

The bold line in Figure 5 describes the nature of the free entry corporate equilibria as a function of the power struggle in firms α . Several points are worth noticing. First, at $\alpha = 1$, the mode of organization stops to matter. At this value of α , preferences of principals and managers are perfectly congruent and there is no conflict in the firm. Second, with a decrease in α , the equilibrium firm organization moves from the central P-organization with power at the top of the organization to the decentralized A-organization with power delegated to the manager and finally to the single managed O-organization. Typically, with a decrease in α , the stakes rise and firms require a larger level of profit B^* to enter the market under both organizations. As the conflict of interest in firms rise, principals start to monitor. Initially, for large values of α in the range of $[\alpha_P, 1]$, the firms' free entry stakes B^* are not too high. Therefore, firms' monitoring does not kill the initiative of agents even under the P-organization. Hence, firms choose the latter. However, when α goes down and the power struggle in firms increases, the required stakes to enter the market are high enough to kill the initiative of agents under the P-organization but not under the A-organization. There is a trade-off between control and initiative. The A-organization emerges as a corporate equilibrium for values of α in $[\alpha_0, \alpha_A]$. Finally, as α decreases further (i.e. for values of α smaller than α_0), the required profit level for market entry increases further until the stakes for firms become so high that firms favor control and lose the initiative of managers and the O-firm emerges as the equilibrium organization.

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 single managed O-organization.

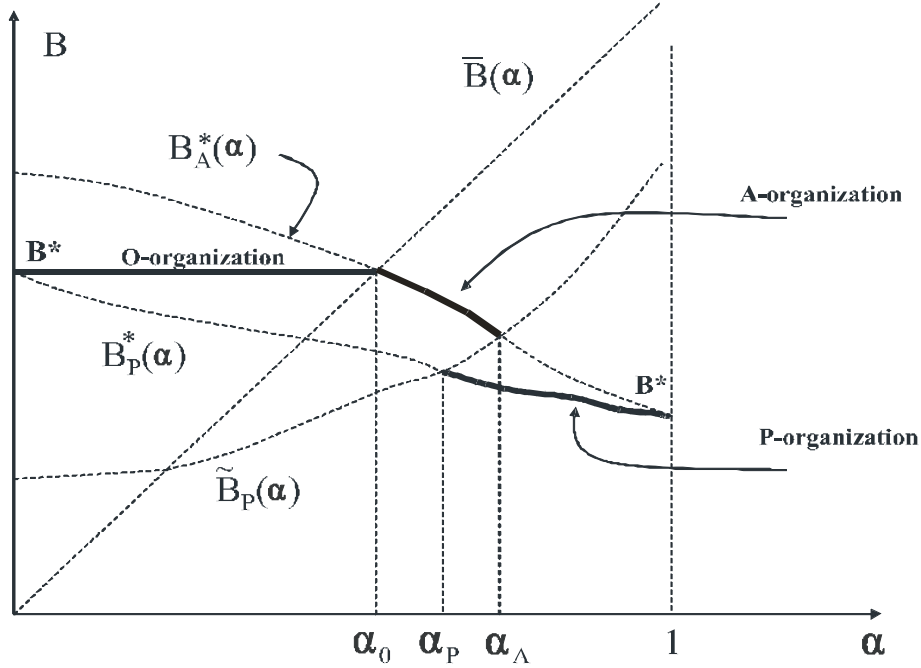


Figure 5: Free Entry Equilibrium Organization

3.3 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 in firms. The B^*B^* curve (derived in Figure 5) determines free entry profits and the profit maximizing choice of firm organization. The $B = \widehat{B}(\alpha)$ curve (derived in Figure 4) determines profits, the toughness of competition in the market as well as the power struggle in firms. An equilibrium $E = (B^e, \alpha^e)$ is defined by an intersection point of the two curves. Since B^*B^* is downward sloping in α and $\widehat{B}(\alpha)$ is increasing in α , we show in the appendix that such an organizational equilibrium (B^e, α^e) always exists. The model is then solved recursively. Once the equilibrium values of B^e and α^e and an equilibrium organizational regime $i \in \{P, A, O\}$ are obtained, one can derive the corresponding threshold cost \tilde{c}_D^i 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 , the equilibrium number of effective firms N_i , the number of entering firms $M_i = N_i / (E_i + (1 - E_i)e)$ and output, revenues and mark-up levels of low costs P-firms and high costs A-firms. Finally, the labor market equilibrium

gives the output level of the numeraire good 0.

