Corporate Hierarchies and International Trade: Theory and Evidence *

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Abstract

Corporate organization varies within a country and across countries with country size. Larger countries have larger firms with flatter more decentral corporate hierarchies compared to smaller countries. Firms in larger countries change their corporate organization less fast than firms in smaller countries. Furthermore, corporate diversity within a country is correlated with the pattern of heterogeneity among firms in size and productivity. The paper develops a theory which explains these stylized facts and which links these features to the trade environment that countries and firms face. We introduce heterogenous firms with internal hierarchies in a Krugman (1980) model of trade.The model simultaniously determines firms' organizational choices and heterogeneity across firms in size and productivity.We show that international trade and the toughness of competition in international markets induce a power struggle in firms which eventually leads to decentralized corporate hierarchies. We show further that trade triggers inter-firm reallocations towards more productive firms in which CEOs have power in firms. Based on unique data of 660 Austrian and German corporations we offer econometric evidence which is consistent with the models predictions.

JEL Classification: F12, F14, L22, D23

Keywords: international trade with endogenous firm organizations and endogenous toughness of competition, firm heterogeneity, power struggle in the firm, corporate organization in Austria and Germany, empirical test of the theory of the firm

1 Introduction

In international trade theory firms are treated as a black box. The firm is characterized by a production function according to which the factors of production (capital, labor) are transformed into consumption goods. Moreover, these firms are assumed to be of equal size and productivity. In reality, however, firms consist of organizations with an inner life and differ in size, productivity, and type of firm organization. We document these differences in firm size and productivity in Table 1 based on a sample of 460 German and 200 Austrian global corporations in the period 1997 to 2001.[1]

Table 2 and 3, in turn, illustrate the variation in corporate organization among German and Austrian firms. Corporate organization appears to vary within a country and across countries with country size. Larger countries have larger firms with more decentralized corporate decisions compared to smaller countries.

In Germany, the large country, firms tend to have an internal power structure which is cooperatively run between the top of the organization (the CEO) and the divisional level (see Table 2). In 50.4 percent of firms the CEO and the division manager decide together over decisions ranging from acquisitions to hiring a secretary, in 24.4 percent of firms decisions are taken mainly by top management, while in 25 percent of firms decisions are delegated to lower levels of the corporate hierarchy. In Austria, the small country, almost 40 percent of firms organize decisions centrally compared to 24 percent among German corporations. Decisions have been ranked between 1 and 5 with 1 as a centralized decision taken at the top of the organization and 5 as a decentralized decision taken at the divisional level. Firms are then ranked by their level of centralization in decision making over 16 decisions. The numbers in the first column of Table 2 are averages over the 16 decisions untertaken by the firm. A firm with an average of 1 has a centralized power structure while a firm with an average of 5 has a decentralized one. An average of 3 indicates a cooperative decision structure.[2]

[1] For more details on the data see section 7 and Marin (2004).

[2] With a population of 8 million Austria is one tenth the size of Germany with a population of 82 million people. In 1998 Austria has an export ratio of 44.9 percent of GDP and Germany of 28.7 percent.

Table 1 Firm Size and Productivity Distribution Austrian and German Firms

size			productivity		
	Austria	Germany		Austria	Germany
firm sales in millon EUR	in percent of total firms		firm sales per worker in EUR	in percent of total firms	
0 - 25	26.56	27.54	0 - 0.1	10.47	21.66
25 - 50	15.63	11.41	0.1 - 0.15	17.80	26.20
50 - 100	20.31	12.66	0.15 - 0.2	19.37	11.84
100 - 250	14.58	15.14	0.2 - 0.3	18.32	16.37
250 - 1000	15.63	20.10	0.3 - 0.5	14.66	9.07
1000 - 57000	7.29	13.15	0.5 - 10	19.37	14.86

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

Table 2 Power Distribution among Corporations

	Austria	Germany
	all decisions [1]	
averages over decisions ranging from 1 to 5 [2]	in percent of all firms	
1.00 - 2.50	39.16	24.35
2.51 - 3.50	41.26	50.43
3.51 - 5.00	19.58	25.22

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

[1] all decisions include: decision over acquisitions, financial decisions, new strategy, finding acquisitions, transfer prices, introduction of new products, R&D expenditures, budget, hiring more than 10% of current personnel, hiring two workers, change of supplier, price increase of product, decision over product price, moderate wage increase, firing of personnel, hiring a secretary

[2] Decisions are ranked between 1 and 5 with 1 as the decision taken by the CEO at the top of the headquarter and 5 as the decision taken at divisional level. Firms are ranked by their level of centralization in decision making over 16 decisions. The numbers are averages over the 16 decisions undertaken by firms. A firm with a mean of 1 is centralized and a firm with a mean of 5 is decentralized.

Corporate diversity among German firms can also be seen from Table 3 which shows the type of organization firms use. 26.5 percent of firms have the traditional functional U-form organization, 20.5 percent adopt the divisional M-form organization with groups and/or sectors (matrix organization), and 25.5 percent opt for the holding company structure. The centralized U-form organization

concentrates power at the top of the corporate hierarchy, while the simple divisional and the M-form introduces profit centers at the divisional level providing incentives for workers at lower levels of the corporate hierarchy.[3]

Corporate organization differs not only in a cross-section of firms, but has also been changing over time (see Table 3). In fact, 58 percent of firms indicate that they have changed their mode of organization. German corporations have been shifting away from the functional U-form organization towards the holding company structure on the one hand and to the divisional M-form organization with groups and/sectors (matrix organization) on the other. The U-form organization declined from 45.5 percent of firms using it before the change to 26.5 percent of firms still using it today. Table 3 shows that this transformation has happened in the last 10 years. Ten years ago 40.4 percent of firms still had the U-form organization. The shift towards the holding structure (from 7.5 percent to 25.5 percent today) has happened more slowly over a longer period of time. The matrix organization (M-form) increased from 10.5 percent of firms using it before the change to 20.5 percent today. Most of the shift towards the matrix organization has already been completed in the last decade, since 18.6 percent of firms had this organization installed already 10 years ago (compared to 20.5 percent today).[4]

Table 3 **Organizational Change in German Corporations**

	in percent of all firms with a change in organization			
	today	before	5 years before	10 years before
functional (U-form)	26.50	45.52	33.53	40.38
holding (H-form)	25.50	7.46	19.41	14.10
multidivisional	12.50	17.16	13.53	14.74
divisional with groups and/or sectors (M-form)	20.50	10.45	20.00	18.59
divisional with functions (MU-form)	15.00	18.66	13.53	12.18
other	-	0.75	-	-

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

The transformation of the corporate sector in Germany and Austria in the last decade can be seen also in Table 4 which provides information on when these

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

[4]Empirical evidence on the changing nature of corporate hierarchies is scarce. Besides anecdotal evidence in the business press there are a few studies which document these corporate changes for US corporations see Ostermann (1996), Holmstrom and Kaplan (2001), Rajan and Wulf (2003).

organizational changes have been introduced. Countries more exposed to trade (smaller countries like Austria) change their corporate organization faster than larger countries less exposed to trade like Germany.

In Austria the share of firms with a new organization (less than two years of age) is almost twice as large compared to Germany. Note also, that more than 40 percent of global firms in Germany and Austria use an organizational structure which is not older than 8 years. However, there is still a large share of firms which have not yet gone through these changes (around 30 to 40 percent of firms have organizations which are older than 15 years of which 16.9 and 30.6 percent, respectively have not changed their organization since the firm has been founded).

