Corporate Hierarchies and International Trade: Theory and Evidence *

Dalia Marin, University of Munich†
Thierry Verdier, Paris School of Economics-ENPC‡

This Version: May 2014

Abstract

Corporate organization varies within countries and between countries. We develop a theory which explains the variation in levels of decentralization across firms and links it to the trade environment that firms face. We introduce firms with internal hierarchies in a Melitz and Ottaviano (2008) model of international trade. We show that international trade increases the conflict of interest between CEO/owners and middle managers within firms and these eventually lead to decentralized corporate hierarchies. We test the theory with original data on the internal organizations of 2200 Austrian and German firms and find that the empirical evidence is consistent with the model's predictions.

JEL Classification: F12, F14, L22, D23

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

*We would like to thank Robert Gibbons, Denis Gromb, Irena Grosfeld, Elhanan Helpman, Daniel Sturm, Francesca Fabbri and seminar participants at Harvard, Princeton, New York, New York Fed, Freiburg, CEPR-ERWIT, Vienna, NBER ITO, Second VW Conference on Globalization and Contracts, Paris, GESY SFB/TR 15 and the European Economic Association Congress, Vienna for helpful comments and Thorsten Hansen for excellent research assistance. We are greatful for financial support from the Volkswagen Foundation through the network grant 'Globalization and the Organization of Firms and Markets', from the European Commission under the FP7 Framework programme SCience, Innovation, FIrms and Markets in a Globalised World"' (SCI-FI GLOW) and from the German Science Foundation (DFG) through GESY SFB/TR 15 and through a research grant DFG-Ma 1823/3-1. Marin would like to thank the Stern School of Business, New York University for its hospitality where some of the paper was written.

†Dalia Marin, University of Munich, Dalia.Marin@lrz.uni-muenchen.de

‡Thierry Verdier, Paris School of Economics, Thierry.Verdier@pse.fr

1 Introduction

Corporate organization varies within countries and between countries. Empirical evidence on corporate organization across time, across countries, and across firms has become available only recently. Rajan and Wulf (2006) and Marin and Verdier (2007) document a shift to more decentralized decision making and the removal of hierarchical layers in firms over time. Marin and Verdier (2007) and Marin (2008) show for a cross section of 2200 firms in Austria and Germany that larger firms tend to have more decentralized decision making and that Germany, the larger economy, has corporations with more decentralized hirarchies compared to Austria, the smaller economy. We collected data on the internal organization of 2200 firms in Austria and Germany by asking the CEO in firms "Who decides in your company over the corporate decisions such as the decision over acquisitions, finance, new strategy, R&D, to introduce a new product, to change a supplier, and the decision over hiring and firing of personell, please rank between 1 taken at headquarters and 5 taken at the divisional level?"[1] Similarly, Bloom et al (2010) show with a similar measure of decentralization between headquarters and middle managers which they collected for several countries such as the US, UK, Europe, and Asian countries that the US, UK, and Norther European countries have firms which are the most decentralized, while Asian countries tend to have the most centralized corporate organizations.

The empirical evidence on corporate organization described above raises several questions. First, can differences in the trade exposure of firms account for the observed corporate diversity across firms? Second, why are firms changing their mode of organization? Can increased integration into world markets explain this trend towards less hierarchical organizations?

In this paper, we offer a model that explains differences in corporate hierarchies across firms. We introduce firms with internal hierarchies (a CEO and a division manager) in a monopolistic competition model of trade. Our model simultaneously

[1] We use this information on the internal organization of firms in the empirical section of this paper. For a full list of the corporate decisions for which we have information on who takes the decision in the firm, see Tables A1 and A2 of the Data Appendix.

determines the organizational choices of firms and heterogeneity across firms in size and productivity. Moreover, in our model, firms choose their organizational structure in response to the trade environment that they face.

We develop an industry equilibrium model with a monopolistic competitive sector with differentiated goods that combines the Aghion-Tirole (1997) (AT) theory of the firm with the Krugman (1980) theory of international trade. Rather than using constant elasticity of substitution (CES) utility as in Krugman (1980), we adopt the Melitz and Ottaviano (2008) structure of preferences with a linear demand across a continuum of varieties. In this way, the price elasticity of demand is no longer exogenously fixed but changes with the toughness of competition in the market. Unlike Melitz and Ottaviano (2008) though, we assume that production of varieties in the monopolistic sector are done by ex ante identical firms with an internal organization that follows AT. A principal hires an agent to monitor projects and workers to produce goods. There are m potential methods of production of which one maximizes profits and another one maximizes a private benefit for the agent. Hence, there is a conflict of interest between the principal/owner and her agent as the payoffs of the parties depend on who's project is implemented. The principal and the agent gather information to understand which of the m ways of running the firm maximizes profits and the private benefit of the agent, respectively. If both parties find out which are their preferred projects, the decision rights reside in the party with *formal power*. If only one of the parties learns which is his/her preferred project, the uninformed party always rubber-stamps this project. In this case, the informed party has *real power*. In choosing between retaining formal power or delegating power to the agent, the principal trades off the benefit from control against the manager's loss of initiative.

The first result of the paper states that congruence between the principal and her agent increases with the intensity of competition in the market. When competition becomes tougher (with an increase in the number of firms and/or with an increase in the proportion of low cost firms in the market) relative profits decline between a firm in which the agent has power (an A-firm) and a firm in which the principal decides over the project (a P-firm). Hence, it becomes more costly to delegate power to the agent. It matters more who runs the firm because, as com-

petition increases, the revenues of high-cost A-firms go down by more than those of low-cost P-firms and they try to fight the loss in revenues by lowering markups more than P-firms.

We then solve for industry equilibrium (imposing free entry). We find that congruence between the principal and her agent increases the stakes of firms and thus increases the free entry profit level that firms require to enter the market. We find further, that congruence affects the corporate equilibrium that emerges in the economy. When the conflict of interest between the principal and her agent is small, preferences over projects between the principal and agent are fairly congruent and the principal invests little in information collection. Under these circumstances, the initiative of the agent can be kept alive and there are no costs of control. Hence, principals find it optimal to keep control. On the other hand, when the conflict of interest is large, the principal's investment in information collection will also tend to be large, and the agent's initiative will be killed even when he/she is given formal power. Hence, there is no gain in assigning formal power to the agent and principals keep control. Finally, there may exist intermediate levels of conflict in the firm for which principals find it optimal to delegate formal power to the agent to induce her 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 the market is an important determinant of the equilibrium mode of organizations. In small countries, competition tends to be weak and the conflict of interest between principals and middle managers will also tend to be small and principals tend to monitor little. On the other hand, in large countries, competition and the conflict of interest between principals and agents in firms are both intense and principals tend to monitor a lot. It follows that small and large countries will tend to have firms in which principals keep formal control, while in medium-sized countries organizations of firms may prevail in which decision power is delegated to middle managers.

Finally, we derive predictions from our model and expose them to the data. We predict that in a cross-section of firms, firms will have more decentralized corporate hierarchies when they face tougher competition and more exposure to

trade. We test these predictions for a cross-section of firms with the original data of 2200 corporations in Austria and Germany in 1998-1999. We find that these predictions are not rejected by the data. More specifically, we identify a non-monotonic relationship between the level of decentralization in firms and the trade exposure firms face. We also find that for the corporate decisions for which empowerment of middle managers may matter most (such as the decision over R&D or the decision to introduce a new product) trade and competition have the strongest effect on the allocation of authority in the firm.

The paper contributes to a new and fast growing body of literature on organizations in general equilibrium models of international trade.[2] 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 degree of conflict between principals and agents inside the firm with the trade environment that firms face. Trade liberalization increases the costs of delegating power to a manager, since it matters more for profits who runs the firm. In earlier work (Marin and Verdier (2008a)) we introduce firms' organizational choices in a Dixit and Stiglitz model of monopolistic competition. However, in this model, market size and trade have no effect on corporate organization. As is typical for a model of monopolistic competition of the Dixit and Stiglitz (1977) type, an increase in market size leads to an increase in the number of varieties produced without affecting the size of firms, markups and firm organization. In this paper, we incorporate endogenous markups using the linear demand system as in Melitz and Ottaviano (2008). Markups across firms respond now to the toughness of competition in a market. In this way, our model exhibits a link between trade liberalization, firm size and the mode of organization that firms choose.

In contrast to the present paper, we examine in Marin and Verdier (2012) 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 de-

[2]For a survey of this literature, see Helpman (2006), Spencer (2005) Helpman, Marin and Verdier (2008), Antras and Rossi-Hansberg (2009), and Marin (2012).

terminants of the equilibrium mode of organization. We find further that when two countries with different relative factor endowments open up to trade, their factor prices will tend to converge and this could induce a convergence in corporate cultures leading all principals in both countries to delegate power (even when no principal in any of the two countries was delegating in autarky). Surprisingly, as in Marin and Verdier (2012) with North-South trade between dissimilar countries, we find in the present paper that manager empowerment and the move to flatter corporate hierarchies emerge as an equilibrium when the world economy is governed by North-North trade as well.

In Marin and Verdier (2008b), we develop a theory in which organizational choices determine productivity differences between business firms. Rather than employing the customary assumption of an exogenous distribution of productivity as in Melitz (2003), heterogeneity in productivity arises as a result of the endogenous allocation of power inside the corporation. The model delivers new margins of trade adjustment: the monitoring margin and the organizational margin. Depending on which of these margins dominates, trade liberalization may lead to higher or lower productivity.

Several recent papers also examine how changes in the market environment affect the internal organization of firms. Caliendo and Rossi-Hansberg (2012) analyse the effect of international trade on the internal organization of firms based on a model of knowlege hierarchies. They consider a different model of firm organization than we do. Instead of focusing on how competition affects the trade off between control and initiative in firms as we do in this paper they concentrate on problem solving and knowledge transmission inside the firm a la Garicano (2000) and Garicano and Rossi-Hansberg (2006). Interestingly, inspite of being based on a different model of firm organization, trade liberalization results also in a more decentralized firm organization as is the case in our paper.