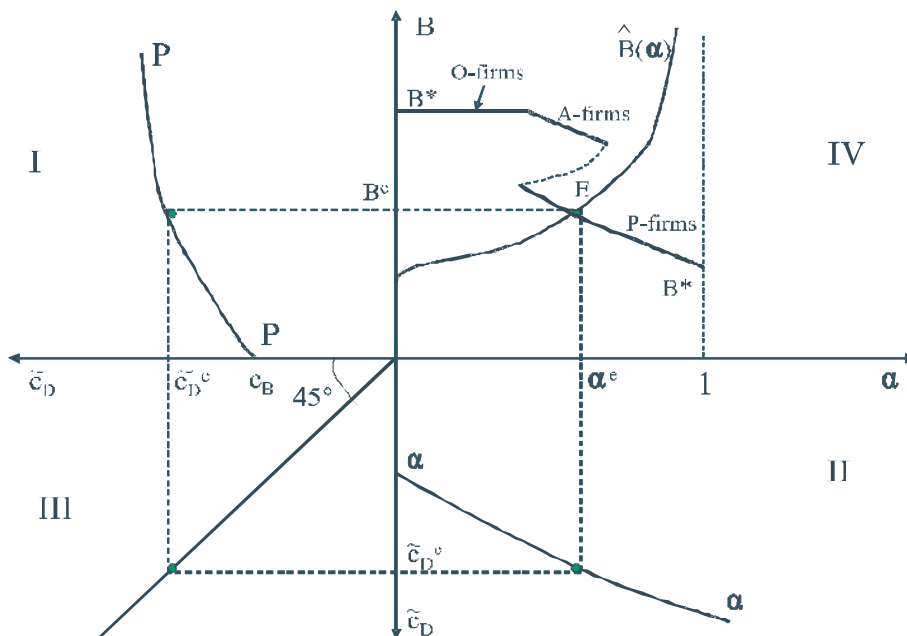


Figure 6: Corporate Equilibrium and Competition

4 Market Size and Corporate Equilibrium

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 in firms and the optimal firm organization.

The effect of a change in market size L is illustrated in Figure 7. We know from (15) 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 ($\alpha\alpha$) in quadrant II. Given that profits of high costs and low costs firms are both directly proportional to market size, a change in L has no direct effect on the conflict of interest α , 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

Therefore, principals in firms monitor only 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 takes intermediate levels, profits, competition and the conflict in 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 in firms become so large that principals in firms prefer control no matter what. There is again no trade-off between control and initiative and the single managed O-firm without agents' effort emerges as the equilibrium organization.

Note that when the market is neither too small nor too large there is more than one equilibrium mode of organization. One equilibrium is the P-organization with high agents' effort and another is the A-organization. These multiple equilibria arise due to a "strategic complementarity" among firms at the decision stage of optimal firm organization. At an intermediate level of market size the attractiveness between the two modes of organization depends on the organizational decisions taken by other firms in the market. Each firm individually would choose the A-organization at this size of the market, since in between the curves $\tilde{B}_P(\alpha)$ and $\bar{B}(\alpha)$ the A-organization is optimal. However, when the firm anticipates at this stage that all the other firms will choose the P-organization, then, she also anticipates that it will be hard to survive competition with a formal A-organization and hence she chooses a P-organization as well. Similarly, when firms anticipate that all the other firms will choose the A-organization, then they expect to be viable competitors in the market with an A-organization. The multiplicity of organizational equilibria arises due to a coordination problem among firms which comes from the fact that firms' choice of organization affects the toughness of competition in the market.¹⁵

Moreover, when the organizational equilibrium shifts from P to A with an increase in market size, the power struggle between principals and managers may decline rather than increase. In fact, in an A-organizational equilibrium, firms have on average higher costs of production than in a P-equilibrium. Agents are more likely to have real power in firms in an A-equilibrium and to implement their best "high cost" project. This in turn reduces the toughness of competition in the economy and hence reduces the conflict of interest in

¹⁵We explore how the firms' choice of organization affects the nature of competition in Marin and Verdier (2008).

firms. This is illustrated in Figure 8 which shows how α is affected by a change in L . For low values of L , a P-organizational equilibrium prevails and an increase in market size tends to reduce the value of α within that regime. When L becomes big enough, an A-equilibrium becomes feasible and the conflict in firms declines as α jumps upwards to a higher value. A further increase in L in the A-regime again toughens competition and increases the conflict in firms (α continues to decline). Finally, when L is increasing even further, the O-firm emerges as the new equilibrium and α keeps declining¹⁶. 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 single managed O-firm. Within each organizational regime (P, A or O), the conflict of interest between principals and managers increases with market size. A shift in the organizational regime from P to A at first reduces the power struggle in firms.

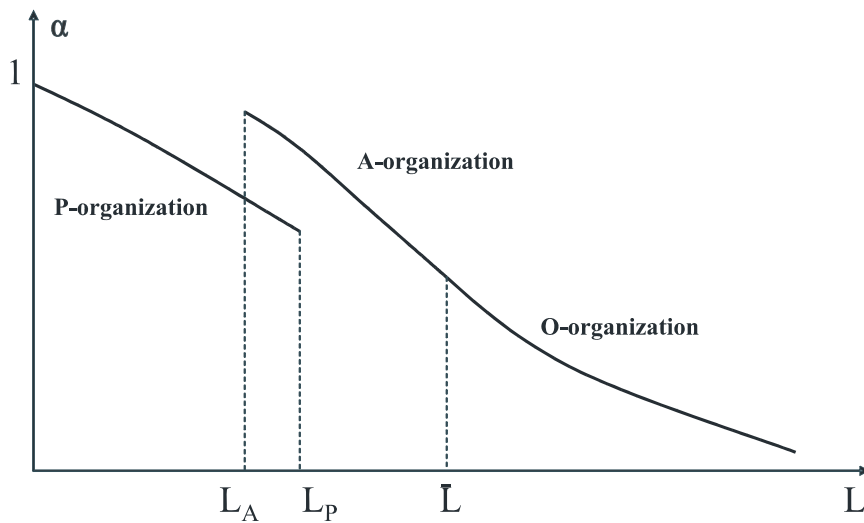


Figure 8: Market Size and Conflict in the Firm

¹⁶Though it is effectively irrelevant, as in that regime, the agent never has "real power" (his initiative is killed).

5 Empirical Evidence

In this section we use unique survey data of 660 global corporations in Austria (200) and Germany (460) to test the predictions of our theory. We first derive the predictions from the theory. We then examine the relationship between the allocation of power in firms and international trade. Finally, we study the relationship between the power struggle in firms and the trade environment. As predicted by the theory, we show that the level of decision making as well as the power struggle in Austrian and German corporations can be explained by market size and competition.