Table 4 Age of Organization in Corporations

	Austria	Germany
less than two years	26.2	15.6
two to eight years	21.4	27.1
nine to fifteen years	14.1	23.7
more than fifteen years	38.3	33.5
of which unchanged since foundation	30.6	16.9

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

The described features raise two questions. First, is there a connection between the observed diversity in corporate organization on the one hand and the pattern of heterogeneity among firms in terms of size and productivity on the other? More specifically, do firms differ in terms of size and productivity because they adopt different types of organizations or have firms different organizations because they differ in size and productivity? Second, why are firms changing their mode of organization? Can an increased integration into world markets explain these changes in corporate organization over time?

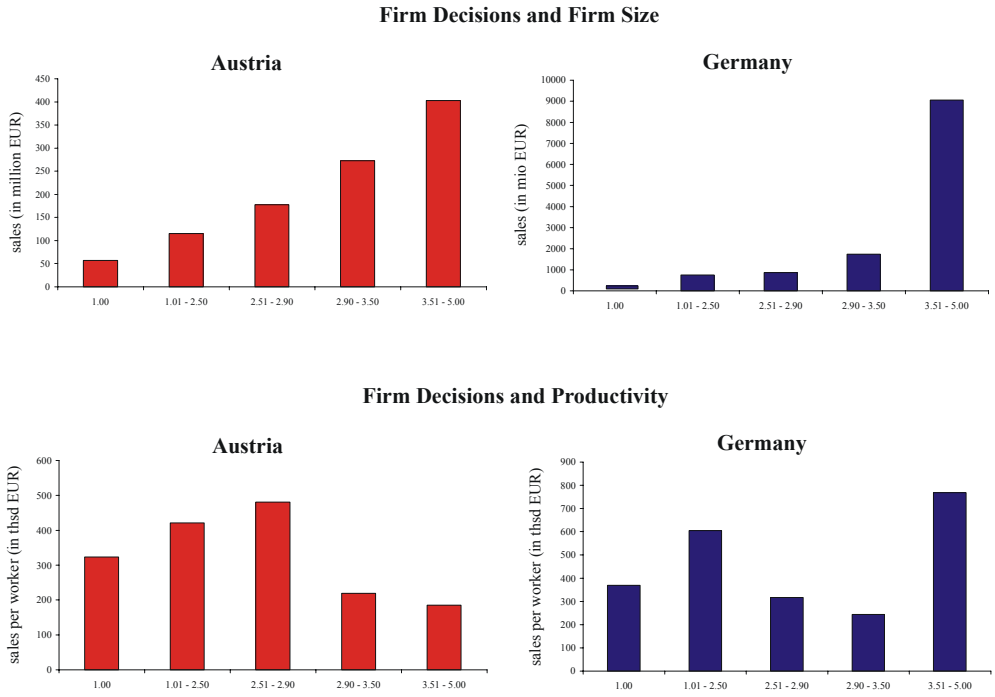
Figure 1 provides a first illustration of how the level of centralization of decision making in the firm is related to firm size and productivity. Larger firms in terms of revenue tend to have a more decentralized power structure inside firms, while the relationship between productivity and power in the firm is ambigious. In Germany firms with a more delegated decision structure tend to be more productive, while in Austria they appear to be less so. In any case, the figure suggests a strong association between the mode of organization of authority in the firm and firm performance.

Figure 2 unveils the pattern between trade exposure (captured by the firm's export ratio) and the power allocation in the firm. Firms more exposed to the world economy tend to delegate decision power to lower levels of the corporate hierarchy in Austria, while German firms tend to centralize decisions with more trade exposure. We consider 16 corporate decisions as listed in Table 2. However, the relationship between the export ratio and power in the firm appears to be non monotonic in both countries.

In order to take a closer look at how the pattern of power relations inside firms respond to the trade environment firms face we pick from the list of 16 firm decisions the decisions centrally organized at the CEO level on the one hand and the R&D decisions on the other and examine them separately. Centrally organized decisions have a stronger potential of being decentralized. R&D decisions may have a stronger need to be decentralized. We define a decision to be centrally organized when it has been ranked by firms above 2 on average in the range of 1 (central decision) and 5 (decentral decision). With this definition the following decisions turn out to be central decisions both among Austrian and German corporations: the decision over acquisitions, financial decisions, and the decision over a new strategy. The decision over R&D (decision over R&D expenditure and the introduction of a new product) tend to be more cooperatively decided between the CEO and the divisional level in both countries (it is ranked 2.67 by German corporations and 2.44 by Austrian corporations).[5] Among German corporations the decisions at different levels of the corporate hierarchy do not appear to respond differently to trade exposure (the pattern of the three pictures looks more or less the same for German corporations), while among Austrian firms the central decisions and in particular the R&D decisions become much stronger decentrally organized when the firm is more exposed to trade.

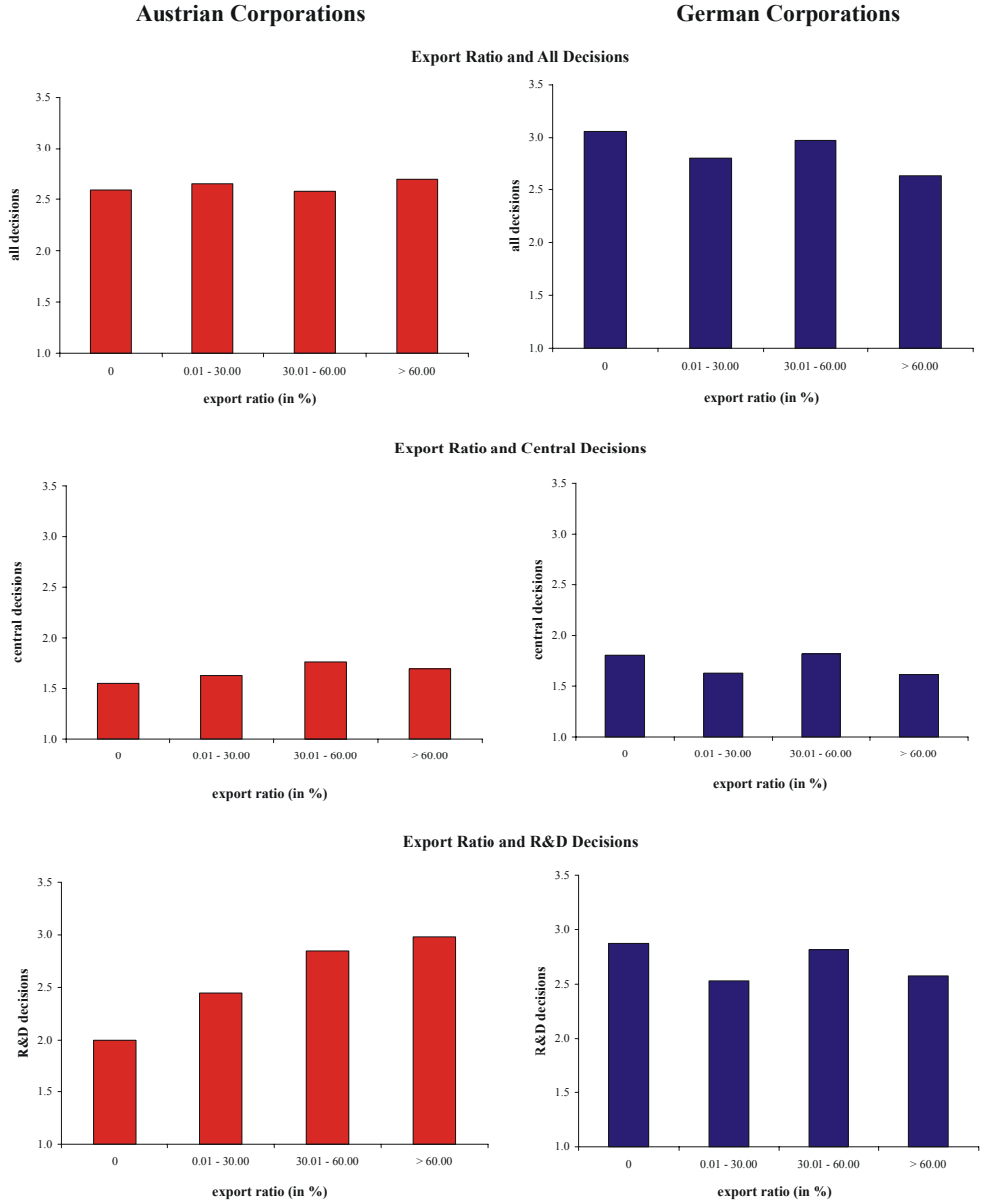
[5]For the ranking of decisions by the level of corporate hierarchy see Tables A1 and A2 of the appendix A.