Alonso, Dessein and Matouschek (2013) consider a multi-divisional firm and examine how the optimal organization of a firm adapts to changes in market competition. They show that a more centralized organization may be optimal in response to an increase in market competition by allowing for more coordination

between interdependent divisions. However, Alonso et al's analysis is of partial equilibrium nature and does not allow for feed back effects. We instead consider in this paper an industry equilibrium where market competition affects the organizational choice of each individual firm and the resulting pattern of organization of firms feeds back to the market place. More importantly, more centralization in response to more competition is not an exclusive outcome of the paper of Alonso et al (2012), since both Caliendo et al as well as our paper predict a non monotonic relationship between the level of decentralization and competition. More centralized organization can emerge under some circumstances when competition is very tough (as in our paper) or when it becomes optimal to change the number of corporate layers (as in Caliendo et al 2012).

Adopting like us the Aghion-Tirole framework, Puga and Trefler (2010) consider the problem of optimal choice of organizational form, and whether or not to involve a supplier in incremental innovation in the context of residual incompatibilities that arise when such incremental innovation occurs in low-wage countries. Embedding this choice of organizational form into a general equilibrium model, they discuss the conditions under which a low-wage country will attract rich-country firms and engage in incremental innovation.

In addition to the theoretical literature, a new empirical literature has emerged recently 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 (2006) 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. The paper most closely to ours is Bloom, Sadun and Van Reenen (2010). They use a similar measure of decentralization between headquarters and middle managers as we do which they collected for several countries and they also find a positive correlation between the level of decentralization and product market competition.

Guadalupe and Wulf (2010) (GW) use the Canadian-US Free Trade Agreement (FTA) in 1989 as a natural experiment to address issues of causality. They see the FTA as an exogenous increase in competition for US firms in industries

where tariffs were removed. GW analyze panel data for the US and their measure of organization is the breadth and depth of hierarchy defined as the number of positions reporting to the CEO and the number of positions between the CEO and the division managers. They find that increased foreign competition leads to downsizing and the removal of hierarchical layers in the corporation.

The paper is organized into the following sections. Section 2 studies the optimal choice of firm organization. Sections 3 and 4 embed the organizational choice into a monopolistic competition model and derive the conflict of interest inside the firm as a function of market competition. Section 5 opens the economy up to trade and studies the role of international trade in determining corporate equilibrium. Section 6 describes the dataset and presents empirical evidence that supports the view that trade and competition can explain the allocation of power in firms. Section 7 concludes. The proofs of the results and the description of the data are relegated to the Appendix.

2 Power in the Firm

2.1 An Aghion-Tirole Model of Firm Organization

In this section, we first present a simple model of optimal firm organization based on Aghion-Tirole (1997). Specifically 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. In our model, the benefit B of the principal will be the profit generated by the firm.[3] The private benefit b of the agent reflects all pecuniary and non-pecuniary non-contractual benefits that can accrue to him

[3]In the next section B is endogenized by the intensity of competition in product markets.

when he implements his preferred project. These benefits can be 'perks' or social status or other intangible reputational benefits associated with the project.

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.[4] α is a congruence parameter capturing the degree of conflict between the principal and her agent. The lower α, the more the principal's payoff is reduced when the agent's best project is implemented and hence the larger the conflict of interest between the principal and agent.

Both parties may acquire information on possible ways to run the firm. However, we assume that the CEO has managerial overload. By spending some resource costs the principal learns the payoffs of all projects with probability E and remains uninformed with probability $1 - E$. This generates costs of information collection of $g_P(E) = \frac{E^2}{2}$. Similarly, by exerting some effort $g_A(e) = ke$ with $e \in [0, \overline{e}]$, $k < b$ 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.

The Aghion-Tirole (1997) organizational perspective makes the distinction between *"formal"* and *"real power"* on decision-making inside the firm. B and b are supposed to be known *ex ante* although the parties do not know *ex ante* which project yields such a payoff. We assume also that, among the m projects, there are some with very high negative payoffs to both parties, implying that choosing a project randomly without being informed is not profitable to both agents who instead prefer to do nothing (project 0). This aspect, together with the fact that

[4]Alternatively, 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 the exposition, we simply set $\beta = 0$.

each uninformed party prefers to rubber-stamp the other informed party's suggestion rather than do nothing, implies that private information about payoffs gives decision control to the informed party. In this case, the informed party has *"real power"* in the firm. There are two sources of power in the firm: *"formal power"* which is allocated to the manager by contract and *"real power"* which parties may obtain by being better informed.

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

Specifically under the P-organization, the principal has formal power in the firm and the principal's and agent's expected payoffs are given by:

$$U_P(E,e) = EB + (1-E)e\alpha B - g_P(E) - w$$
$$\nu_P(E,e) = (1-E)eb - g_A(e)$$

With probability E, the principal becomes fully informed about her payoffs and picks her preferred project with monetary payoff B, while the agent receives 0. With probability $1-E$, the principal remains uninformed about payoffs. The agent may then learn with probability e and suggest his best project to the principal (who accepts it). The principal receives a monetary payoff 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 with the principal (who has formal power). The case of a O-organization is then a special case of the P-organization with the agent not actively engaging in the firm (ie. for $e = 0$).

Under the A-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. When however 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. Reflecting these facts the two parties' expected payoffs can then be written as:

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

To determine the optimal organization of the firm, we solve the model in two steps. First we characterize the subgame perfect equilibrium in effort levels E^*, e^* under each mode of organization when profits gradually increase. Then to determine the equilibrium organizational form, we consider which of these organizations yields higher utility to the principal and is preferred by him/her.

2.2 Nash Equilibria in Information Collection Efforts (E, e)

As shown in the appendix, the first step highlights the trade-off between the principal's control and the agent's initiative. Control by the principal comes with the cost of loosing the agent's initiative. Indeed, looking at the incentives of the principal and the agent, it can be seen that the principal tends supervises more, the higher her stake in the project (the larger is B), the larger the conflict of interest between the principal and the agent (the lower is α) and the lower the agent's effort e. Conversely, the agent undertakes more initiative the higher his own stake (the larger is b) and the lower the principal's interference (the lower is E). At equilibrium under an A-organizational form, the advantage of delegating formal power to the agent is that the latter takes more initiative to become informed. In our specification, this will indeed always induce maximum agent's effort. Conversely, under the P-organization in which formal power is kept by the Principal, the agent's effort is significantly reduced when the principal's stakes are large enough and the latter supervises intensively; In particular when those stakes B are larger than some threshold $\widetilde{B}_P(\alpha)$, this triggers a situation with minimum effort from the agent ($e = 0$), a situation that we described as an O-organization.

Depending on the organizational forms, the solution of the efforts' game analysis provides the equilibrium utility levels $u_P(B)$, $u_O(B)$ and $u_A(B)$ for the principal under respectively the P-organization, the O-organization and the A-organization. These are described in Table 1:

Formal power to principal $(B \leq \widetilde{B}_P(\alpha))$ *(P-organization)*	$u_P(B) = U_P(\frac{B(1-\overline{e}\alpha)}{g}, \overline{e})$ $= \frac{B^2(1-\alpha\overline{e})^2}{2} + \overline{e}\alpha B - w$
Formal power to principal $(B > \widetilde{B}_P(\alpha))$ *(O-organization)*	$u_O(B) = U_P(\frac{B}{g}, 0)$ $= \frac{B^2}{2} - w$
Formal power to agent (all $B > 0$) *(A-organization)*	$u_A(B) = U_A(\frac{B(1-\overline{e})}{g}, \overline{e})$ $= \frac{B^2(1-\overline{e})^2}{2} + \overline{e}\alpha B - w$

Table 1: Equilibrium Principal's Payoff Structure

where $\widetilde{B}_P(\alpha)$

$$\widetilde{B}_P(\alpha) = \frac{1 - k/b}{1 - \overline{e}\alpha}$$

is the threshold level of profits at which the agent's initiative is killed under the P-organization. This threshold $\widetilde{B}_P(\alpha)$ depends positively on the degree of congruence between the principal and the agent α. Indeed, the larger is α the more aligned are the interests of the principal and the agent. Hence, for a given B, the less likely the principal intervenes and accordingly, the more likely that the initiative of the agent is not crowded out. Hence, a larger value of α shifts up the threshold value of $\widetilde{B}_P(\alpha)$ at which such initiative crowding out occurs.

2.3 The Choice of Firm Organization

In choosing between retaining formal power (a P or a O-organization) or delegating power to the agent (the A-organization), the principal trades off the benefit from control against the manager's loss of initiative. In appendix B, we define

$$\overline{B}(\alpha) = \frac{2\alpha}{2 - \overline{e}}$$

as the level of profit such that $u_O(B) = u_A(B)$[5] and we show the following proposition which characterizes the equilibrium choice of organization.

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

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

- For $B \leq \widetilde{B}_P(\alpha)$, the principal prefers the P-firm over the A-firm with $e_P^* = \overline{e}$ and $E_P^* = \frac{B(1-\alpha\overline{e})}{g}$;

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

- For $\overline{B}(\alpha) \leq B$, the O-firm yields higher utility to the principal than the A-firm with $e_P^* = 0$ and $E_P^* = \frac{B}{g}$.

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

The firm's optimal choice of organization is illustrated in Figure 1. The $\tilde{B}_P(\alpha)$ curve captures the cost of having control in the firm in terms of the loss of agent 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

[5] $\overline{B}(\alpha)$ 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.

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 $\bar{B}(\alpha)$ curves, the cost of control outweighs the benefit and the firm opts 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.