5.1 Predictions

We start by examining the relationship between international trade and firms' mode of organization. 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 $\widehat{B}(\alpha)$ curve along the B^*B^* -curve in quadrant IV. Hence, with an increase in L competition becomes more intense (\widetilde{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 single managed O-firm. Thus, we have

Prediction 1: In a cross section of firms, firms will have more decentralized corporate hierarchies and face tougher competition in larger countries.

Next, we study the relationship between trade shares and firms' mode of organization. Smaller economies will import more varieties from the foreign larger economy as home consumers want to consume all varieties produced in the world economy. Hence, smaller countries will have larger trade shares than larger economies.¹⁷ 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 $\widehat{B}(\alpha)$ -curve in Figure 7 compared to larger countries. This corresponds to an increase in the toughness of competition (along $\widehat{B}(\alpha)$ \widetilde{c}_D declines). Hence, in smaller economies it becomes more likely that the corporate equilibrium shifts from a central O-organization to a decentralized A-organization in response to trade liberalizations. Thus, we have

¹⁷For the relationship between trade shares and country size, see Helpman and Krugman (1985).

Prediction 2: In a cross section of firms, organizational change towards less hierarchical organizations is more likely to happen in firms in smaller countries.

Finally, we examine the relationship between trade and the power struggle in firms. We can derive this relationship from Figure 7 and Figure 8. In Figure 7 an increase in L shifts up the $\widehat{B}(\alpha)$ curve moving α leftward along the B^*B^* curve in quadrant IV. As a result, the power struggle in firms increases with an increase in L . Hence, we have

Prediction 3: In a cross section of firms, the power struggle between CEOs/owners and managers in firms will be more intense in larger more competitive countries.

5.2 Specification

We start by examining the relationship between the power allocation in firms and trade. In order to test Prediction 1 we report estimates from regressions of the form

$$\ln(\text{power})_{ij} = \theta_1 + \theta_2(\text{comp})_{ij} + \theta_3 \text{nation} + \theta_4(\text{nation} * \text{comp}_{ij}) + \theta_4 \ln(\# \text{segm})_{ij} + \epsilon_{ij} \quad (21)$$

where i denotes firm and j denotes country. power_{ij} indicates whether headquarters or middle managers have power in the corporation. It 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} is a measure of competition with *verymany*, *many*, or *few* when firms face very many, many or few competitors, respectively. nation is a dummy variable taking the value 1 for the large country Germany and zero for Austria. In light of Prediction 1, we test for the hypotheses $\theta_2 > 0$ and $\theta_3 > 0$ that firms decentralize decision power in the corporation in more competitive environments compared to when the firm faces no competitor. In particular, we test for the hypothesis $\theta_4 > 0$ that country size magnifies the effect of competition on the power allocation in firms.¹⁸ Finally, we control for firm size by including the number of business segments in firms $(\# \text{segm})_{ij}$ to account for the possibility that larger

¹⁸This follows directly from Figure 7 where larger countries have tougher competition and hence have steeper $\widehat{B}(\alpha)$ -curves than smaller countries. The appendix derives the properties of the $\widehat{B}(\alpha)$ -curve as a function of country size L and the level of conflict α .

more diversified firms are more likely to delegate power to lower levels of the corporation. ϵ_{ij} is an error term.

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

$$age_{ij} = \partial_1 + \partial_2(compf)_{ij} + \partial_3(nation) + \partial_4(nation * compf_{ij}) + \nu_{ij} \quad (22)$$

where age_{ij} is an indicator for organizational change. It is a dummy variable taking the value 1 and zero otherwise when firms have been using the current organization less than four years. $compf_{ij}$ is a measure of competition with *verymany*, *many*, or *few* when firms face very many, many or few foreign competitors, respectively. In light of Prediction 2, we test for $\partial_4 < 0$ that firms exposed to more foreign competition and located in the smaller country are more likely to introduce organizational change. ν_{ij} is an error term.

Finally, we examine the power struggle in firms α as stated in Prediction 3. We run a regression with the following specification

$$conflict_{ij} = \lambda_1 + \lambda_2(comp)_{ij} + \lambda_3(nation * comp_{ij}) + \lambda_4(nation) + \lambda_5 \ln(\#segm)_{ij} + \mu_{ij} \quad (23)$$

where $conflict_{ij}$ is a measure of the "power struggle" in firms. $conflict_{ij}$ denotes the number of links between business segments in corporations. It is a dummy variable taking the value 1 and zero otherwise when there is no link between business segments. We assume that the conflict of interest in firms is large when there is no link between business segments and declines with the number of links. The dummy variable is constructed from the variable $conflict$ which ranges from 1 (perfect link) to 5 (no link), see the data section for more details. The idea is that in corporations with little links between business segments middle managers of divisions will have diverting interests from the rest of the firm. With little links to the firm, middle managers are likely to pursue their own goals without depending on the cooperation of the rest of the firm. Hence, in such firms it is likely that congruence between

CEO/owners and middle managers is low.¹⁹ In light of Prediction 3 we test for $\lambda_2 > 0$ and $\lambda_4 > 0$, that when the market environment becomes more unfriendly it is more likely that the conflict of interests between different layers of management increases. We also include (*nation*comp_{ij}*) to test for $\lambda_3 > 0$ that country size makes this effect stronger. Finally, we control for the number of business segments (*#segm_{ij}*) to account for the possibility that the presence or absence of links between business segments in the corporation will depend on how diversified the firm is.