Figure 1 Level of Centralization, Firm Size and Productivity



horizontal axis: level of centralization of decisions in the firm include 16 decisions as listed in Table 2. Decisions are ranked between 1 and 5 with 1 as the decision taken by the CEO at the top of the headquarter and 5 as the decision taken at divisional level. Firms are ranked by their level of centralization in decision making over 16 decisions. The numbers are averages over the 16 decisions undertaken by firms. A firm with a mean of 1 is centralized and a firm with a mean of 5 is decentralized.

Figure 2 Power in the Firm and Trade Exposure



horizontal axis: firms' exports in percent of firms' sales

vertical axis: all decisions include: decision over acquisitions, financial decisions, new strategy, finding acquisition, transfer prices, introduction of new products, R&D expenditures, budget, hiring more than 10% of current personnel, hiring two workers, change of supplier, price increase of product, decision over product price, moderate wage increase, firing of personnel, hiring a secretary. Decisions are ranked between 1 and 5 with 1 as the decision taken by the CEO at the top of the corporation and 5 as the decision taken at the divisional level. Firms are ranked by their level of centralization in decision making over 16 decisions. The numbers are averages over the 16 decisions undertaken by firms. A firm with a mean of 1 is centralized and a firm with a mean of 5 is decentralized.

central decisions include: financial decisions, decisions over acquisitions, and decisions over a new strategy. A decision is centrally organized when the firm ranked it above 2 in the range of 1 (central decision) and 5 (decentral decision).

R&D decisions include decisions over R&D expenditures and the introduction of a new product. The decisions over R&D are cooperatively decided between the CEO and the divisional level. It is ranked 2.67 among German corporations and 2.44 among Austrian corporations.

In this paper we offer a model that explains these stylized facts. We introduce heterogenous firms with internal hierarchies (a CEO and a division manager) in a Krugman (1979) model of trade under monopolistic competition. Our model simultaniously determines firms' organizational choices and heterogeneity across firms in size and productivity. Moreover, in our model firms choose their organization in response to the trade environment they face.

Our model builds on a new body of literature in international trade. We combine within industry heterogeneity of Melitz (2003) and Melitz and Ottaviano (2003) with power in the firm of Marin and Verdier (2002) and Aghion and Tirole (1997). This allows us to study the impact of international trade and international competition on corporate organization on the one hand and on inter-firm reallocations within an industry on the other. The paper contributes in several respects to this literature. Melitz (2003) introduces firm productivity heterogeneity into a Krugman model of trade by an exogenous equilibrium distribution of productivity. We endogenize firm heterogeneity by firms' choice of organization. Our model generates an endogenous 'mix' of firms with different productivity and size levels which is driven by their organizational choices.

Aghion and Tirole (1997) focus on a single firm and do not consider how the market environment affects the inner life of the firm. Moreover, they assume an exogenous degree of conflict between the CEO and the division manager in the firm. We endogenize the power struggle inside the firm by the toughness of competition the firm faces - the number and average productivity of competing firms in the market.

Marin and Verdier (2001) introduce firms' organizational choices in a Dixit and Stiglitz model of monopolistic competition. However, in their 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. We incorporate endogenous markups using the linear demand system as in Melitz and Ottaviano (2003). Markups across firms respond now to the toughness of competition in a market. This way our model exhibits a link between trade liberalization, market size and the mode of organizations firms choose. Trade liberalization leads to bigger firms which earn larger profits although markups are smaller. It also leads to a larger power struggle inside firms.[6] As profits and the conflict in the firm rise the CEO in the firm monitors more potentially destroying the initiative of her division manager. At some point she delegates power to the division manager to encourage his initiative. In a cross section of countries, larger countries will have

[6]In Marin and Verdier (2003a, 2003b) we examine the effect of trade on corporate organization in a Helpman and Krugman trade model in which countries differ in factor endowments.

tougher competition and more decentralization of power in the firm, while smaller countries will face less competition and have more centralized firms. In a cross section of firms, larger firms will have more decentralized corporate organization than smaller firms.

Our model predicts intra-firm reallocations from high cost to low cost firms resulting in an increase in average productivity of an industry following episodes of trade liberalizations similar to Melitz (2003). However, the mechanism by which this occurs differs. Rather than through the exit of the least productive firms, trade liberalization increases average productivity by inducing the CEOs/owners in firms to monitor more leading to a larger fraction of firms in which the CEO has 'real power' in the firm and in which she chooses the cost minimizing project. However, in contrast to Melitz (2003), a large enough trade shock may lower productivity in the liberalizing country by inducing a change in corporate organization from a P-organizational equilibrium to an A-organizational equilibrium in which power is delegated to the division manager to encourage his enthusiasm to find new projects for the firm.

To be completed

2 The closed economy

2.1 Demand

Consider an economy with L consumers. Preferences are defined over a continuum of differentiated varieties indexed by $i \in \Omega$ and an homogenous good chosen as the numeraire. Consumers have all the same preference structure given by

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

where q_0 and q_i are respectively consumption of the numeraire good and consumption of variety i of the differentiated sector.The demand parameters β, γ and η are positive with β and η giving the substitution between the differentiated varieties and the numeraire and the parameter γ as the degree of product differentiation between the varieties. When $\gamma = 0$, varieties are perfect substitutes and consumers care only about the total consumption level over all varieties given by

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

We have L workers in the economy, each endowed with one unit of labor. Let p_i be the price of variety i. We assume that consumers have positive demands

for the numeraire good. Then standard utility maximization gives the individual inverse demand function

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

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

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

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

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

It follows that

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

Hence, after substituting

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

Total demand for variety i is then given by

$$q_i = L q_i = \frac{\beta L}{\gamma + N\eta} - \frac{L}{\gamma}\, p_i + \frac{N\eta}{\gamma + N\eta} \frac{L}{\gamma}\, \overline{p} \tag{2}$$

where q_i is the market demand for variety i . Note that in this linear demand system for varieties, the price elasticity of demand is now also driven by the 'toughness' of competition in the market induced either by a lower average price for varieties $\overline{p}$ or more product varieties N. The price elasticity of demand increases with lower $\overline{p}$ and larger N.