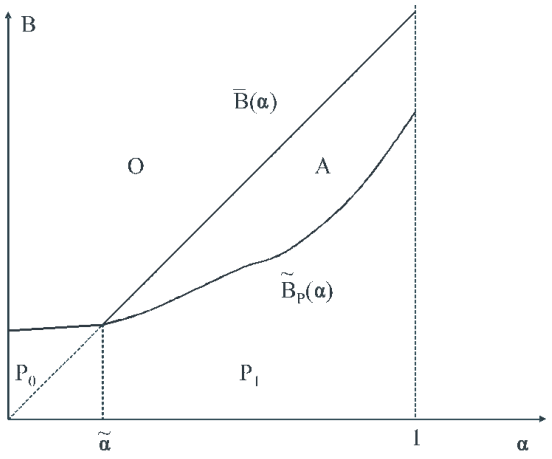

Figure 1: Optimal Organization of the Firm

3 Monopolistic Competition

To embed our previous model of the firm's organization into an industry equilibrium framework, we consider the horsework model of monopolistic competition with linear-quadratic preferences. More precisely, let an economy with L consumers with preferences defined over a continuum of differentiated varieties indexed by $i \in \Omega$ and a homogenous good chosen as the numéraire:

$$U = x_0 + \beta \int_{i\in\Omega} x_i di - \frac{1}{2}\gamma \int_{i\in\Omega} x_i^2 di - \frac{1}{2}\eta \left[\int_{i\in\Omega} x_i di\right]^2$$

with x_0 and x_i respectively the consumptions of the numéraire 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 numéraire good and γ giving the degree of product differentiation between varieties i. The total demand for variety i can be expressed in the usual way as

$$q_i = Lx_i = \frac{\beta L}{\gamma + N\eta} - \frac{L}{\gamma}\, p_i + \frac{N\eta}{\gamma + N\eta}\frac{L}{\gamma}\, \overline{p} \tag{1}$$

where q_i is the market demand for variety i , p_i is the price of variety i, N the number of varieties and $\overline{p}$ the average price index given by $\overline{p} = \frac{1}{N}\int_{i\in\Omega} p_i di$.

The numéraire good 0 is produced with constant returns of scale (one unit of good 0 requires one unit of labour) under perfect competitive conditions. This pins down the wage rate $w = 1$.

Each variety of the differentiated good is produced under monopolistically competitive conditions. Supposing that a given variety i is produced with marginal cost c_i, one obtains in the usual way the equilibrium monopolistic profit level of a firm with cost c_i as [6]:

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

where c_D is a cutoff cost level

$$c_D = \frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta}\, \overline{c} \tag{3}$$

which is the cost level of a firm which is indifferent between remaining or leaving the industry and $\overline{c}$ is the average cost in the industry $\overline{c} = \frac{1}{N}\int_{i\in\Omega} c_i di$. Firms with cost $c_i < c_D$ earn positive profits. The cutoff cost level c_D captures the 'toughness' of competition in an industry. As is well known, with such linear demand system, 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 $\overline{p}$ or a larger number of varieties N.[7]

[6] For more details on the model see Ottaviano-Tabuchi-Thisse (2002) or Melitz-Ottaviano (2008).

[7] This is in contrast to CES utility used in the Dixit and Stiglitz 1977 model in which markups are fixed and exclusively determined by the taste for the variety parameter γ.

4 Organization, Congruence, and Competition

4.1 Endogenous Congruence Inside the Firm

We incorporate now the choice of firm organization into the production side described in section 2. This allows us to endogenize profits B and congruence α within firms. We naturally capture the basic agency problem between a Principal and an agent from the fact that the agent's preferred project is not cost minimizing. The idea here is that, rather than necessarily choosing a technology of production that minimizes costs, the agent prefers to implement a project that allows him to capture private benefit such as perks, prestige or personal intellectual or social interest. Specifically, we assume that the cost minimizing project (as preferred by the principal) implies production of variety with a marginal production cost $c_i = c_B$. Conversely, the agent's preferred project implies a production cost $c_i = c_b = \varphi c_B$ and $\varphi > 1$. φ therefore reflects the basic technological impact of the agency problem inside the firm. As we will see, mediated by market competition, this will translate in a particular degree of congruence α between the Principal and the agent.

More precisely, from (2) we can rewrite the principal's profits when her best project is implemented as:

$$B = \pi(c_B) = \frac{L}{4\gamma}\left[c_D - c_B\right]^2 = \frac{Lc_B^2}{4\gamma}\left[\widetilde{c}_D - 1\right]^2 \qquad \text{with} \qquad \widetilde{c}_D = \frac{c_D}{c_B} \tag{4}$$

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

The congruence parameter between the principal and her agent α can also be expressed as a function of the cost gap $\widetilde{c}_D$

$$\alpha = \frac{\pi(c_b)}{\pi(c_B)} = \left[\frac{\widetilde{c}_D - \varphi}{\widetilde{c}_D - 1}\right]^2 \tag{5}$$

The conflict of interest in firms becomes more intense (α becomes smaller) with

a decline in relative profits between a high cost firm $\pi(c_b)$ in which the agent implements his best project and a low cost firm $\pi(c_B)$ in which the principal implements his preferred project. Relative profits between these two types of firms decline with an increase in competition (with smaller $\widetilde{c}_D$), because the revenues of high-cost firms go down by more than the revenues of low-cost firms. Indeed high cost firms try to fight the loss in revenues by lowering markups more than low cost firms. With more intense competition, it matters more who runs the firm and delegation of decision making power to the agent becomes more costly to firms. [8]

The two relationships (4) and (5) describe how $\widetilde{c}_D$, jointly affects profits and the degree of congruence inside firms. Eliminating $\widetilde{c}_D$, they define a relationship between B and α that has to be satisfied by any firm and given by

$$B = \widehat{B}(\alpha) = \left[\frac{\varphi - 1}{1 - \sqrt{\alpha}}\right]^2 \frac{L}{\gamma} \frac{c_B^2}{4} \tag{6}$$

The appendix shows that $\widehat{B}(.)$ satisfies $\widehat{B}(0) > 0$ and $\widehat{B}(1) = +\infty$ and has a positive slope in the space (B, α). A downward move along $\widehat{B}(.)$ is associated with an increase in market competition (a decrease in $\widetilde{c}_D$).

4.2 Organizational Equilibria and Free Entry

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

[8] It can be noted that the property that congruence inside the firm declines with market competition holds in more general competitive contexts. Specifically, consider a market structure generating equilibrium profits $\pi(c, \delta)$ for a firm with cost c and facing some degree of market toughness captured by some index δ. Denoting $\epsilon_\delta^\pi(c) = -\frac{\delta}{\pi}\frac{\partial \pi}{\partial \delta}$ the elasticity of profit with respect to δ, it is easy to see that the degree of congruence $\alpha = \frac{\pi(c_b,\delta)}{\pi(c_B,\delta)}$ is a decreasing function of δ when the elasticity $\epsilon_\delta^\pi(c)$ is an increasing function of the firm's cost. Our set-up provides a specific micro-founded context in which that property holds.

who has *real* power in the organization. Finally there is production, consumption and factor market clearing.

The free entry conditions for a given choice of firm organization can be written as $Max\{u_P(B), u_A(B), u_O(B)\} = 0$. The "Max" argument in free entry conditions reflects the fact that each firm decides its optimal type after market entry. Taking into account the fact that $w = 1$ and using Table 1, three types of free entry equilibria are possible:

i) Equilibrium with P-organization and $e_P^* = \overline{e}$. The free entry condition in such a regime is

$$u_P(B) = \frac{B^2(1-\alpha\overline{e})^2}{2} + \overline{e}\alpha B - 1 = 0 \tag{7}$$

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

ii) Equilibrium with A-organization and $e_A^* = \overline{e}$. The free entry condition in such a regime is

$$u_A(B) = \frac{B^2(1-\overline{e})^2}{2} + \overline{e}\alpha B - 1 = 0 \tag{8}$$

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

iii) Equilibrium with O-organization and $e_P^* = 0$. Finally the free entry condition in this regime is

$$u_O(B) = \frac{B^2}{2} - 1 = 0 \tag{9}$$

which gives the solution $B_0^* = \sqrt{2}$. Such an equilibrium exists when $\sqrt{2} > \overline{B}(\alpha)$.

The structure of organizational equilibria with free entry are illustrated in Figure 2 in the space of profits B and congruence α. This figure combines the profit maximizing choice of organization of Figure 1 and the free entry conditions (7), (8) and (9).

Specifically, the curves $B_P^*(\alpha)$ and $B_A^*(\alpha)$ depict the free entry profit levels that a firm requires to enter the market as a P-firm and as an A-firm (conditions (7)

and (8)) while the horizontal line $B_0^* = \sqrt{g}$ gives the free entry profit level for O-firms (condition (9)). Both curves $B_P^*(\alpha)$ and $B_A^*(\alpha)$ slope down at rate α, since the revenues of both firms increase with α and thus firms require a lower profit to enter the market. Moreover 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.

Combining the free entry curves $B_P^*(\alpha)$, $B_A^*(\alpha)$ and $B = B_0^*$ with the two curves $\tilde{B}_P(\alpha)$ and $\overline{B}(\alpha)$ that characterize the optimal organization, one obtains the bold curve B^*B^* that characterizes the nature of free entry corporate equilibria as a function of the degree of congruence α within firms.

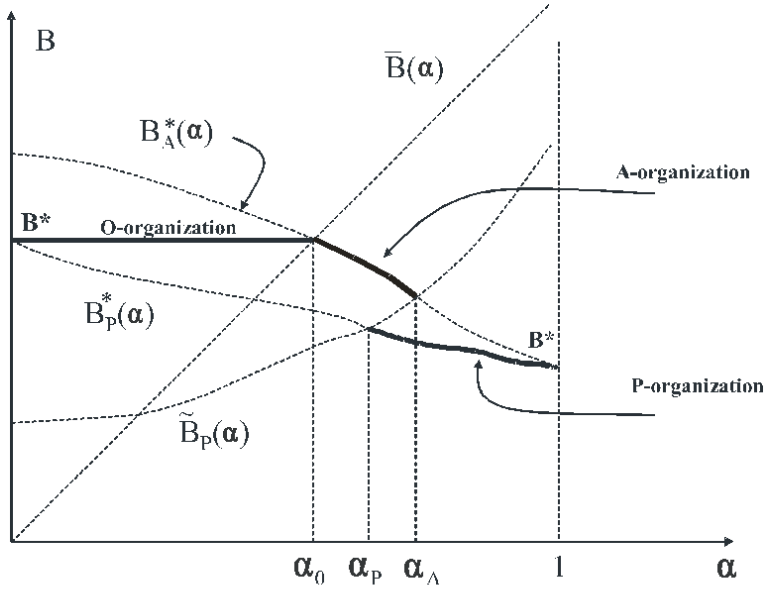

Figure 2: Free Entry Equilibrium Organization

Several points are worth noticing. First, at $\alpha = 1$, the mode of organization does not 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 P-organization with power at the top of the firm to the decentralized A-organization 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 and the free entry stake B^*corresponds to the curve $B_P^*(\alpha)$.When α keeps increasing and the conflict of interest between the principal and her agent in firms becomes more intense the required stakes to enter the market are sufficiently large to kill the initiative of agents under the P-organization but not under the A-organization. There is now a trade-off between control and initiative. The A-organization emerges as a corporate equilibrium for values of α in $[\alpha_0, \alpha_P]$. Consider a value of α in that range in Figure 2. The corresponding free-entry profit levels under A-organization and P-organization are B_1 and B_2 respectively. But we know that for such a value of α, if B lies above the $\tilde{B}_P(\alpha)$ curve, the firm should optimally choose A-organization. Hence the relevant free-entry profit is given by B_1 which lies on the $B_A^*(\alpha)$ curve[9]. 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 loose the initiative of managers. The O-firm emerges as the equilibrium organization at the flat part $B_0^* = \sqrt{2}$.