5.3 The Data

We conducted a survey of 660 global corporations in Austria (200 firms) and in Germany (460 firms) in the period 1997-2001. Due to the length of the questionnaire, we personally visited the firms in Austria and Germany, respectively 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 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 and the divisional level, organizational form, incentive system used for its workers, wages and educational qualifications of the firm's workers, 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.²⁰

The left-hand side variable *power_{ij}* of equation (21) is obtained from the

¹⁹The use of *conflict* as a proxy for the power struggle between CEO/owners and middle managers (the level of congruence in the language of Aghion and Tirole 1997) has been inspired by the corporate finance literature on the one hand and the literature on social networks on the other which both emphasize links and contacts in organizations. The corporate finance literature sees the 'diversification discount' as an expression of an inefficiency arising in conglomerates with too little links between different divisions of the corporation, see Bolton and Scharfstein (1998) for a review and Rajan, Servaes and Zingales (2000) for an explanation. The literature on social networks views social capital as bridges across 'structural holes', see Burt (2002), for the concept of social embeddedness, see Granovetter (1973).

²⁰For more information on the data see Marin (2006).

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 of firing of personnel, and the decision to hire a secretary.²¹ 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 the headquarters and middle managers.

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 less than four years.

The left hand side variable $conflict_{ij}$ of equation (23) is obtained from the question 'What links exist between the business segments of your corporation - a technical link (input-output relationship between segments), a financial link (cash flow of one segment finances an other segment), an economic link (similar market knowledge between product lines of different divisions)?' The variable *conflict* is ranked between 1 (perfect link) and 5 (no link). The link is perfect (1) when the firm has only one business segment, (2) when the business segments in the firm have a technical, financial as well as economic link, (3) when only two out of the three links are present, (4) when only one out of the three links are present, and (5) when none of these links exists. The variable used in equation (23) is transformed to a dummy variable with

²¹In some cases these decisions in the corporation were ranked by the divisional manager, when the firm is a very large conglomerate. In this cases the interview was conducted at the divisional level.

value 1 when there is no link between segments and zero when at least one link exists between business segments.

The right hand variable $comp_{ij}$ and $compf_{ij}$ 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 (269) or few (253) competitors (out of 630 firms) on local markets, while they face many (447) and few (112) foreign competitors. No firm is a monopolist either locally or worldwide, while some firms did not find it profitable to enter the local market (76 firms) or world markets (48 firms). Since many of these firms are multi product firms, the subjective measure of competition is an average description over the firms' product range. The measure of firm size $\#segm$ is obtained 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.

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 t-values are computed allowing for heteroskedasticity at the firm level. Furthermore, all regressions include a set of industry dummies. The omitted category for competition is 'no competitor'. In columns 1, 2 and 5 we focus on local competition. We first include $comp$ and the country dummy $nation$ separately to test for $\theta_2 > 0$ and $\theta_3 > 0$. We also include $\#segm$ to control for firm size as well as for the fact that the variable $comp$ reflects an average of the competitive conditions over the product range of multiproduct firms. We also include a range of additional firm-level controls to check whether the correlations we report are driven by omitted variables. The additional firm-level covariates are: the log of output per worker and the fraction of employees with an academic degree. Firms that are more skill intensive and more productive appear significantly more likely to be decentralized. The estimated coefficients on $comp$ and on $nation$ are not statistically significant and $\#segm$ is significant and positive suggesting that more diversified firms tend to decentralize power. We then interact $comp$ with $nation$ to examine whether the effect of competition

on the decision to decentralize power in corporations is magnified in larger markets. We indeed find this. The coefficient on *comp*nation* is now highly significant and positive for very many competitors. Moreover, *comp* alone becomes now significant and negative for very many competitors. This suggests that firms decentralize power only when faced with both a larger market as well as tougher competition. However, they tend to remain centralized when competition intensifies without an increase in market size.²² The size of the estimated coefficient on *comp * nation* is 0.64 increasing the average rank of corporate decisions by 23 percent from 2.81 to 3.45 (see Tables A1, A2, A3) This indicates that in large markets competition has a quantitative important effect on firms' decision to decentralize power.²³

In column 5 we focus on the two corporate decisions for which the empowerment of middle managers matters most, the decision over R&D and the decision to introduce a new product. We indeed find that firms in the larger market respond with more decentralization of these decisions in response to tougher competition. Note also, that the marginal effects of *comp*nation* are more than twice as large in the R&D decisions sample as in the all corporate decisions sample.

In columns 3, 4 and 6 we turn to foreign competition to test Prediction 2. Consistent with our theory we find that *compf* is positive and highly significant and *compf * nation* is negative and highly significant for many and very many competitors when we interact *compf* with *nation* in column 4. Overall, the results of Table 4 give support to Prediction 1 and Prediction 2 that firms in larger more competitive markets and firms more exposed to trade tend to have more decentralized corporate hierarchies.

²²Note, that an increase in the intensity of competition without an increase in market size is a movement down along the $\hat{B}(\alpha)$ -curve in Figure 8, while an increase in market size with an increase in competition shifts the same curve to the left upwards.