2.1.1 Production

The numeraire good 0 is produced with constant returns to scale (one unit of good 0 requires one unit of labor) and under perfect competitive conditions. Each variety of the differentiated good is produced under monopolistically competitive conditions. Suppose that a given variety i is produced with marginal cost c_i, then profits for that variety can be written as

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

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

$$q_i = q(c_i) = \frac{L}{\gamma} \left[p(c_i) - c_i\right] \tag{3}$$

or

$$\frac{\beta}{\gamma + N\eta} - \frac{1}{\gamma}\, p(c_i) + \frac{N\eta}{\gamma + N\eta}\frac{1}{\gamma}\, \overline{p} = \frac{1}{\gamma}\left[p(c_i) - c_i\right]$$

Note, that output per firm increases with the size of the market. Thus, larger countries will have larger firms.[7]

The profit maximizing price can be written as

$$p(c_i) = \frac{1}{2}\left[c_i + \frac{\beta\gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta}\, \overline{p}\right] \tag{4}$$

with the (absolute) markup over price as

$$m(c_i) = p(c_i) - c_i = \frac{1}{2}\left[\frac{\beta\gamma}{\gamma + N\eta} + \frac{N\eta}{\gamma + N\eta}\, \overline{p} - c_i\right] \tag{5}$$

Note, that in addition to the taste for variety parameter γ the markup is now also determined by the toughness of competition in the market induced either by a lower average price for varieties $\overline{p}$ or a larger number of varieties N. This stands in contrast to the CES utility function used in the Dixit and Stiglitz model in which markups are constant and exclusively determined by the taste for variety parameter γ.

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

$$\overline{p} = \frac{\overline{c} + \frac{\beta\gamma}{\gamma + N\eta}}{\frac{2\gamma + N\eta}{\gamma + N\eta}} \tag{6}$$

$$\overline{c} = \frac{1}{N}\int_{i\in\Omega} c_i di \tag{7}$$

Substituting (6) into (5) gives an expression for the markup $m(c_i)$:

$$m(c_i) = \frac{1}{2}\left[\frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta}\, \overline{c} - c_i\right]$$

and for profits

$$\pi(c_i) = \frac{L}{4\gamma}\left[\frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta}\, \overline{c} - c_i\right]^2$$

[7] This stands in contrast to the Dixit and Stiglitz model in which output per firm does not depend on market size. In this model a larger market increases the number of varities without changing firm size.

Free entry into the industry ensures zero expected profits for a potential entrant. Denote the cutoff cost level c_D as

$$c_D = \frac{2\beta\gamma}{2\gamma + N\eta} + \frac{N\eta}{2\gamma + N\eta}\,\overline{c} \tag{8}$$

which is the cost level of a firm who is just indifferent about remaining in the industry. This firm earns zero profits as its price is driven down to its marginal costs, $p(c_D) = c_D$. Firms with cost $c_i < c_D$ earn positive profits. This cut off cost level, in turn, determines the number of firms in the industry N. The cut off cost level c_D captures the 'toughness' of competition in an industry. The cut off cost level c_D declines and competition is tougher with more firms around (the larger N), with more low cost firms in the market (the lower average costs $\overline{c}$), and when varieties are closer substitutes (the smaller γ). The cutoff level c_D summarizes the effects of both the average price and number of firms on the performance measures of all firms: output $q(c_i)$, price $p(c_i)$, revenue $r(c_i) = p(c_i)q(c_i)$, absolute and relative mark-ups $m(c_i)$ and $m(c_i)/c_i$, and profits $\pi(c_i)$.They can be written as

$$\begin{aligned} q_i &= q(c_i) = L\frac{c_D - c_i}{2\gamma}, \qquad p_i = p(c_i) = \frac{c_D + c_i}{2}, \qquad r_i = r(c_i) = \frac{L}{4\gamma}\left(c_D^2 - c_i^2\right) \\ m_i &= m(c_i) = \frac{c_D - c_i}{2}, \qquad \frac{m(c_i)}{c_i} = \frac{c_D - c_i}{2c_i}, \qquad \pi_i = \pi(c_i) = \frac{L}{4\gamma}\left[c_D - c_i\right]^2 \end{aligned} \tag{9}$$

2.1.2 Power in the Firm

In this section, we present our model of the choice of firm organization. We consider a firm with the simplest hierarchy consisting of a CEO (the principal P) hiring a division manager (the agent A) to implement a production project. There are m potential and a priori identical projects (or ways to produce a good). Payoffs are ex ante unknown to both parties. 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. Let αB be the principal's expected benefit when the agent's preferred project is implemented with $(0 \leq \alpha \leq 1)$. Assume, for simplicity, that the agent's expected benefit when the principal's preferred project is implemented is 0.[8] The lower α, the larger the conflict of interest between the principal and her agent.

B and b are supposed to be known ex ante though the parties do not know ex ante which project yields such payoff. We assume also that, among the m

[8]Alternatively, one can assume that the agent receives a benefit of βb when the principal's preferred project is implemented with $(0 \leq \beta \leq 1)$. α and β would then be congruence parameters between the principal and the agent capturing the degree of trust between the principal and the agent. Here, to simplify exposition we simply set $\beta = 0$.

projects, there are some with very high negative payoffs to both parties, implying that choosing randomly a project without being informed is not profitable to both agents who instead prefer to do nothing (project 0). This aspect, together with the fact that each uninformed party prefers to rubber-stamp the other informed's party suggestion to do nothing, implies that private information about payoffs gives decision control to the informed party. In this case, the informed party has "*real power*" rather than "*formal power*" in the firm. Thus, there are two sources of power in the firm, because it is allocated to the manager "*formal authority*" which is ex-ante contractible, or because the manager is better informed, "*real authority*"[9]

Parties may acquire information on the payoff structure in the following way. By spending some resource cost

$$g_P(E) = g\frac{E^2}{2}$$

the principal P learns the payoff structure of all projects with probability E and remains uniformed with probability $1 - E$. Similarly, by exerting some effort

$$g_A(e) = ke \text{ with } e \in [0, \overline{e}],\ k < b$$

the agent learns the payoff structure 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.

Decisions are taken in the following sequence. The principal allocates formal power to herself (P-organization) or to the agent (A-organization). Then the two parties collect information about projects' payoff simultaneously. The party who does not have decision power suggests a project (or nothing) to the other party. Finally, the party with power rubber stamps the other party's suggestion or selects an alternative project, or decides to do nothing. Hence, the party with formal authority, whenever informed, picks her preferred project. When she remains uninformed ex post, that party rubber-stamps the suggestion of the other party who, whenever informed, has real authority over the project choice and gets his preferred project implemented. When neither party has information on the payoff structure, no project is undertaken by the firm.

Let us look then at the equilibrium informational efforts of the two parties under the two organizations.

[9] As emphasized by Aghion and Tirole 1997, the amount of information acquisition is at the heart of the distinction between "formal" and "real" decision power in firms.