The preceding discussion can be summarized in the following statement:

Statement 1: When the degree of congruence in firms decreases, the corporate equilibrium organization moves from the centralized P-organization to the decentralized A-organization to the singly managed O-organization.

[9]Note also that when α in $[\alpha_P, \alpha_A]$, the model produces multiple corporate organizational equilibria. The reason for such multiple equilibria comes from a "strategic complementarity " among firms at the decision stage of optimal firm organization. At an intermediate level of competition, the attractiveness between the P and A modes of organizations depends on the organizational decisions taken by other firms in the market. Each firm individually would choose the A-organization, since in between the curves $\tilde{B}_P(\alpha)$ and $\overline{B}(\alpha)$ 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 because P-organizations have on average lower costs, market competition will be tougher, making it harder to survive with an A-organization. Therefore, market entry as an A-firm is not profitable and the firm's best choice after entry will be to choose a P-organization as well. Conversely, when the firm anticipates that all the other firms choose the A-organization, then she expects to be a viable competitor in the market with an A-organization. Thus, it also opts for an A-organization after market entry.

4.3 Corporate Equilibrium and Competition

We are finally ready to describe the corporate equilibrium organization. This is fully illustrated in Figure 3 which explores how the free entry organizational equilibria we have just derived in the previous section interact with the toughness of competition and the degree of congruence within firms.

The curve (PP) in quadrant I shows how the firm's profits B vary with $\widetilde{c}_D$ (relationship (4)). The curve has a positive slope, because when $\widetilde{c}_D$ declines and competition becomes tougher, profits decline as revenues and markups become smaller. The curve $(\alpha\alpha)$ in quadrant II shows how $\widetilde{c}_D$ affects the conflict of interest inside firms α (relationship (5)). The curve has a positive slope because, when $\widetilde{c}_D$ 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 45^0 line making sure that the two curves $(\alpha\alpha)$ and (PP) are drawn for the same value of $\widetilde{c}_D$. Finally quadrant IV shows two curves. The B^*B^* curve (derived in Figure 2) determines free entry profits and the profit maximizing choice of firm organization. The second curve is the $\widehat{B}(.)$ curve from equation (6) that relates congruence to profits through the toughness of competition.

An equilibrium $E =(B^e, \alpha^e)$ is defined by the intersection point of the B^*B^* curve and the $\widehat{B}(.)$ curve. Since B^*B^* is downward sloping in α and $\widehat{B}(\alpha)$ is increasing in α, we show in appendix B that such an organizational equilibrium (B^e, α^e) always exists.[10] 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 $\widetilde{c}_D^i$ in quadrant II of Figure 3. Similarly, the equilibrium level of monitoring by firms E_i is obtained, from which we can then back up all the variables of the monopolistic competitive model (equilibrium average costs $\overline{c}^i$, number of effective firms N_i, number of firms entering $M_i = N_i/(E_i + (1 - E_i)e)$, output, revenues and markup levels of low cost

[10]Because of the strategic complementarities of organizational choices as discussed in the previous footnote, for some parameter values the model can exhibit multiple corporate free entry equilibria when the $B = \widehat{B}(\alpha)$ curve crosses the B^*B^* in the range of congruence $\alpha \in [\alpha_P, \alpha_A]$. Marin and Verdier (2008a) provide a full discussion of such cases in the context of a model of monopolistic competition with Dixit Stiglitz preferences. We concentrate our discussion here on situations where there is a unique equilibrium.

P-firms and high cost A-firms). Finally, the labour market equilibrium gives the output level of the numéraire good 0.

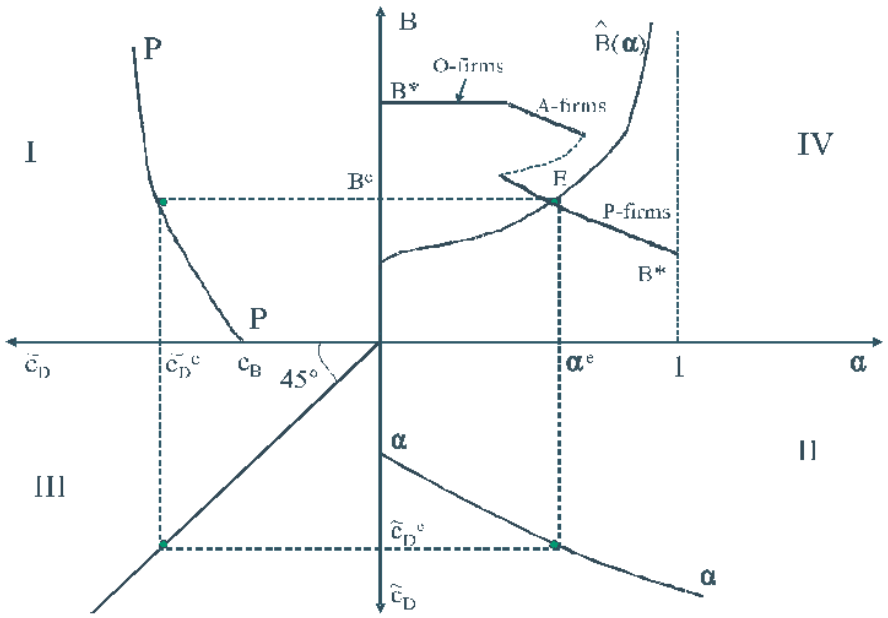

Figure 3: Equilibrium Structure

5 International Trade 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 congruence within firms and the optimal firm organization.

The effect of a change in market size L is illustrated in Figure 4. We know from (4) 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 4. At the same time, a change in L does not affect the curve $(\alpha\alpha)$ in quadrant II. Given that the profits of high cost and low cost firms are both directly proportional to market size, a change in L has no direct effect on the conflict of interest α, everything else being equal. Thus, an increase in L shifts up the curve

$\widehat{B}(\alpha)$ in quadrant IV of Figure 4. Note also that the free entry curve B^*B^* is not affected by a change in L.

As a consequence, market size affects the equilibrium organization of firms. An increase in L makes the equilibrium point E (intersection of $\widehat{B}(\alpha)$ and B^*B^*) move along B^*B^* upward from a P-equilibrium with power at the top of the organization to an A-equilibrium with power delegated to the divisional level, to finally a singly managed O-equilibrium regime without internal hierarchies.[11] Note also that with an increase in market size, α moves leftward along the B^*B^* curve. Hence, the conflict of interest within the firm increases with an increase in L. Finally, in quadrant II of Figure 4, an increase in L increases the toughness of competition in the market (decreases $\widetilde{c}_D$).

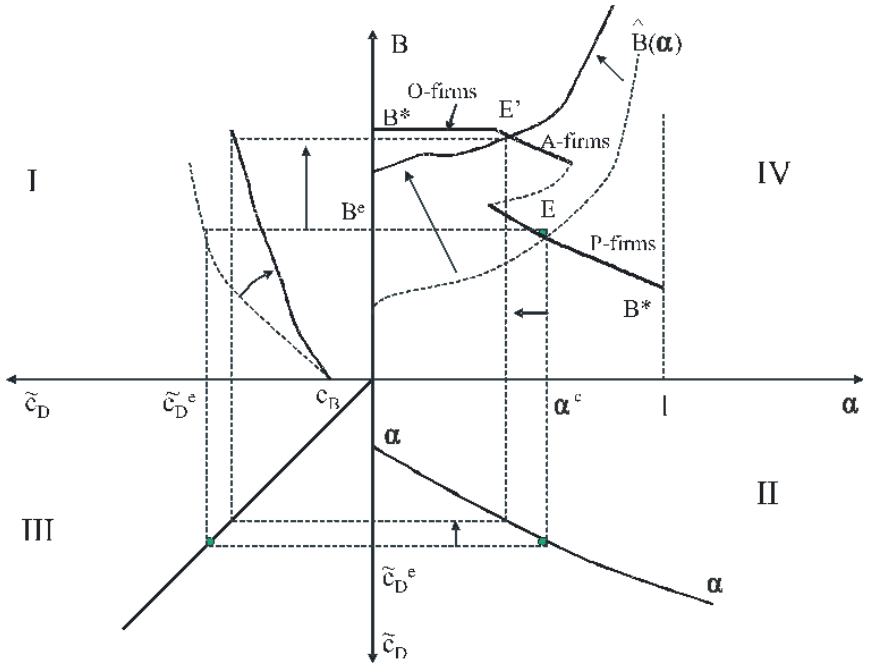

Figure 4: A Change in Market Size

Intuitively, an increase in market size increases the firms' outputs and profits, encouraging the entry of other firms, tougher competition and smaller markups.

[11] We provide in the appendix sufficient conditions for α_0 to be smaller than α_P in Figure 3, ensuring that for intermediate values of market size L, there always exist an A-equilibrium with power delegated to the divisional level.

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

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

6 Empirical Evidence

In this section, we test the predictions of our theory against original data of 2200 global corporations in Austria and Germany. We first describe the survey and the data. We then examine the relationship between the allocation of power in firms and international trade. Finally, we analyse how the trade environment affects

the speed of organizational change. As predicted by the theory, we show that the level of decision-making inside firms as well as the speed of organizational change in Austrian and German corporations can be explained by the trade environment that firms face.

6.1 The Data

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

The organizational data of the sample are unique in several dimensions. They include detailed information on the internal organization of the corporations such as power relations between the CEO/owner and middle managers at the divisional level and the organizational form. Table A3 of the data appendix gives summary statistics of all the variables used in this paper.[12]

The variable *power* measures authority in the firm and is obtained from the question 'Who decides over the following issues concerning your corporation, head-

[12]For more information on the data see Marin (2010).