²³Using an elaborate measure of management practices for the US, UK, Germany, and France, 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**

Dependent Variable	Level of Decentralization of Power					
	All corporate decisions				R&D decisions	
	(1)	(2)	(3)	(4)	(5)	(6)
A. Local Competition						
few competitors	0.005 <i>[0.032]</i>	0.054 <i>[0.307]</i>			-0.395** <i>[2.416]</i>	
many competitors	0.076 <i>[0.534]</i>	0.138 <i>[0.778]</i>			-0.370** <i>[2.267]</i>	
very many competitors	-0.079 <i>[0.422]</i>	-0.783*** <i>[3.530]</i>			-1.142*** <i>[5.949]</i>	
<u>competition*nation</u>						
few competitors		-0.233 <i>[1.201]</i>			0.395 <i>[1.332]</i>	
many competitors		-0.228 <i>[1.196]</i>			0.737** <i>[2.508]</i>	
very many competitors		0.639*** <i>[2.714]</i>			1.458*** <i>[4.296]</i>	
B. Foreign Competition						
few competitors			0.001 <i>[0.008]</i>	0.209 <i>[1.641]</i>		
many competitors			0.09 <i>[1.011]</i>	0.351** <i>[2.000]</i>		-0.008 <i>[0.058]</i>
very many competitors			0.142 <i>[1.013]</i>	0.565*** <i>[2.785]</i>		0.606** <i>[2.549]</i>
<u>competition*nation</u>						
few competitors						
many competitors				-0.258 <i>[1.516]</i>		-0.054 <i>[0.200]</i>
very many competitors				-0.574** <i>[2.315]</i>		-0.209 <i>[0.612]</i>
nation	0.048 <i>[0.547]</i>	0.228 <i>[1.353]</i>	0.067 <i>[0.911]</i>	0.317** <i>[2.131]</i>	-0.636** <i>[2.372]</i>	-0.001 <i>[0.004]</i>
log (# business segments)	0.209*** <i>[3.010]</i>	0.203*** <i>[2.894]</i>	0.184*** <i>[3.342]</i>	0.175*** <i>[3.136]</i>	0.238*** <i>[3.261]</i>	0.250*** <i>[3.116]</i>
Industry dummies	yes	yes	yes	yes	yes	yes
Mean of dependent variable			0.97		0.88	
Observations	153	153	165	165	139	134
Adjusted R-squared	0.084	0.089	0.099	0.11	0.127	0.114

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: All coefficients are marginal effects from ordinary least square estimations. Robust t-values corrected for arbitrary variance-covariance matrix at the firm level in parentheses. The dependent variable is transformed in logs and indicates whether "corporate decisions are taken at the CEO level at the top of the organization (1=centralized decisions) or by middle managers at the divisional level (5=decentralized decisions)". R&D decisions subsample includes two corporate decisions only, the decision over R&D expenditures and the decision to introduce a new product. All corporate decisions include all decisions listed in Tables A1 and A2. The omitted category for local and foreign competition is "no competitor". All regressions include a control for output per worker and the proportion of workers with an academic degree. See text and Tables A1, A2 and A3 of the Appendix for variable definitions.

5.4.2 Organizational Change

Table 5 reports probit maximum likelihood estimates of equation (22). All z-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 fraction of workers with an academic degree and the log of capital stock divided by sales. In column 1 we interact *compf* with *nation* to test for ∂_4 and we include *#segm* to control for the fact that firm size may influence the speed of organizational change. We find that *compf * nation* is negative and significant suggesting that a stronger exposure to international competition is more conducive to organizational change in the smaller country. In column 2 we proceed to local competition to examine whether the competitive conditions on the local market exhibit a similar effect on the decision to introduce organizational change. We do find this. Local competition is positive and highly significant suggesting that in more competitive environments firms tend to have younger organizations. *Comp * nation* turns out negative and significant which may suggest that it proxies for *compf * nation*. Therefore, we rerun the regression to include *comp*, *compf* as well as *compf * nation*. In this specification, given in column 3, *comp* stops to have a significant influence on the speed of organizational change. The findings of Table 5 give support to Prediction 2 that firms in the smaller country more exposed to international competition are more likely to introduce organizational change.

Table 5 **Determinants of Organizational Change**

Dependent Variable (mean=0.39)	Age of Organization less than 4 years		
	(1)	(2)	(3)
<u>A. Foreign Competition</u>			
few competitors	-0.535 [0.750]		
many competitors	-0.161 [0.255]		0.429 [1.034]
very many competitors			0.543 [0.782]
<u>competition*nation</u>			
few competitors	0.641 [1.416]		1.026** [2.055]
many competitors	-0.691*** [2.737]		-0.659** [2.523]
very many competitors	-1.614* [1.927]		-1.413* [1.703]
<u>B. Local Competition</u>			
few competitors		12.150*** [20.552]	0.612 [1.234]
many competitors		11.846*** [22.909]	0.483 [0.926]
very many competitors		6.485*** [11.318]	0.063 [0.108]
<u>competition*nation</u>			
few competitors		-12.752*** [30.560]	
many competitors		-12.673 [.]	
very many competitors		-7.11 [.]	
nation		12.210*** [38.779]	
log (# business segments)	-0.299 [1.526]	-0.152 [0.837]	-0.382* [1.873]
Industry dummies	yes	yes	yes
Observations	191	197	189
Pseudo R-squared	0.082	0.09	0.151

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: All coefficients are marginal effects from probit maximum likelihood estimations. Robust z-values 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". All regressions include a control for output per worker, for the proportion of workers with an academic degree and for the ratio of physical capital to output. See text and Table A3 of the Appendix for variable definitions.