P-organization

We start with the case where the principal has formal power in the firm. The two parties' expected payoffs are then

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

With probability E, the principal becomes fully informed about her payoffs and picks her preferred project with monetary payoff B, while the agent receives 0. With probability $1-E$, the principal remains uninformed about payoffs. The agent may then learn with probability e the pay-off structure 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. Or the agent may remain also uninformed in which case, no project is undertaken.

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

$$\text{Principal: } B(1-e\alpha) = gE \qquad \text{and} \qquad \text{Agent: } \begin{array}{c} e = \overline{e} \text{ if } k \leq b(1-E) \\ = 0 \text{ if } k > b(1-E) \end{array} \tag{10}$$

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

There are three possible Nash equilibria in effort levels[10] Selecting the equilibrium with the highest agent's effort (which is also the one preferred by the principal), we can compute the Nash equilibrium level of efforts under the P-organization as

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

with

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

[10]For a discussion of the three Nash equilibria see Aghion and Tirole 1997.

$\widetilde{B}_P(\alpha)$ captures the threshold level of profits at which the agent's initiative is killed under the P-organization. For monetary payoffs over the threshold level $\widetilde{B}_P(\alpha)$, the principal exerts so much control (i.e. the effort E_P^*) that she kills the initiatives of the agent to acquire information by himself.

From this discussion, we can finally derive the equilibrium expected utility of the principal under the P-organization as

$$\begin{aligned} u_P^* &= E_P^* B + (1 - E_P^*) e_P^* \alpha B - g\frac{(E_P^*)^2}{2} - w \\ &= g\frac{(E_P^*)^2}{2} + e_P^* \alpha B - w \end{aligned}$$

A-organization

Consider now the case where the principal has delegated decision control to the agent and thus the agent has formal authority. Now the principal is prevented from overruling the agent's decision when both have acquired information. The two parties' expected payoffs are then

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

Now the agent chooses his preferred project when informed. When the principal is informed and the agent is uninformed, the principal suggests her preferred project, which is then implemented by the agent. The analysis is similar to the one for the P-organization. Observing that $b > k$, we easily get the following characterization of the Nash equilibrium effort levels[11]

$$e_A^* = \overline{e} \text{ and } E_A^* = \frac{B(1 - \overline{e})}{g} \tag{11}$$

It is clear that the agent' s initiative is better promoted under a A-organization than under a P-organization. The reason is that under the A-firm the agent has formal authority and therefore has better effort incentives than when the principal has formal authority. Hence, it requires a larger principal's effort to

[11]When $\beta > 0$, we can show that there exists a threshold $\widetilde{B}_A$ given by

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

such that the agent's initiative is killed under the A-organization when $B > \widetilde{B}_A$. Intuitively, above the threshold level $\widetilde{B}_A$ the principal's stakes are so high that she acquires information E_A^* leading to a high probability of intervention which, in equilibrium, leads to minimum agent's effort $e_A^* = 0$.

kill the initiative of the agent under the A-firm than under the P-firm. Actually under our specification, the agent will always provide maximum effort under the A organization while the initiatives will be shut-off under the Porganization for profits of the principal large enough.

The Choice of Firm Organization

We turn now to determine the optimal firm organization. We summarize and compare the different modes of organization for different profit levels of the principal.

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

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

$$u_P^* = g\frac{(E_P^*)^2}{2} + e_P^*\alpha B - w \quad \text{and} \quad v_P^* = g\frac{(E_A^*)^2}{2} + e_A^*\alpha B - w$$

Given that $e_P^* = e_A^* = \overline{e}$, and that $E_P^* > E_A^*$ in this regime, it follows that $u_P^* > v_P^*$. Thus, the *P-organization dominates the A-organization.* At this profit level there is no trade-off between the principal's control and the agent's initiative. When B is low, the principal monitors and intervenes little under both organizations because her stakes are small. Therefore, both organizations give sufficient effort incentives to the agent. However, the principal prefers the P-organization over the A-organization, since the former gives her more control over the firm.

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 maximal effort $e_A^* = \overline{e}$ under the A-organization. Thus, the principal's expected utilities under the two organizations, respectively are given by

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

$u_P^* > v_P^*$ and thus the principal prefers the P-firm over the A-firm when

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

$\overline{B}(\alpha)$ is the critical profit level at which the principal is indifferent between the P-organization and the A-organization. When B is larger than $\bar{B}(\alpha)$, the principal prefers to exert more control with no agent's initiative to less control while keeping the agent's initiative.

The optimal firm organization switches in the following way. i) For $\overline{B}(\alpha) \leq \widetilde{B}_P(\alpha)$, the P-organization with agent's effort dominates the A-organization. ii) For $\widetilde{B}_P(\alpha) < \overline{B}(\alpha)$, on $\left[\widetilde{B}_P(\alpha), \overline{B}(\alpha)\right]$ the A-organization dominates, and above $\overline{B}(\alpha)$, the O-organization without agent's effort is the optimal firm organization.[12]

We summarize the preceding discussion in the following proposition. It states the optimal firm organization as a function of the principal's monetary payoff B when her preferred project is implemented.

Proposition 1 *i) If $\overline{B}(\alpha) < \widetilde{B}_P(\alpha)$ the P-organization dominates the A-organization for all values of B*

ii) If $\widetilde{B}_P(\alpha) < \overline{B}(\alpha)$, the firm moves from the P-organization with agent's initiative to an A-organization to a P-organization without agent's initiative as the profit level increases.

- For $B \leq \widetilde{B}_P(\alpha)$ the P-firm dominates 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 dominates 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 dominates the A-firm with $e_P^* = 0$ and $E_P^* = \frac{B}{g}$

Intuitively, the firm's 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. The P-firm dominates the A-firm, because it gives the principal more power over the organization. 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 in both firm organizations. Since P has more control under the P-firm compared to the A-firm, the principal prefers the P-firm. At intermediate levels of profits there is a trade-off between control and initiative. At some intermediate value of B, the A-firm dominates to give the agent sufficient incentives for initiative. When the profit level B keeps increasing however, the gain emanating from the agent initiative is overcome by the loss of control of the principal and the O-firm with no incentives for the agent becomes the optimal organization.

The choice of firm organization is illustrated in Figure 3. The $\tilde{B}_P(\alpha)$ - curve relates the profit level to the incentives inside the firm and thus to the costs of producing. Recall that the $\tilde{B}_P(\alpha)$ curve represents the profit level at which the

[12]The O-firm is a P-firm without the agent's initiative and can be thought of a P-firm without an internal hierarchy.

effort incentive of the agent is killed under the P-organization. $\tilde{B}_P(\alpha)$ is upward sloping in α because with an increase in α the conflict of interest between the principal and the agent declines (the preferences between the principal and the agent become more similar). At a given profit level B, the principal intervenes less when the agent's preferred project is more congruent with her objectives, allowing the profit level at which the agent's initiative is killed to go up. In the area below the $\tilde{B}_P(\alpha)$ -line the P-firm keeps the agent's initiative alive, while in the area above $\tilde{B}_P(\alpha)$ the agent does not exert any effort under the O-organization.