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

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

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

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

6.2 International Trade and the Level of Decentralization

6.2.1 Prediction:

We start by examining the relationship between international trade and the mode of organization of firms. An increase in trade is captured in our model by an increase in market size L. From Figure 4, 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 singly managed O-firm. Thus, we have:

Prediction 1: In a cross-section of firms, firms will have more decentralized

corporate hierarchies when they are facing tougher competition and a stronger exposure to international trade.

6.2.2 Specification:

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

$$\ln power_{ij} = \theta_1 + \theta_2 comp_{ij} + \theta_3 trade_{ij} + \theta_4 nation_j + \theta_5 w'_{ij} + \in_{ij} \qquad (10)$$

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

6.2.3 Results:

Our main findings are given in Tables 2 to 2c which present ordinary least squares estimates of equation (10) for the level of decentralization of the 13 corporate decisions. All p-values are computed allowing for heteroskedasticity at the firm level as well as for industry-clustered standard errors. Furthermore, all regressions include a set of industry dummies as well as a range of additional firm-level controls to avoid reported correlations being driven by omitted variables. The additional firm-level covariates are log sales and log segments as well as log output per worker. Larger, more diversified and more productive firms appear to be significantly more likely to be decentralized. Table 2a gives the estimates for the most centralized O-decisions which are the decision on acquisitions, finance, and strategy, Table 2b

shows the calculations for the P-corporate decisions which are cooperately decided between the CEO and middle managements, which are the decision over budget, R&D, the decision over a new product, the decision to hire more than 10 percent of personnel, and the decision to change the supplier, and finally Table 2c reports the estimates for the most decentralized A-decisions which are the decision over product price, over a moderate wage increase, the decision to hire 2 workers and the decision to hire a secretary. Table 2 summarizes the main findings of Table 2a to 2c by aggregating the results for all O-decision, all P-decisions, and all A-decisions, respectively to make the results more readable. Furthermore, we normalize our measure of decentralization by rescaling the index to mean zero and standard deviation of one to make the estimates easier to interpret. Each value of the normalized index indicates its difference from the mean of the original decentralization index in number of standard deviations. In the upper panel of Tables 2 to 2c we show the estimates with the sectoral measures of trade and competition and in the lower panel the estimates with the firm level measures of trade and competition.

We start to report the results of Table 2. In the sectoral specification of the upper panel of Table 2 we include the Lerner index as a sectoral measure of competition, the import share or export share to capture foreign competition in the domestic market or in world markets, as well as the tariff rate at the sectoral level. Columns 1 and 2 use as the dependent variable the standardized measure of decentralization of all 13 corporate decisions, columns 3 and 4 report the results for the standardized measure of decentralization of all O-decisions included in Table 2a, columns 5 and 6 show the estimates for the standardized measure of decentralization of all P-decisions included in Table 2b, and finally, columns 7 and 8 report the results for the standardized measure of decentralization of all A-decisions included in Table 2c.

As can be seen from Table 2 none of the decisions appear to respond to the sectoral Lerner index as a measure of domestic competition except for the A-decisions. Firms faced with more domestic competition tend to decentralize even more the decentralized A-decisions. A closer look at the results for the individual A-decisions in Table 2c reveals, however, that the finding is driven mainly by

the most decentralized corporate decision of hiring a secretary, while the other A-decisions appear to become more centralized with more competition (hiring two workers) or do not respond to changes in the Lerner index. Moreover, when examining the P-decisions in more detail in Table 2b, we find that firms tend to recentralize also these decisions (R&D, and hiring more than 10 percent of personnel) with more competition.

Turning to the proxies for trade and foreign competition in Table 2 we find that a stronger exposure to international competition in the domestic market or in world markets - as measured by the import share or the export share - also induces firms to recentralize the decision making process except for the O-decisions which do not respond to more foreign rivals. Furthermore, in more protected markets - as measured by an increase in the sectoral import tariff rates - firms appear to decentralize more if at all. These results turn out to be even stronger at the level of the indiviual corporate decisions in Table 2b and 2c. Firms respond with more centralization to a stronger exposure to trade.

The reported results for competition and trade are at odds with Prediction 1. However, one problem with the sectoral measures of competition and trade is that they do not adequately capture the amount of competition the firm truly faces as it measures the average exposure to competition and trade of the sector. As we know from Melitz (2003), however, the average exposure to competition and trade does not capture the true exposure to trade and competition of firms depending on their productivity level. Since firms' exposure to trade and competition varies at the firm level, we prefer a firm level measure of trade and competition to which we turn now in the lower panel of Table 2. Our theory predicts a non-monotonic relationship between competition, trade, and the decision to decentralize (as shown in Figure 4 and Statement 2). Firms have to reach a critical level of competition before they start to decentralize (they move from P- to the A-organisation). Accordingly, the sectoral measures of competition and trade may show centralization in response to competition or no effect on the level of decentralization, because they underestimate the true exposure to trade and competition. Our data, indeed, show that the sectoral measures of competition are a weaker measure of trade and competition compared to the firm level measures of trade and competition. The

Determining the Level of Power in Corporations
(mean level of decentralization)

SECTORAL Level Measures of Trade and Competition

Dependent Variable	Normalized Average All Decisions (1-0 - 5.0)		Normalized Average O-Decisions (1.0 - 2.5)		Normalized Average P-Decisions (2.5 - 3.5)		Normalized Average A-Decisions (3.5 - 5.0)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lerner	0.0125	0.00173	-0.00254	-0.00658	0.0118	0.00208	0.0190**	0.00841
	(0.0135)	(0.00942)	(0.0196)	(0.0170)	(0.0147)	(0.0123)	(0.00545)	(0.00454)
import share	-0.229		-0.255		-0.309*		0.00889	
	(0.174)		(0.164)		(0.122)		(0.124)	
export share		-0.695*		-0.268		-0.634***		-0.675*
		(0.268)		(0.183)		(0.109)		(0.307)
tariffs	0.240	0.208	0.226	0.212	0.264	0.235*	0.119	0.0904
	(0.130)	(0.112)	(0.172)	(0.173)	(0.128)	(0.108)	(0.131)	(0.102)
log(sales)	0.0361	0.0546	-0.0281	-0.0196	0.0201	0.0378	0.0715	0.0878*
	(0.0383)	(0.0283)	(0.0965)	(0.0901)	(0.0435)	(0.0488)	(0.0342)	(0.0339)
nation	-0.0839	-0.181	0.391*	0.417**	-0.240	-0.291	-0.190*	-0.372**
	(0.0765)	(0.0921)	(0.159)	(0.144)	(0.151)	(0.152)	(0.0771)	(0.130)
Industry Dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	491	491	491	491	490	490	489	489
Adjusted R-squared	0.066	0.086	0.091	0.089	0.104	0.117	0.042	0.069

FIRM Level Measures of Trade and Competition

Dependent Variable	Normalized Average All Decisions (1-0 - 5.0)	Normalized Average O-Decisions (1.0 - 2.5)	Normalized Average P-Decisions (2.5 - 3.5)	Normalized Average A-Decisions (3.5 - 5.0)
	(1)	(2)	(3)	(4)
A. Local Competition				
few competitors	0.102	-0.142	0.497**	-0.175
	(0.155)	(0.286)	(0.173)	(0.119)
many competitors	0.223	0.146	0.708***	-0.378*
	(0.172)	(0.245)	(0.116)	(0.167)
very many competitors	-0.127	-0.242	0.204	-0.304
	(0.189)	(0.367)	(0.174)	(0.387)
B. Foreign Competition				
few competitors	1.029**	1.335***	2.453***	-1.030***
	(0.353)	(0.293)	(0.331)	(0.265)
many competitors	0.959**	1.276***	2.316***	-0.986***
	(0.299)	(0.200)	(0.350)	(0.254)
very many competitors	0.809***	0.987***	2.173***	-1.021**
	(0.206)	(0.248)	(0.201)	(0.317)
log(sales)	0.0313*	-0.0239	0.00555	0.0830***
	(0.0145)	(0.0439)	(0.0108)	(0.0186)
nation	-0.0564	0.302	-0.0907	-0.245
	(0.236)	(0.173)	(0.297)	(0.185)
Industry Dummies	yes	yes	yes	yes
Observations	1,064	1,064	1,063	1,062
Adjusted R-squared	0.067	0.137	0.086	0.066

Notes: *** p<0.01, ** p<0.05, * p<0.1. All coefficients are estimates from ordinary least squares with industry-cluster robust standard errors in parentheses. The dependent variable is a normalized index of the level of decentralization with mean=0 and stdev.=1. The level of decentralization indicates whether the respective decisions are taken at the CEO-level at the top of the organization (centralized decision, smaller values) or by managers at the divisional level (decentralized decision, larger values). *Normalized Average All Decisions* is the normalized average over all corporate decisions given individually in tables 2a - 2c. *Normalized Average O-Decisions* is the normalized average over all O-decisions given individually in Table 2a. *Normalized Average P-Decisions* is the normalized average over all P-decisions given individually in Table 2b. *Normalized Average A-Decisions* is the normalized average over all A-decisions given individually in Table 2c. The omitted category for local and foreign competition is "no competitor". All estimates include in addition industry-specific controls, physical capital per sales and a constant.

Table 2: Determining the Level of Power in Corporations

data in Table A3 of the Appendix indeed suggest that the firm level measure of trade indicates a much stronger exposure to trade compared to the sectoral trade ratios. Firms in our data sample have more foreign than domestic competitors

when they are facing very many and many competitors (the ratio is 1.4).

When we turn to the lower panel of Table 2 with the firm level measures of competition and trade, we find, indeed, that firms decentralize when faced with more foreign competitors (the estimated coefficients on few, many, and very many foreign competitors are positive and higly significant at conventional levels) except for the decentralized A-decisions. [14] For the decentralized A-decisions (with a level of decentralization ranging between 3.5 to 5 in the index of decentralization) firms become more centralized with more foreign competition. The estimated coefficients on the number of foreign rivals as perceived by firms are all negative and highly significant at conventional levels. We see this pattern as further evidence for a non-monotonic relationship between competition and the level of decentralization in firms. When firms are already decentralized they recentralize power to top management when the market environment becomes tougher (they move from the A-organization to the O-organization in the parliance of our model). It becomes more important to control costs rather than to empower middle management. A closer inspection of the results for the most decentralized decisions, indeed, suggests that they are all concerned with a moderate change in costs or prices of the firm supporting the view that when competition becomes more intense firms start to care more about costs and to recentralize the decisions affecting the costs and prices of firms. [15][16]

Note, that with the firm level measure of domestic competition firms do not appear to respond much to changes in domestic competitive pressures except for the P-decisions which clearly become more decentralized. In particular, the decision to introduce a new product becomes more decentralized as it is more important to give power to the manager who has better information and is closer

[14]The omitted category for domestic and foreign competition is 'no competitor'.