5.4.3 The Level of Conflict in Corporations.

Table 6 reports Probit maximum likelihood estimates of equation (23). All z-values are corrected for heteroskedasticity at the firm level. All regressions are estimated with a set of industry dummies. We include the log of output per worker as an additional control to avoid omitted variable bias. It is likely that the number of links between business segments ('synergies') and labour productivity are correlated. The results are consistent with Prediction 3 - all key variables take the expected signs and are statistically significant at the 1 percent level. Column 1 and 4 examine whether competition and market size have each separately made it more likely that middle managers pursue their own interests rather than that of the firm. We find that firms are more likely to have no link between business segments in larger markets and when faced with more local as well as foreign competitors. We then interact competition with market size in columns 2 and 3 (local competition) and in columns 5 and 6 (foreign competition) to test for $\partial_3 > 0$. The interaction of *competition* with *nation* only marginally provides additional information when *competition* is included as a covariate in the regressions (columns 2 and 5), while it does so when combined with *nation* (columns 3 and 6).²⁴

²⁴We have also run ordered probit estimates which emphasize the number of links between business segments rather than whether there is a link at all with similar but somehow weaker results in particular for the case of local competition. Furthermore, we calculated probit estimates for the technical, financial, and economic link each separately with similar results. Apparently, it is not the number or type of links that seems to matter, but whether there is a link at all. The estimates are available from the authors upon request.

Table 6 **Determinants of the Level of Conflict in the Firm**

Dependent Variable (mean = 0.02)	No link between business segments					
	local competition			foreign competition		
	(1)	(2)	(3)	(4)	(5)	(6)
<u>competition</u>						
very many competitors	4.576*** [3.148]	-0.12 [0.246]		4.162*** [2.759]	-0.459 [1.063]	
many competitors	4.755*** [3.188]	4.234*** [7.871]		4.097*** [2.754]	3.637*** [7.434]	
few competitors	4.407*** [2.742]	-0.022 [.]		4.379*** [3.249]	-0.444 [.]	
<u>competition*nation</u>						
very many competitors		4.812 [.]	4.714*** [11.692]		4.871 [.]	4.23 [.]
many competitors		0.52 [1.335]	4.781*** [12.982]		0.621* [1.702]	4.079*** [12.177]
few competitors		4.491 [.]	4.486*** [8.640]		5.068 [.]	4.443*** [10.281]
nation	0.812** [2.267]		-3.916 [.]	0.796** [2.271]		-3.344*** [7.619]
log (# business segments)	-0.051 [0.341]	-0.052 [0.335]	-0.058 [0.380]	-0.045 [0.283]	-0.037 [0.230]	-0.041 [0.254]
Industry dummies	yes	yes	yes	yes	yes	yes
Observations	467	467	467	450	450	450
Pseudo R-squared	0.082	0.094	0.079	0.069	0.078	0.072

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: All coefficients are marginal effects from probit maximum likelihood estimation. Robust z-values corrected for arbitrary variance-covariance matrix at the firm level in parentheses. Dependent variable is a dummy variable indicating whether there is no link between business segments. The omitted category for local and foreign competition is "no competitor". All regressions include a control for output per worker. See text and Table A3 of the Appendix for variable definition.

6 Conclusion

Can differences in countries exposure to trade account for the observed differences in corporate organization across countries and firms? Can an increased integration into the world economy explain the trend towards less hierarchical organizations in rich countries? We have developed a model that combines the Krugman cum Melitz and Ottaviano model of trade with the Aghion and Tirole theory of the firm to answer these questions raised in the introduction. Our model traces a link between the size of nations, competition and corporate organization which can account for the facts identified in the in-

roduction. We derive predictions from our model which we test with unique firm level survey data for two countries.

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Appendix A: The Data

Table A1 Decisions Ranked by Level of Corporate Hierarchy

Austrian Corporations

	mean
1. decision over acquisitions	1.31
2. financial decisions	1.76
3. new strategy	1.86
4. transfer prices	2.25
5. hiring more than 10% of current personnel	2.42
6. R&D expenditures	2.44
7. budget	2.63
8. introduction of new products	2.76
9. change of supplier	3.04
10. moderate wage increase	3.12
11. decision over product price	3.37
12. hiring two workers	3.44
13. hiring a secretary	3.95

Table A2 Decisions Ranked by Level of Corporate Hierarchy

German Corporations

	mean
1. decision over acquisitions	1.35
2. financial decisions	1.91
3. new strategy	2.01
4. find acquisition	2.58
5. transfer prices	2.58
6. hiring more than 10% of current personnel	2.66
7. R&D expenditures	2.67
8. introduction of new products	2.68
9. budget	2.74
10. change of supplier	3.31
11. decision over product price	3.56
12. price increase of product	3.63
13. moderate wage increase	3.76
14. hiring two workers	4.04
15. firing of personnel	4.28
16. hiring a secretary	4.32

Table A3 **Definition of Variables and Descriptive Statistics**

Variable	Observations	Description	Mean	Minimum	Maximum	Stand. Dev.
Organizational Information						
power	256	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&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.	2.81	1.00	5.00	0.89
power R&D	207	R&D decision: 2 corporate decision which are the decision over R&D expenditures and the decision to introduce a new product.	2.67	1	5	1.22
# business segments	638	number of business segments in the firm	3.29	0	14	1.96
conflict	625	links (technical, financial, economic) between business segments ranked between 1 (perfect link) and 5 (no link), 1= one segment, 2= all three links are present, 3= two links are present, 4= one link is present, 5= no link is present	2.51	1	5	0.95
technical link	527	dummy variable equal to 1 and 0 otherwise, if there is a technical link between business segments. A technical link exists if there is an input-output relationship between segments.		D= 1, 406 observations		
financial link	448	dummy variable equal to 1 and 0 otherwise, if there is a financial link between business segments. A financial link exists if the cashflow of a segment finances another segment.		D= 1, 339 observations		
economic link	531	dummy variable equal to 1 and 0 otherwise, if there is an economic link between business segments. An economic link exists if market knowledge between product lines of different divisions are similar.		D= 1, 447 observations		
age	380	dummy variable equal to 1 and 0 otherwise if firm uses the current organization less than 4 years.		D= 1, 122 observations		