In Figure 3, the $\bar{B}(\alpha)$- line relates the profit level to the market environment of the firm and thus to the benefit of having an efficient mode of organization. Recall that the $\bar{B}(\alpha)$ -line represents the profit level at which the principal is indifferent between the O-firm with $e = 0$ and the A-firm with the agents maximum initiative $\overline{e}$ (this is the relevant comparison because the principal always prefers the P-firm with $\overline{e}$ compared to the A-firm with $\overline{e}$). $\overline{B}(\alpha)$ is upward sloping in α. An increase in congruence α makes delegating power to the agent less costly to the principal since an inefficient mode of organization translates into a smaller loss in market share. Therefore, the threshold level of profits at which the principal is indifferent between the P-firm and the A-firm also moves up. In the area below the $\bar{B}(\alpha)$- line the gain is larger when the agent's initiative is sustained even when the principal looses control. Thus, the principal prefers to delegate power to the agent. In the area above the $\bar{B}(\alpha)$- line the reverse is the case and thus the principal prefers to keep control.

We are now ready to analyze which organization will emerge in response to changes in the amount of conflict in the firm. In the area P_0 , the conflict of interest is so large that it is very costly for the principal to give up control. Therefore the P-firm dominates for all values of B. In the area P_1 below the $\tilde{B}_P(\alpha)$ curve the principal chooses the P-firm as her organization. In this area the gain of having control outweights the costs, since at $B < \tilde{B}_P(\alpha)$ the agent's initiative can be kept alive under the P-organization. In the area A, in between the two curves $\tilde{B}_P(\alpha)$ and $\bar{B}(\alpha)$ the principal chooses the A-firm, since in this area delegating control allows to maintain the agents initiative while at the same time it does not cost too much in terms of loss in profits, since $B < \bar{B}(\alpha)$. Finally, in the area P_2, the firm chooses the O-organization since in the region $\tilde{B}_P(\alpha) < \bar{B}(\alpha) < B$ the principal's stakes are so high that the costs of having control become smaller relative to its gain.

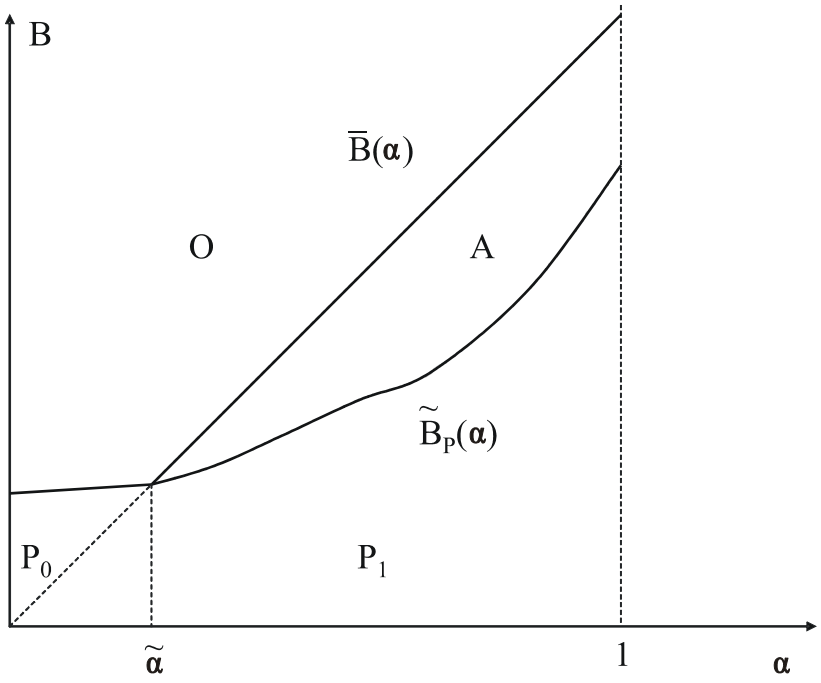


Figure 3: The Optimal Choice of Firm Organization

3 The Toughness of Competition and the Power Struggle inside Firms

We incorporate now the model of firm organization into the production side described in section 2. Sofar profits B and the conflict in the firm α are exogenous which become endogenous in this section. Recall the distinction between formal and real power in the firm. There are two types of firms depending on who has *real* (as opposed to formal) authority in the organization More precisely, assume that firms in which the principals' preferred project is implemented produce the good with production cost $c_i = c_B$. Call these firms "real P-firms". Similarly firms in which the agent's preferred project is implemented produce the good with larger production cost $c_i = c_b = \varphi c_B$ and $\varphi > 1$. Call these firms "real A-firms". The idea here is that the agent does not always choose the cost minimizing project but rather one that is best for him and maximizes his perks. Thus, even in a 'formal P-firm' in which the principal keeps formal control, the agent's preferred high cost project may get implemented. This will happen when the principal decides not to get informed and to rubber stamp the agent's suggestion. We then have a 'real A-firm' in a formal P-equilibrium.

From (9) we can then rewrite the principal's profits when her best project is implemented as

$$B = \pi(c_B) = \frac{L}{4\gamma}\left[c_D - c_B\right]^2 = \frac{Lc_B^2}{4\gamma}\left[\widetilde{c}_D - 1\right]^2 \qquad \text{with} \qquad \widetilde{c}_D = \frac{c_D}{c_B} \tag{12}$$

$\widetilde{c}_D$ is the cost gap between firms with zero profits c_D and the low cost P-firms c_B. The smaller this gap the harder it is to earn positive profits in the market. Thus, $\widetilde{c}_D$ reflects the thoughness of competition that a firm faces. Similarly, the conflict parameter α can also be expressed as a function of the cost gap $\widetilde{c}_D$

$$\alpha = \frac{\pi(c_b)}{\pi(c_B)} = \left[\frac{\widetilde{c}_D - \varphi}{\widetilde{c}_D - 1}\right]^2 \tag{13}$$

The smaller $\widetilde{c}_D$, the tougher is competition in the market and the larger is the conflict of interest between the principal and her agent (the smaller α). A low $\widetilde{c}_D$ means that the firm faces a competitive environment with lots of active firms and lots of low cost firms around her. Under these circumstances, any given cost differential between a high cost A-firm and a low cost P-firm, as captured by φ, translates into a larger differential in market shares and profits. Delegating power to the agent becomes therefore more costly to firms. The low cost P-firms set lower prices, produce larger outputs and earn higher revenues and profits than high cost A-firms as can be seen by the following expressions

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

$$p_B = p(c_B) = c_B\ \frac{\widetilde{c}_D + 1}{2} \quad \text{while } p_b = p(c_b) = c_B\ \frac{\widetilde{c}_D + \varphi}{2}$$

$$r_B = r(c_B) = \frac{Lc_B^2}{4\gamma}\left(\widetilde{c}_D^2 - 1\right) \quad \text{while} \quad r_b = r(c_b) = \frac{Lc_B^2}{4\gamma}\left(\widetilde{c}_D^2 - \varphi^2\right)$$

$$\pi_B = \pi(c_B) = \frac{Lc_B^2}{4\gamma}\left[\widetilde{c}_D - 1\right]^2 \quad \text{while} \quad \pi_b = \pi(c_b) = \frac{Lc_B^2}{4\gamma}\left[\widetilde{c}_D - \varphi\right]^2$$

However, low cost P-firms do not pass on all of the cost differential to consumers in the form of lower prices. They also set higher markups than high cost A-firms. This can be seen by expressing the markup of P-firms and A-firms, respectively as a function of $\widetilde{c}_D$

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

The two relationships (12) and (13) describe how the thoughness of competition, given by the threshold parameter $\widetilde{c}_D$, jointly affects profits and the power

struggle inside the firm. Eliminating $\widetilde{c}_D$, they define a relationship between B and α that has to be satisfied by any firm. From (12) we get