[15]The estimated coefficients on few, many, and very many competitors are fairly similar and do not show a non-monotonic pattern as is suggested by our theory. This appears to indicate that within this measure of competition firms do not hit the threshold of competition which induces a change in the organization.

[16]Note that the number of observations drop to 479 with the sectoral measure as compared to the firm measure (1035), since the regressions with the firm measure include services which are dropped when we use the WITS trade data in the sectoral regressions.

to the market. The difference in firms' organizational response to domestic and foreign rivals is consistent with our theory as firms with only domestic rivals face weaker competitive pressures compared to firms with foreign rivals and, thus, are less inclined to change the decision making in the firm. We now from the heterogeneity literature of trade (Melitz 2003) that firms engaging in trade face tougher competition than firms operating only on the domestic market.

Delegating power to middle managers may be more beneficial for some decisions than others. In Table 2b we focus on corporate decisions for which empowerment of middle managers may matter most as is the case for the decisions which are cooperatively decided between headquarters and middle managers such as the decision over R&D or the decision to introduce a new product (Table 2b). Here we indeed find that competition and trade have a stronger effect on the allocation of authority in the firm both with the sectoral as well as with the firm level measures of competition and trade.

Overall, we take the findings given in Tables 2 to 2c as supporting Prediction 1 that firms exposed to tougher competition and more trade introduce more decentralized corporate hierarchies and that the relationship between the level of decentralization and trade and competition is non-monotonic.

7 Conclusion

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

Determining the Level of Power in Corporations
O-Decisions (mean level of decentralization 1.0 - 2.5)

SECTORAL Level Measures of Trade and Competition

Dependent Variable	acquisitions (1.40)	finance (1.64)	strategy (1.85)
Lerner	-0.00994	0.00826	-0.00000529
	(0.0105)	(0.0105)	(0.0276)
import share	0.0741	-0.0723	-0.504
	(0.0801)	(0.0712)	(0.428)
export share			
tariffs	0.212	0.105	0.199
	(0.138)	(0.0891)	(0.157)
log(sales)	-0.111	0.0679	-0.00762
	(0.158)	(0.0949)	(0.0417)
nation	0.520	0.133	0.240
	(0.310)	(0.203)	(0.237)
Industry Dummies	yes	yes	yes
Observations	479	489	487
Adjusted R-squared	0.076	0.070	0.090

FIRM Level Measures of Trade and Competition

Dependent Variable	acquisitions (1.40)	finance (1.64)	strategy (1.85)
A. Local Competition			
few competitors	-0.689**	0.0521	0.341
	(0.289)	(0.185)	(0.412)
many competitors	-0.468*	0.332	0.456
	(0.245)	(0.281)	(0.451)
very many competitors	-0.656	-0.280	0.410
	(0.364)	(0.330)	(0.580)
B. Foreign Competition			
few competitors	0.673*	1.152***	1.073**
	(0.286)	(0.278)	(0.317)
many competitors	0.690**	0.887***	1.195***
	(0.235)	(0.174)	(0.223)
very many competitors	0.717**	0.876**	0.528**
	(0.238)	(0.300)	(0.201)
log(sales)	-0.0305	0.0490	-0.0673
	(0.0474)	(0.0463)	(0.0375)
nation	0.203	0.212	0.295*
	(0.229)	(0.172)	(0.129)
Industry Dummies	yes	yes	yes
Observations	1,035	1,040	1,055
Adjusted R-squared	0.083	0.111	0.135

Notes: *** p<0.01, ** p<0.05, * p<0.1. All coefficients are estimates from ordinary least squares with industry-cluster robust standard errors in parentheses. The dependent variables are the level of decentralization and are normalized to mean = 0 and s.d. = 1 and indicate whether the respective decisions are taken at the CEO-level at the top of the organization (centralized decision) or by managers at the divisional level (decentralized decision). The omitted category for local and foreign competition is "no competitor". All estimates additionally include industry-specific controls, physical capital per sales and a constant.

Table 2a: Determining the Level of Power in Corporations - O-Decisions

Determining the Level of Power in Corporations

P-Decisions (mean level of decentralization 2.5 - 3.5)

SECTORAL Level Measures of Trade and Competition

Dependent Variable	budget (2.70)	r&d (2.73)	new products (2.77)	hiring >10% (2.85)	supplier (3.22)
Lerner	0.0150	-0.0262**	0.00344	-0.0187**	0.0381
	(0.0181)	(0.00525)	(0.00665)	(0.00422)	(0.0254)
import share			-0.181	0.0880	-0.448**
			(0.111)	(0.0887)	(0.107)
export share	-0.693**	-0.947*			
	(0.215)	(0.399)			
tariffs	0.255**	0.216*	0.214	0.0205	0.149***
	(0.0580)	(0.0887)	(0.178)	(0.0708)	(0.0268)
log(sales)	-0.0601	-0.00633	0.131	0.0874	-0.0862*
	(0.0383)	(0.0617)	(0.0776)	(0.0461)	(0.0321)
nation	-0.112	0.0131	-0.328	-0.204	0.00496
	(0.0537)	(0.266)	(0.279)	(0.109)	(0.128)
Industry Dummies	yes	yes	yes	yes	yes
Observations	484	245	450	489	471
Adjusted R-squared	0.102	0.204	0.153	0.099	0.095

FIRM Level Measures of Trade and Competition

Dependent Variable	budget (2.70)	r&d (2.73)	new products (2.77)	hiring >10% (2.85)	supplier (3.22)
A. Local Competition					
few competitors	0.283**	0.422	0.359	0.0851	0.230
	(0.0919)	(0.382)	(0.213)	(0.217)	(0.188)
many competitors	0.474***	1.044**	0.413**	0.490**	0.192
	(0.0785)	(0.374)	(0.148)	(0.158)	(0.282)
very many competitors	0.0207	0.546	0.554***	-0.279	-0.0958
	(0.246)	(0.378)	(0.122)	(0.159)	(0.331)
B. Foreign Competition					
few competitors	1.977***	0.959**	1.312***	1.833***	1.288**
	(0.280)	(0.283)	(0.375)	(0.297)	(0.380)
many competitors	2.065***	0.404	1.308***	1.602***	1.319***
	(0.243)	(0.261)	(0.340)	(0.288)	(0.307)
very many competitors	1.796***	omitted	0.843***	1.805***	1.700***
	(0.215)		(0.220)	(0.151)	(0.309)
log(sales)	-0.0940**	0.109	0.0366	0.0805***	-0.0147
	(0.0394)	(0.0721)	(0.0468)	(0.0230)	(0.0544)
nation	-0.0138	-0.0102	-0.106	-0.113	-0.164
	(0.287)	(0.104)	(0.328)	(0.183)	(0.267)
Industry Dummies	yes	yes	yes	yes	yes
Observations	1,049	354	954	1,034	1,001
Adjusted R-squared	0.089	0.268	0.095	0.106	0.113

Notes: *** p<0.01, ** p<0.05, * p<0.1. All coefficients are estimates from ordinary least squares with industry-cluster robust standard errors in parentheses. The dependent variables are the level of decentralization and are normalized to mean = 0 and s.d. = 1 and indicate whether the respective decisions are taken at the CEO-level at the top of the organization (centralized decision) or by managers at the divisional level (decentralized decision). The omitted category for local and foreign competition is "no competitor". All estimates additionally include industry-specific controls, physical capital per sales and a constant.

Table 2b: Determining the Level of Power in Corporations - P-Decisions

Determining the Level of Power in Corporations
A-Decisions (mean level of decentralization 3.5 - 5.0)

SECTORAL Level Measures of Trade and Competition

Dependent Variable	product price (3.75)	mod. wage increase (4.10)	hiring 2 workers (4.26)	hiring secretary (4.62)
Lerner	0.00770	0.0246	-0.0197**	0.0263*
	(0.00624)	(0.0172)	(0.00604)	(0.0114)
import share	-0.506**			0.554***
	(0.116)			(0.0475)
export share		-0.528	-0.485*	
		(0.618)	(0.186)	
tariffs	0.326**	0.125	-0.0606	-0.000141
	(0.0927)	(0.0787)	(0.0623)	(0.146)
log(sales)	-0.107***	0.0306	0.205**	0.129***
	(0.0193)	(0.100)	(0.0697)	(0.00786)
nation	0.0613	-0.0666	-0.628***	-0.266**
	(0.120)	(0.260)	(0.113)	(0.0856)
Industry Dummies	yes	yes	yes	yes
Observations	465	477	489	488
Adjusted R-squared	0.119	0.050	0.170	0.120

FIRM Level Measures of Trade and Competition

Dependent Variable	product price (3.75)	mod. wage increase (4.10)	hiring 2 workers (4.26)	hiring secretary (4.62)
A. Local Competition				
few competitors	-0.461	0.0825	-0.444	0.232**
	(0.282)	(0.157)	(0.321)	(0.0836)
many competitors	-0.343	0.00324	-0.368	-0.167
	(0.377)	(0.206)	(0.345)	(0.144)
very many competitors	-0.692	0.281	-0.623	-0.128
	(0.494)	(0.214)	(0.469)	(0.237)
B. Foreign Competition				
few competitors	-1.085**	-0.807**	-0.532*	-0.706***
	(0.413)	(0.232)	(0.276)	(0.110)
many competitors	-0.729***	-0.878**	-0.434	-0.924***
	(0.178)	(0.277)	(0.266)	(0.134)
very many competitors	-0.772**	-0.770***	-0.452*	-0.655***
	(0.236)	(0.213)	(0.196)	(0.142)
log(sales)	0.0311	0.0395	0.129**	0.0743**
	(0.0343)	(0.0417)	(0.0396)	(0.0307)
nation	-0.0521	-0.319	-0.170	-0.293
	(0.130)	(0.223)	(0.260)	(0.174)
Industry Dummies	yes	yes	yes	yes
Observations	1,003	1,027	1,034	1,052
Adjusted R-squared	0.126	0.031	0.060	0.105

Notes: *** p<0.01, ** p<0.05, * p<0.1. All coefficients are estimates from ordinary least squares with industry-cluster robust standard errors in parentheses. The dependent variables are the level of decentralization and are normalized to mean = 0 and s.d. = 1 and indicate whether the respective decisions are taken at the CEO-level at the top of the organization (centralized decision) or by managers at the divisional level (decentralized decision). The omitted category for local and foreign competition is "no competitor". All estimates additionally include industry-specific controls, physical capital per sales and a constant.