Definition of Variables and Descriptive Statistics continued

Variable	Observations	Description	Mean	Minimum	Maximum	Stand. Dev.
Measures of Competition						
local competition		local competition as perceived by firms				
very many competitors	630	dummy variable equal to 1 and 0 otherwise when firm does not enter the market				D=1, 76 observations
many competitors	630	dummy variable equal to 1 and 0 otherwise when firm faces many competitors				D=1, 269 observations
few competitors	630	dummy variable equal to 1 and 0 otherwise when firm faces few competitors				D=1, 253 observations
no competitors	608	dummy variable equal to 1 and 0 otherwise when firm faces no competitors				D=1, 32 observations
foreign competition		foreign competition as perceived by firms				
very many competitors	608	dummy variable equal to 1 and 0 otherwise when firm does not enter the market				D=1, 48 observations
many competitors	608	dummy variable equal to 1 and 0 otherwise when firm faces many foreign competitors				D=1, 447 observations
few competitors	608	dummy variable equal to 1 and 0 otherwise when firm faces few foreign competitors				D=1, 112 observations
no competitors	630	dummy variable equal to 1 and 0 otherwise when firm faces no foreign competitors				D=1, 1 observation
Other Firm Level Information						
skill intensity of workforce	242	proportion of workers with an academic degree	16	0	335	27
labour productivity	561	sales per worker	426767	17384	9689711	1029074
physical capital to output	357	physical capital to output ratio	0.92	0	130	7.23
nation	665	dummy variable equal to 1 if the country is Germany and 0 if it is Austria				D = 1, 457 observations

Appendix B

- **Existence of (B^e, α^e) equilibrium with free entry:**

- *Lemma 1: At all values $\alpha < 1$ such that $\widehat{B}(\alpha) = \widetilde{B}_P(\alpha)$ we have that $\widehat{B}'(\alpha) > \widetilde{B}'_P(\alpha)$.*

Proof: We have

$$\widetilde{B}'_P(\alpha) = \frac{g(1 - k/b)}{(1 - \bar{e}\alpha)^2} \bar{e} \quad \text{and} \quad \widehat{B}'(\alpha) = \frac{(\varphi - 1)^2 L c_B^2}{(1 - \sqrt{\alpha})^3} \frac{1}{\gamma 4 \sqrt{\alpha}}$$

At a value of α such that $\widehat{B}(\alpha) = \widetilde{B}_P(\alpha)$, we have

$$\frac{g(1 - k/b)}{(1 - \bar{e}\alpha)} = \frac{(\varphi - 1)^2 L c_B^2}{(1 - \sqrt{\alpha})^2} \frac{1}{\gamma 4}$$

therefore at such a point:

$$\frac{\widehat{B}'(\alpha)}{\widetilde{B}'_P(\alpha)} = \frac{1 - \bar{e}\alpha}{\bar{e}} \frac{1}{(1 - \sqrt{\alpha}) \sqrt{\alpha}} = \frac{1 - \bar{e}\alpha}{\bar{e}(\sqrt{\alpha} - \alpha)} > 1$$

as $1 - \bar{e}\alpha > \bar{e}(\sqrt{\alpha} - \alpha)$ is equivalent to $1 > \bar{e}\sqrt{\alpha}$ which is valid as $\bar{e} < 1$ and $\alpha < 1$.

Lemma 1 says that when curve $\widehat{B}(\alpha)$ crosses curve $\widetilde{B}_P(\alpha)$, it has to cross it from below. It also means that there is at most one point $\alpha < 1$ such that $\widehat{B}(\alpha) = \widetilde{B}_P(\alpha)$.

Consider then the following

$$\textbf{Assumption B : } \sqrt{2g} > (\varphi - 1)^2 \frac{L c_B^2}{\gamma 4}$$

which says that the cost differential $\varphi - 1$ between "high cost" and "low cost" firms is not too high (or the "product differentiation" parameter γ is sufficiently large) to allow a "high cost" firms to make positive recurrent profits in a monopolistic equilibrium. where all the other firms are "low cost". Formally this assumption means that $\widehat{B}(0) < \sqrt{2g} = B_0^*$ the required free entry recurrent profit under a O-organization.(necessarily a "low cost" firm) . Thus, we have the following result :

- *Proposition* : Assume that assumption B holds. Then there exists at least one free entry organizational equilibrium (B^e, α^e) (defined by the intersection point of the two curves B^*B^* and $\widehat{B}(\alpha)$) such that : a) firms choose optimally their organizations, b) whenever firms produce they choose optimally their production and prices to maximize profits, c) there is free entry.

Proof: There are different cases to consider :

i) Suppose first that $\widehat{B}(\alpha)$ never crosses curve $\widetilde{B}_P(\alpha)$ (ie. There does not exist a value of $\alpha < 1$ such that $\widehat{B}(\alpha) = \widetilde{B}_P(\alpha)$). This means that for all values of $\alpha \in [0, 1]$ $\widehat{B}(\alpha) > \widetilde{B}_P(\alpha)$ or $\widehat{B}(\alpha) < \widetilde{B}_P(\alpha)$. Given, that $\lim_{\alpha \rightarrow 1} \widehat{B}(\alpha) = +\infty$, it follows that for all $\alpha \in [0, 1]$ $\widehat{B}(\alpha) > \widetilde{B}_P(\alpha)$.