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

and from (13) we have

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

Therefore, the relationship between B and α is given by

$$B = \widehat{B}(\alpha) = \left[\frac{\varphi - 1}{1 - \sqrt{\alpha}}\right]^2 \frac{L}{\gamma}\frac{c_B^2}{4} \tag{14}$$

The construction of the $\widehat{B}(.)$ curve is described in Figure 4. The curve (PP) in quadrant I plots equation (12) and shows how the firm's profits B vary with $\widetilde{c}_D$ (relationship 12)). The curve is positively sloped, 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 plots equation (13) and shows how $\widetilde{c}_D$ affects the conflict of interest inside the firm α (relationship (13)). The curve is positively sloped, because when $\widetilde{c}_D$ declines and competition becomes tougher, the conflict of interest in the firm rises (α becomes smaller). When competition becomes tougher delegating power to the agent costs more in terms of profits, since the differential between A-firms and P-firms in terms of revenues and markups becomes wider. Low-cost A-firms lose revenues by more and try to fight it by lowering markups by more than high-cost P-firms. Quadrant III just plots the 45^0-line ensuring that the two curves $(\alpha\alpha)$ and (PP) are drawn for the same value of $\widetilde{c}_D$. Then the $\widehat{B}(.)$ curve is obtained in quadrant IV which shows how the conflict of interest in the firm α affects profits B. The curve is positively sloped, because with an increase in $\widetilde{c}_D$ and α competition and the conflict in the firm decline and firms earn higher profits. A given value of conflict α in quadrant IV is associated with a value of market competition $\widetilde{c}_D$ in quadrant II which results in a level of profits B in quadrant I, generating a point M on curve $\widehat{B}(.)$ in quadrant IV.

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

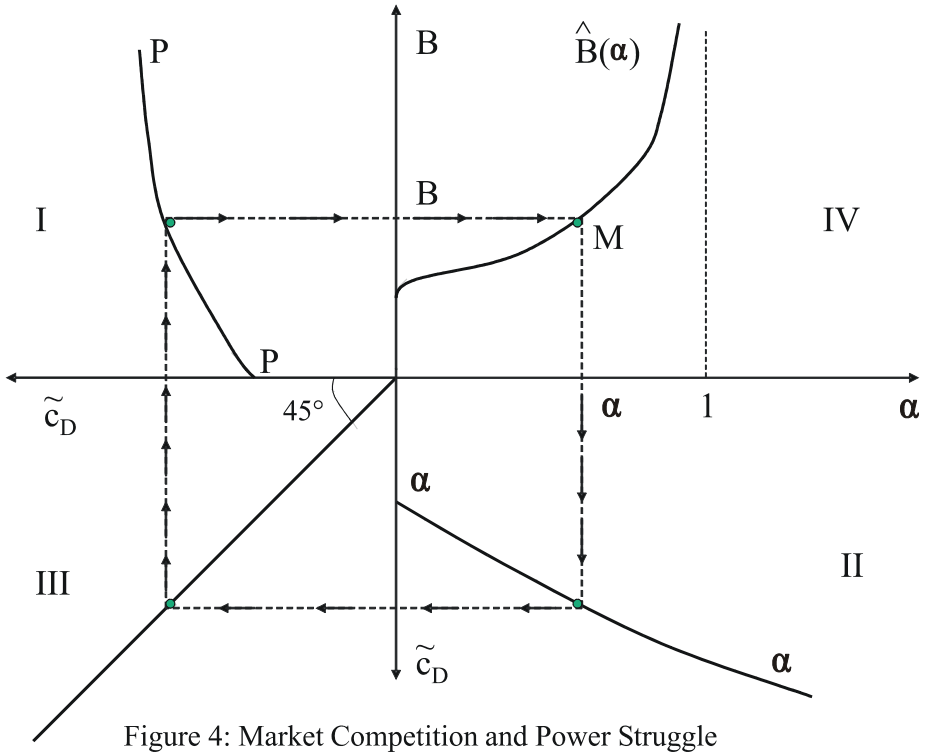


Figure 4: Market Competition and Power Struggle

3.1 Industry Equilibrium with 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 the following. In a first stage, firms decide whether or not to enter the market and to hire an agent to monitor projects. At this stage, there is free entry. In a second stage, firms decide who has *formal* power in the organization by choosing between the formal P-firm and the formal A-firm. In a third stage, information collection efforts are realized by the two parties and a project is selected. This, in turn, determines who has *real* power in the organization. Finally there is production, consumption and factor market clearing.

The free entry conditions for a given choice of firm organization can be written as $Max\{U_P(B), U_A(B), U_0(B)\} = w = 1$ where $U_P(B)$, $U_A(B)$, and $U_0(B)$ are the profit levels of the firm gross of the wage of the agent under each organization P, A or O.[13] The "Max" argument in the free entry conditions reflects the fact

[13]With the previous notation these profit levels are
$U_P(B) = u_P + w = g\frac{(E_P^*)^2}{2} + e_P^*\alpha B = \frac{B^2(1-\alpha\overline{e})^2}{2g} + \overline{e}\alpha B$
$U_A(B) = u_A + w = g\frac{(E_A^*)^2}{2} + e_A^*\alpha B = \frac{B^2(1-\overline{e})^2}{2g} + \overline{e}\alpha B$
$U_0(B) = u_0 + w = g\frac{(E_0^*)^2}{2} = \frac{B^2}{2g}$

that each firm decides about its optimal type after market entry. 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

$$U_P(B) = g\frac{(E_P^*)^2}{2} + \overline{e}\alpha B = 1 \tag{15}$$

This gives a unique positive solution $B_P = B_P^*(\alpha)$ which is the profit level required to make a firm indifferent between entering and not entering the market as 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

$$U_A(B) = g\frac{(E_A^*)^2}{2} + \overline{e}\alpha B = 1 \tag{16}$$

This free entry condition gives similarly 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 such a regime is

$$U_0(B) = g\frac{(E_0^*)^2}{2} = 1 \tag{17}$$

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

It is worth noting that the labor market condition is automatically cleared by the output adjustment on the numeraire good 0 which also pins down the wage rate to 1.

3.1.1 Free Entry and Power Struggle

Next, we analyze how the firm's incentives to enter the market are affected by the power struggle in the firm. In terms of the model, we look at how the equilibrium conditions for free entry for P-firms, A-firms, and O-firms, respectively are affected by changes in α. We do this with the help of Figure 5. Recall that the curves $B_P^*(\alpha)$ and $B_A^*(\alpha)$ are the free entry profit levels that a firm requires

to enter the market as a P-firm and as an A-firm, respectively. Both curves slope down with α, since both firms revenues increase with α and thus firms require a lower profit to enter the market. The $B_A^*(\alpha)$ curve lies above the $B_P^*(\alpha)$ curve, since for any given α, A-firms will have a harder time to survive competition in the market. Therefore, A-firms require a larger profit to enter the market. When preferences between the principal and the agent are perfectly congruent (when $\alpha = 1$) , there is no conflict of interest and the organization of the firm stops to matter. Both types of firms will choose the same cost minimizing project (at $\alpha = 1$ the two curves collapse to the same required profit value $B_A^*(\alpha) = B_P^*(\alpha)$).