Table 2c: Determining the Level of Power in Corporations - A-Decisions

References

[1] Acemoglu, D., P. Aghion, R. Griffith, F. Zilibotti. 2005. Vertical Integration and Technology: Theory and Evidence, NBER Working Papers No. 10997.

[2] Acemoglu, D., P. Aghion, C. Lelarge, J. Van Reenen, F. Zilibotti. 2007. Technology, Information, and the Decentralization of the Firm. Quarterly Journal of Economics 122(4). pp. 1759-1799.

[3] Aghion, P. and J. Tirole. 1997. Formal and Real Authority in Organizations. Journal of Political Economy. 105 (1). pp. 1-29.

[4] Alonso R., W. Dessein and N. Matouschek (2013). Organizing to Adapt and Compete, Northwestern University Mimeo.

[5] Bernard, A.B., J.B. Jensen, S.J. Redding and P.K. Schott. Firms in International Trade. Journal of Economic Perspectives 21(3). pp. 105-130.

[6] Bloom, N. and J. Van Reenen. 2006. Measuring and Explaining Management Practices across Firms and Countries, Quarterly Journal of Economics 4. pp. 1351-1408.

[7] Bloom, N., Sadun, R. and Van Reenen J. 2010. Does Product Market Competition Lead Firms to Decentralize? American Economic Review. Papers and Proceedings. 100(2). 434-438.

[8] Dixit, A. and J. Stiglitz .1977. Monopolistic Competition and Optimum Product Diversity.American Economic Review. 67(3). pp. 297-308.

[9] Guadalupe, M.and J.Wulf. 2010. The Flattening Firm and Product Market Competition: The Effect of Trade Liberalization on Corporate Hierarchies. American Economic Journal: Applied Economics, 2(4): 105-27.

[10] Helpman, E. 2006. Trade, FDI, and the Organization of Firms. Journal of Economic Literature 44(3). pp. 589-630.

[11] Helpman, E. and P. Krugman. 1985. Market Structure and Foreign Trade. MIT Press. Cambridge.

[12] Helpman, E. D. Marin, T. Verdier (Eds). 2008. The Organization of Firms in a Global Economy, Harvard University Press.

[13] Holmstrom, B. and St. N. Kaplan. 2001. Corporate Governance and Merger Activity in the United States. Journal of Economic Perspectives 15 (2). pp. 121-144.

[14] Krugman, P. 1979. Increasing Returns, Monopolistic Competition, and International Trade. Journal of International Economics 9. pp. 469-479.

[15] Krugman, P. 1980. Scale Economies, Product Differentiation, and the Pattern of Trade. American Economic Review 70. pp. 950-959.

[16] Marin, D. 2006. A New International Division of Labor in Europe: Outsourcing and Offshoring to Eastern Europe. Journal of the European Economic Association, Papers and Proceedings 4(2) pp. 612-623.

[17] Marin, D. 2008. The New Corporation in Europe.Bruegel Policy Brief 2008/07. Brussels.

[18] Marin, D. 2011. The Opening Up of Eastern Europe at 20: Jobs, Skills and 'Reverse Maquiladoras' in Austria and Germany, in: M. Jovanovic (Ed.) International Handbook on the Economics of Integration, Edward Elgar, vol 2.

[19] Marin, D. 2012. The Theory of the Firm goes Global. Centre for Economic Policy Research, CEPR Discussion Paper No 8880. London

[20] Marin, D. and T. Verdier. 2003. Globalization and the 'New Enterprise'. Journal of the European Economic Association. Papers and Proceedings 1(2-3). pp. 337-344.

[21] Marin, D. and T. Verdier. 2007. Corporate Hierarchies and the Size of Nations, Stern School of Business. New York University. New York.

[22] Marin, D. and T. Verdier. 2008a. Power Inside the Firm and the Market: A General Equilibrium Approach. Journal of the European Economic Association 6(4). pp. 752-788.

[23] Marin, D. and T. Verdier. 2008b. Competing in Organizations: Firm Heterogeneity and International Trade, in: E. Helpman, D.Marin, T.Verdier (Eds.), The Organization of Firms in a Global Economy, Harvard University Press.

[24] Marin, D. and T. Verdier. 2012. Globalization and the Empowerment of Talent. Journal of International Economics 86(2). pp. 209-223.

[25] Melitz, M. 2003. The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations. Econometrica 71(6). pp. 1695-1726.

[26] Melitz, M. and G. Ottaviano. 2008. Market Size, Trade and Productivity, Review of Economic Studies 75. pp. 295 - 316.

[27] Nunn, N. and D. Trefler. 2008. The Boundaries of the Multinational Firm: An Empirical Analysis, in: E. Helpman, D.Marin, T.Verdier (Eds.), The Organization of Firms in a Global Economy, Harvard University Press.

[28] Osterman, P. 1996. Broken Ladders: Managerial Careers in the New Economy. New York: Oxford University Press.

[29] Ottaviano G., T. Tabuchi and J.-F.Thisse 2002, Agglomeration and Trade Revisited, International Economic Review 43, 409-435

[30] Puga, D. and D. Trefler. 2010. Wake up and smell the ginseng: International trade and the rise of incremental innovation in low-wage countries, Journal of Development Economics, Elsevier, vol. 91(1), pp. 64-76.

[31] Rajan, R. G., H. Servaes and L. Zingales. 2000. The Cost of Diversity: Diversification Discount and Inefficient Investment. Journal of Finance 55. pp. 35-80.

[32] Rajan, R. G. and J. Wulf. 2006. The Flattening Firm: Evidence from Panel Data on the Changing Nature of Corporate Hierarchies. Review of Economics and Statistics 88(4). pp. 759-773.

[33] Spencer, Barbara J. 2005. International Outsourcing and Incomplete Contracts, Canadian Journal of Economics 38. pp 1107-1135.

[34] Williamsom, O.E. 1975. Markets and Hierachies. Analysis and Antitrust Implications. New York/London.

Appendix A: The Data

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 A1: Decisions Ranked by Level of Corporate Hierarchy - Austrian Corporations

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 A2: Decisions Ranked by Level of Corporate Hierarchy - German Corporations

Definition of Variables and Descriptive Statistics

Variable	Obser-vations	Description	Mean	Minimum	Maximum	Stand. Dev.
		Organizational Information				
power	1161	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.	2.83	1	5	0.87
normalized power	1161	normalized index of the level of decentralization with mean=0 and stdev.=1.	0.00	-2.10	2.50	1.00
normalized P-decisions	1161	normalized index of the level of decentralization of all P-decisions as listed in Table 2b with mean=0 and stdev.=1.	0.00	-2.08	2.38	1.00
normalized A-decisions	1161	normalized index of the level of decentralization of all A-decisions as listed in Table 2c with mean=0 and stdev.=1.	0.00	-3.85	0.99	1.00
normalized O-decisions	1161	normalized index of the level of decentralization of all O-decisions as listed in Table 2a with mean=0 and stdev.=1.	0.00	-1.20	5.03	1.00
		Measures of Competition				
local competition		local competition as perceived by firms				
very many competitors	2058	dummy variable equal to 1 and 0 otherwise when firm does not enter the market		D=1, 243 observations		
many competitors	2058	dummy variable equal to 1 and 0 otherwise when firm faces many competitors		D=1, 940 observations		
few competitors	2058	dummy variable equal to 1 and 0 otherwise when firm faces few competitors		D=1, 808 observations		
no competitors	2058	dummy variable equal to 1 and 0 otherwise when firm faces no competitors		D=1, 67 observations		

Definition of Variables and Descriptive Statistics (continued)

Lerner index	2053	for a three-digit ISIC Rev. 3 industry j of country k: $Lerner_{jk} = \left(1 - \frac{1}{N_{jk}} \sum_{i \in jk} \frac{profit\ before\ taxes_i}{operating\ revenue_i}\right) * 100\%$ Data source: AMADEUS database (Bureau van Dijk, 2005)	94	73	122	6
		Measures of Trade				
import share	1053	total imports divided by domestic production at three-digit ISIC Rev.3 level in host countries and averaged over the years 1996 to 2000; when the three-digit level information is missing, the two-digit ISIC level is used.	0.38	0.01	1.89	0.35
export share	1053	total exports divided by domestic production at the three-digit ISIC Rev.3 level in host countries and averaged over the years 1996 to 2000; when the three-digit level information is missing, the two-digit ISIC level is used. Source of trade data: WITS-UN COMTRADE database (World Bank, 2009); Source of production data: INDSTAT 4 (three-digit), STAN (two-digit) database (UNIDO, 2008, OECD, 2009)	0.40	0.01	1.05	0.26
foreign competition		foreign competition as perceived by firms				
very many competitors	2010	dummy variable equal to 1 and 0 otherwise when firm does not enter the market		D=1, 194 observations		
many competitors	2010	dummy variable equal to 1 and 0 otherwise when firm faces many foreign competitors		D=1, 1463 observations		
few competitors	2010	dummy variable equal to 1 and 0 otherwise when firm faces few foreign competitors		D=1, 347 observations		
no competitors	2010	dummy variable equal to 1 and 0 otherwise when firm faces no foreign competitors		D=1, 6 observation		
tariff	1067	average effective tariffs on imports in host countries over the years 1996 to 2000 at the three.digit ISIC Rev.3 level; when the three-digit level information is missing, the two-digit ISIC level is used. Data source: WITS-TRAINS database (World Bank 2009)	2.43	0.00	35.28	4.12
		Other Firm Level Information				
sales	1855	firm-level sales (in Mio. Eur)	1,770	0.562	58,000	5,920
labour productivity	1728	sales per worker	477540	17384	9689711	1033243
physical capital to output	1194	physical capital to output ratio	1.93	0	130	12.64
nation	2123	dummy variable equal to 1 if the country is Germany and 0 if it is Austria		D = 1, 1186 observations		

Table A3: Definition of Variables and Descriptive Statistics

Appendix B: Theory

- **The Aghion-Tirole model of firm organization**

In this appendix we discuss in more detail the model of firm organization based on Aghion-Tirole (1997) and the derivations of the main results of section 2. First recall that by spending a resource information collection cost of $g_P(E) = \frac{E^2}{2}$ the principal learns the payoffs of all projects with probability E and remains uninformed with probability $1 - E$. Similarly, by exerting some effort $g_A(e) = ke$ with $e \in [0, \overline{e}]$, $k < b$ the agent learns the payoff of all projects with probability e and remains uninformed with probability $1 - e$. The principal is risk-neutral and the agent is infinitely risk-averse with respect to income. The latter therefore agrees to receive a fixed wage w equal to his opportunity cost. Firms choose between two types of organizations, a P-organization in which the CEO/owner has formal power, and an A-organization in which the CEO delegates formal power to the agent. For convenience, the specific P-organization in which the agent exerts minimum effort is also denoted as a O-organization.