Under assumption B, $\widehat{B}(0) < B_0^*$ and $\widehat{B}(\alpha_A) > \widetilde{B}_P(\alpha_A) = B_A^*(\alpha_A)$. Define $\widehat{\alpha}$ by the relation $B_A^*(\alpha) = B_0^*$ and the function $\Theta_A(\alpha)$ by

$$\Theta_A(\alpha) = B_0^* \text{ for } \alpha \leq \widehat{\alpha} \text{ and } \Theta_A(\alpha) = B_A^*(\alpha) \text{ for } \widehat{\alpha} < \alpha \leq \alpha_A.$$

Then it is easy to see that the function $\Gamma_A(\alpha) = \Theta_A(\alpha) - \widehat{B}(\alpha)$ is strictly decreasing continuous in $\alpha \in [0, \alpha_A]$ with $\Gamma(0) = B_0^* - \widehat{B}(0) > 0$ and $\Gamma_A(\alpha_A) = \Theta_A(\alpha_A) - \widehat{B}(\alpha_A) = B_A^*(\alpha_A) - \widehat{B}(\alpha_A) < 0$. Therefore there exists a (unique) $\alpha_A^e \in [0, \alpha_A]$ such that $\Gamma_A(\alpha_A^e) = 0$ and the pair (B_A^e, α_A^e) with $B_A^e = \Theta_A(\alpha_A^e)$ is a free entry organizational equilibrium.

ii) Suppose now that $\widehat{B}(\alpha)$ crosses curve $\widetilde{B}_P(\alpha)$ (necessarily only once) at some point $\widetilde{\alpha}$.

- If $\widetilde{\alpha} < \alpha_P$, then for all $\alpha \in [\alpha_P, 1]$, $\widehat{B}(\alpha) > \widetilde{B}_P(\alpha)$ and therefore $\widehat{B}(\alpha_A) > \widetilde{B}_P(\alpha_A) = B_A^*(\alpha_A)$. We are back to case i) and there exists $\alpha_A^e \in [0, \alpha_A]$ such that $\Gamma(\alpha_A^e) = 0$ and the pair (B_A^e, α_A^e) with $B_A^e = \Theta_A(\alpha_A^e)$ is a free entry organizational equilibrium.

- If $\alpha_P \leq \widetilde{\alpha} < \alpha_A$ Then we have $\widehat{B}(\alpha_P) < \widetilde{B}_P(\alpha_P) = B_P^*(\alpha_P)$ and $\widehat{B}(\alpha_A) > \widetilde{B}_P(\alpha_A) = B_A^*(\alpha_A)$. Again by the same token we can show that there exists a (unique) $\alpha_A^e \in [0, \alpha_A]$ such that $\Gamma(\alpha_A^e) = 0$ and the pair (B_A^e, α_A^e) with $B_A^e = \Theta_A(\alpha_A^e)$ is a free entry organizational equilibrium.

But we we may also define as well a function $\Theta_P(\alpha)$ by

$$\Theta_P(\alpha) = B_P^*(\alpha) \text{ for } \alpha_P \leq \alpha \leq 1.$$

and $\Gamma_P(\alpha) = \Theta_P(\alpha) - \widehat{B}(\alpha)$ which is strictly decreasing and continuous in $\alpha \in [\alpha_P, 1]$ with $\Gamma(\alpha_P) = B_P^*(\alpha_P) - \widehat{B}(\alpha_P) > 0$ and $\Gamma_P(1) = \Theta_P(1) - \widehat{B}(1) =$

$-\infty < 0$. Therefore there exists as well in this case a (unique) $\alpha_P^e \in [\alpha_P, 1]$ such that $\Gamma_P(\alpha_P^e) = 0$ and the pair (B_P^e, α_P^e) with $B_P^e = \Theta_P(\alpha_P^e)$ is a also a free entry organizational equilibrium.(with P-firms).

- Finally if $\alpha_A \leq \tilde{\alpha}$, then $\hat{B}(\alpha_P) < \tilde{B}_P(\alpha_P) = B_P^*(\alpha_P)$ and by the same token using the function $\Theta_P(\alpha)$ and $\Gamma_P(\alpha) = \Theta_P(\alpha) - \hat{B}(\alpha)$ which is strictly decreasing and continuous in $\alpha \in [\alpha_P, 1]$, we can show that there exists a (unique) $\alpha_P^e \in [\alpha_P, 1]$ such that $\Gamma_P(\alpha_P^e) = 0$ and the pair (B_P^e, α_P^e) with $B_P^e = \Theta_P(\alpha_P^e)$ is a free entry organizational equilibrium.(with P-firms). QED.

Finally, note that when assumption B does not hold, then there cannot be an equilibrium with high cost firms and the only possible equilibrium is an O-firm equilibrium with $\alpha^e = 0$.

• **Properties of $\hat{B}(\alpha, L)$ as a function of conflict and market size:**

From simple differentiation we get

$$\frac{\partial \hat{B}}{\partial \alpha} = \frac{(\varphi - 1)^2 L c_B^2}{(1 - \sqrt{\alpha})^3} \frac{1}{\gamma 4 \sqrt{\alpha}} > 0$$

and

$$\frac{\partial \hat{B}}{\partial L} = \left[\frac{\varphi - 1}{1 - \sqrt{\alpha}} \right]^2 \frac{1 c_B^2}{\gamma 4} > 0$$

$$\frac{\partial^2 \hat{B}}{\partial \alpha \partial L} = \frac{(\varphi - 1)^2}{(1 - \sqrt{\alpha})^3} \frac{1 c_B^2}{\gamma 4 \sqrt{\alpha}} > 0$$

Hence, $\hat{B}(\alpha)$ is increasing in α , is shifted upward with an increase in market size L , and the slope of $\hat{B}(\alpha)$ becomes steeper in larger markets L . **QED.**