Under the P-organization, the principal's and agent's expected payoffs are given by:

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

Under the A-organization, the two parties' expected payoffs are written as:

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

To determine the optimal organization of the firm, we first characterize the subgame perfect equilibrium in effort levels E^*, e^* under each mode of organization as function of the profit level B. Then to determine the equilibrium organizational form, we consider which of these organizations yields higher utility to the principal and is preferred by him/her.

- Nash Equilibrium Efforts and Organizational Payoffs

- **P-Organization**

Under that organizational form, the first order conditions of the two parties with respect to efforts E and e are

$$\text{Principal} \quad : \quad B(1-e\alpha) = E \tag{11}$$

$$\text{Agent} \quad : \quad \begin{array}{l} e = \overline{e} \text{ if } k \leq b(1-E) \\ \quad = 0 \text{ if } k > b(1-E) \end{array} \tag{12}$$

The principal supervises more, the higher her stake in the project (the larger B), the larger the conflict of interest between the principal and agent (the lower α) and the lower the agent's effort e. The agent, in turn, has more initiative the higher his stake (the larger b) and the lower the principal's interference (the lower E). The Nash equilibrium level of efforts under the P-organization are immediately given by[17]:

$$\begin{array}{ll} e_P^* = \overline{e}, \text{ and } E_P^* = B(1-\overline{e}\alpha) & \text{when } B \leq \widetilde{B}_P(\alpha) \\ e_P^* = 0, \text{ and } E_P^* = B & \text{when } B > \widetilde{B}_P(\alpha) \end{array}$$

with

$$\widetilde{B}_P(\alpha) = \frac{1-k/b}{1-\overline{e}\alpha} \tag{13}$$

$\widetilde{B}_P(\alpha)$ is the threshold level of profits at which the agent's initiative are crowded out under the P-organization. For B larger than $\widetilde{B}_P(\alpha)$, the principal exerts an equilibrium effort E_P^* that kills the initiative of the agent. Inspection of (13) shows immediately that $\widetilde{B}_P(\alpha)$ depends positively on the degree of congruence α. The equilibrium expected utility of the principal under the P-organization with

[17]There are three possible Nash equilibria in effort levels. We select the equilibrium with the highest agent's effort which is also the one preferred by the principal. For a discussion of the three Nash equilibria see Aghion and Tirole 1997.

positive effort of the agent (when $B \leq \widetilde{B}_P(\alpha)$ is then:

$$u_P(B) = U_P(B(1-\overline{e}\alpha), \overline{e}) = \frac{B^2(1-\alpha\overline{e})^2}{2} + \overline{e}\alpha B - w \tag{14}$$

O-Organization

Alternatively, whenever profits are sufficiently large ($B > \widetilde{B}_P(\alpha)$), the Nash equilibrium level of efforts implies $e_P^* = 0$ and the agent does not actively engage in the firm under the P-organization. as mentionned in the text we denote such an organization as a 'O-organization'. The equilibrium expected utility of the principal in this case writes as

$$u_O(B) = U_P(B, 0) = \frac{B^2}{2} - w \tag{15}$$

A-Organization

With $b > k$, the Nash equilibrium effort levels under the A-organization are given by:

$$e_A^* = \overline{e} \text{ and } E_A^* = B(1-\overline{e}) \tag{16}$$

The advantage of delegating formal power to the agent is that the agent has more initiative to become informed. In our specification, the agent will always give maximum effort. The equilibrium expected utility of the principal under the A-organization is

$$u_A(B) = U_A(B(1-\overline{e}), \overline{e}) = \frac{B^2(1-\overline{e})^2}{2} + \overline{e}\alpha B - w \tag{17}$$

- **Proof of Proposition 1**

Two cases can be distinguished.
Case 1: $B \leq \widetilde{B}_P(\alpha)$

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

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

Given that $e_P^* = e_A^* = \overline{e}$, 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: $\widetilde{B}_P(\alpha) < B$

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

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

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

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

$\overline{B}(\alpha)$ 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. **QED**.

- **Remark 1**: The linear cost of effort of the agent ensures that there is a corner solution for e. This conveniently gives tractable solutions for the equilibrium game between the principal and the agent. The trade-off between control and initiative at intermediate levels of profits as illustrated in proposition 1 can, however, be obtained for more general principal's and agent's costs of effort. Specifically, one needs: 1) the principal's effort to be bounded from above so that the principal's increased effort cannot compensate for the decreased effort of the agent; 2) the principal's effort response to changes in profits is strong or the agent's effort

response to the principal's effort is strong. This works in particular when either of the two parties has linear costs of effort and the other convex costs of effort.

- **Remark 2**: One could alternatively model the cost of effort of the principal as an opportunity cost. For instance the principal could face a time constraint and the more time he spends monitoring the agent, the less time he has for production. The profit function B would then be a decreasing function $B(E)$ of E and the principal expected payoff would take the following expression $U_P(E,e) = EB(E) + (1 - E)e\alpha B(E) - w$. Under appropriate convexity assumptions on the function $B(E)$, one would again find that the principal supervises more, the lower the agent's effort e and the lower the congruence α with the agent. This provides the same qualitative equilibrium outcomes as proposition 1. This approach would, however, make the subsequent analysis with market structure analytically untractable.

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

  We need the following useful lemma:

- **- 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:

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

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

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

therefore at such a point:

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

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

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 assumption:

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

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" firm to make positive recurrent profits in a monopolistic equilibrium, where all the other firms are "low cost". Formally this assumption means that $\widehat{B}(0) < \sqrt{2} = B_0^*$, the required free entry recurrent profit under O-organization (necessarily a "low cost" firm). Thus, we have the following result :

- **- Proposition 2:** *Assume that assumption B holds. Then there exists at least one free entry organizational equilibrium* (B^e, α^e) *with* $\alpha^e > 0$ *(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 $\lim_{\alpha \to 1} \widehat{B}(\alpha) = +\infty$, 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 and 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).

- iii) Finally if $\alpha_A \leq \widetilde{\alpha}$, then $\widehat{B}(\alpha_P) < \widetilde{B}_P(\alpha_P) = B_P^*(\alpha_P)$ and by the same token using the function $\Theta_P(\alpha)$ and $\Gamma_P(\alpha) = \Theta_P(\alpha) - \widehat{B}(\alpha)$ 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 a O-firm equilibrium with $\alpha^e = 0$.

- **Properties of $\widehat{B}(\alpha, L)$ as a function of α and L**

From simple differentiation we get:

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

and

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

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

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

- **Existence of a free entry organizational A-equilibrium at intermediate values of L.**

The model is able to generate situations with a free entry organizational A-equilibrium when the curve $\widehat{B}(\alpha)$ crosses the free entry curve B^*B^* in the range defined by $B_A^*(\alpha)$, A sufficient condition for this is that α_0 is smaller than α_P in Figure 2, ensuring that for intermediate values of market size L, the two curves $\widehat{B}(\alpha)$ and $B_A^*(\alpha)$ cross. It can be easily checked that $\alpha_0 < \alpha_P$ if and only if $B_P^*(\alpha_0) > \widetilde{B}_P(\alpha_0)$.This can be rewritten as

$$\frac{\left[\widetilde{B}_P(\alpha_0)\right]^2 (1 - \alpha_0 \overline{e})^2}{2} + \overline{e}\alpha_0 \left[\widetilde{B}_P(\alpha_0)\right] - 1 < 0$$

with

$$\widetilde{B}_P(\alpha_0) = \frac{1 - k/b}{1 - \overline{e}\alpha_0}$$

Substitution gives immediately

$$\frac{(1 - k/b)^2}{2} + \overline{e}\alpha_0 \frac{1 - k/b}{1 - \overline{e}\alpha_0} < 1 \tag{18}$$

Note as well that α_0 is the point such $\sqrt{2} = B_0^* = B_A^*(\alpha_0)$ or using the definition of $B_A^*(\alpha)$

$$\alpha_0 = \frac{(2-\overline{e})}{\sqrt{2}}$$

Substituting into (18), one gets the condition

$$\overline{e}\alpha_0 \left[2(1-k/b) - (1-k/b)^2\right] < 2 - (1-k/b)^2$$

or the sufficient condition

$$\overline{e}(2-\overline{e}) < \sqrt{2}\frac{1 - \left(\frac{k}{b}\right)^2 + 2\frac{k}{b}}{\left[1 - \left(\frac{k}{b}\right)^2\right]} \tag{19}$$

Note that given that $\overline{e} < 1$, and $k/b \in]0,1[$, one has

$$\overline{e}(2-\overline{e}) < 1 < \frac{1 - \left(\frac{k}{b}\right)^2 + 2\frac{k}{b}}{\left[1 - \left(\frac{k}{b}\right)^2\right]} < \sqrt{2}\frac{1 - \left(\frac{k}{b}\right)^2 + 2\frac{k}{b}}{\left[1 - \left(\frac{k}{b}\right)^2\right]}$$

therefore (19) is satisfied and $\alpha_0 < \alpha_P$. This ensures that for intermediate values of market size L a free entry organizational A-equilibrium exists. **QED.**