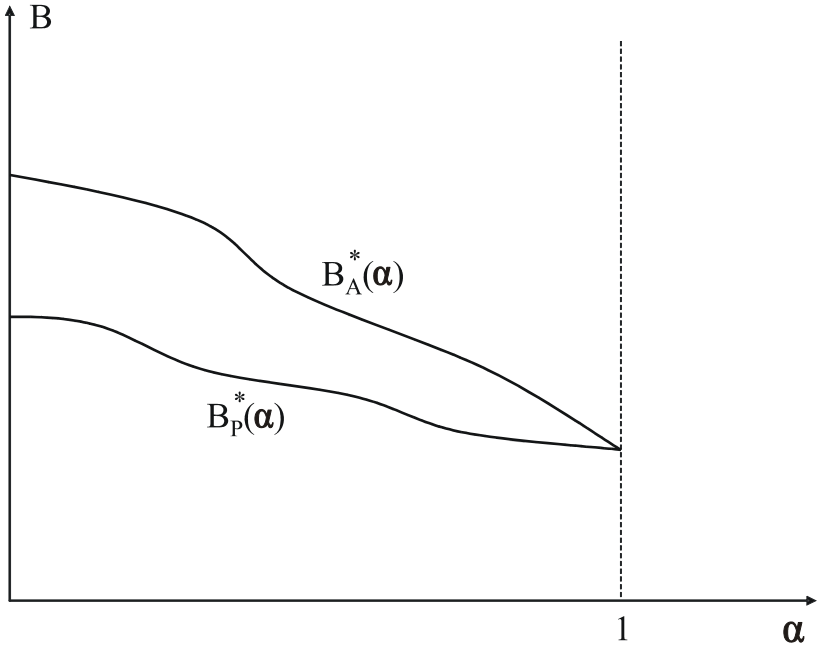


Figure 5: Equilibrium Entry

3.2 Equilibrium Organization with Free Entry

Consider now the structure of organizational equilibria with free entry which are determined in Figure 6. The figure combines the insights of Figure 3 and 5 to analyze the equilibrium mode of organization under free entry. Thus, the figure looks at how endogenous profits (given by the free entry conditions) interact with the firm's optimal choice of organization. The two curves $\tilde{B}_P(\alpha)$ and $\overline{B}(\alpha)$ from Figure 3 determining the optimal choice of organization are plotted as well as the two curves $B_P^*(\alpha)$ and $B_A^*(\alpha)$ from Figure 5 describing the free entry profit levels for P-firms with agent's effort (i.e. $e = \overline{e}$) and for A-firms. In addition, the horizontal line $B_0^* = \sqrt{2g}$ is giving the free entry profit level for the O-firm.

The bold line in Figure 6 describes the nature of the free entry organizational equilibria as a function of the degree of conflict in the firm α. Several points

are worth noticing. First, at $\alpha = 1$, the two organizations are equivalent from the point of view of the firm. At this value, preferences of the principal and the agent are perfectly congruent and there is no conflict in the firm. Second, with a decrease in α, the equilibrium firm organization moves from centralization of power to decentralization of power and finally to a single managed firm (from a P-firm with agent effort to an A-firm to an O-firm). Typically, with an increase in conflict of interest between the firm and her manager, the firm requires a larger level of profit B^* to enter the market under both organizations. This means that the stakes of the firm rise with more conflict in the firm and thus the firm has a larger incentive to monitor projects. Initially, for large values of α in the range of $[\alpha_P, 1]$, the firm's free entry stakes B^* are no too high. Therefore, the firm's monitoring does not kill the initiatives of the agent even under the P-organization. Hence, firms choose the latter. However, when α goes down and conflict increases, the required stakes to enter the market are high enough to kill the initiative of the agent under the P-firm but not under the A-firm. There is a trade-off between control and initiative for the firm. As long as the free entry stakes are not too large (i.e. corresponding to values of α in $[\overline{\alpha}, \alpha_A]$), the A-organization will emerge as an equilibrium free entry outcome for each firm. Finally, as α decreases further (i.e for values of α smaller than $\overline{\alpha}$), the required profit level for market entry increases further until the stakes for the firm become so high that the trade-off between control and initiative balances out in favor of control and the O-firm emerges as the equilibrium organization.

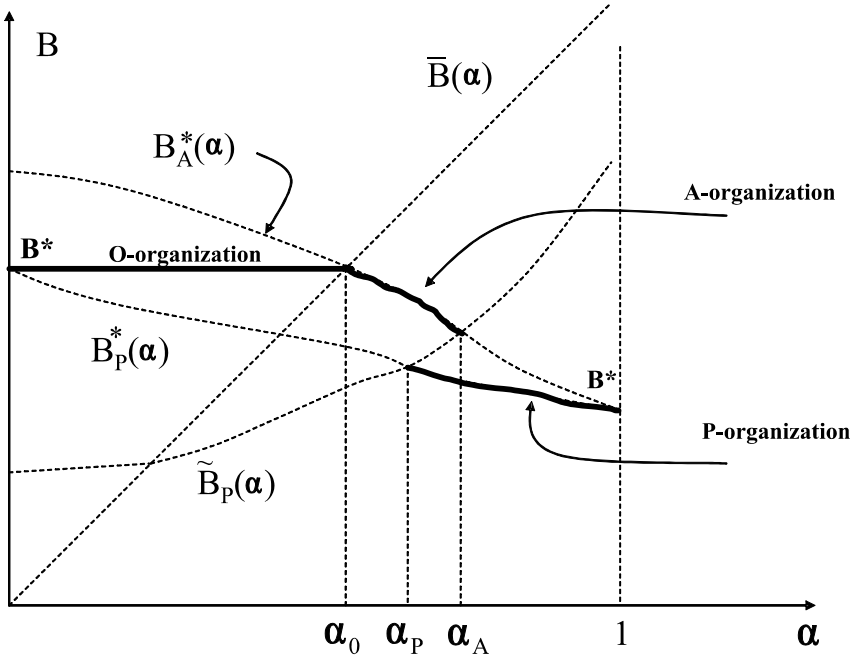


Figure 6: Free Entry Equilibrium Organization

3.3 The Toughness of Competition and Equilibrium Organization

We are now ready to describe the full structure of market equilibria. This is done in Figure 7 which explores how the free entry organizational equilibria we have just derived in the previous section interact with the thoughness of competition and the power struggle in the firm. The B^*B^* curve (derived in Figure 6) determines free entry profits and the profit maximizing choice of firm organization. The $B = \widehat{B}(\alpha)$ curve (derived in Figure 4) determines profits, the thoughness of competition in the market as well as the degree of power struggle in the firm. An equilibrium $E = (B^e, \alpha^e)$ is defined by an intersection point of the two curves. Since B^*B^* is downward sloping in α and $\widehat{B}(\alpha)$ is increasing in α, we show in the appendix that such an organizational equilibrium (B^e, α^e) always exists. The model is then solved recursively. Once the equilibrium values 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 7. Similarly, the equilibrium level of monitoring by firms E_i is obtained, from which we then compute the equilibrium average costs $\overline{c}^i$, the equilibrium number of effective firms N_i, the number of entering firms $M_i = N_i/(E_i + (1 - E_i)e)$ and output, revenues and mark-up levels of low costs P-firms and high costs A-firms. Finally, the labor market equilibrium gives the ouput level of the numeraire good 0.

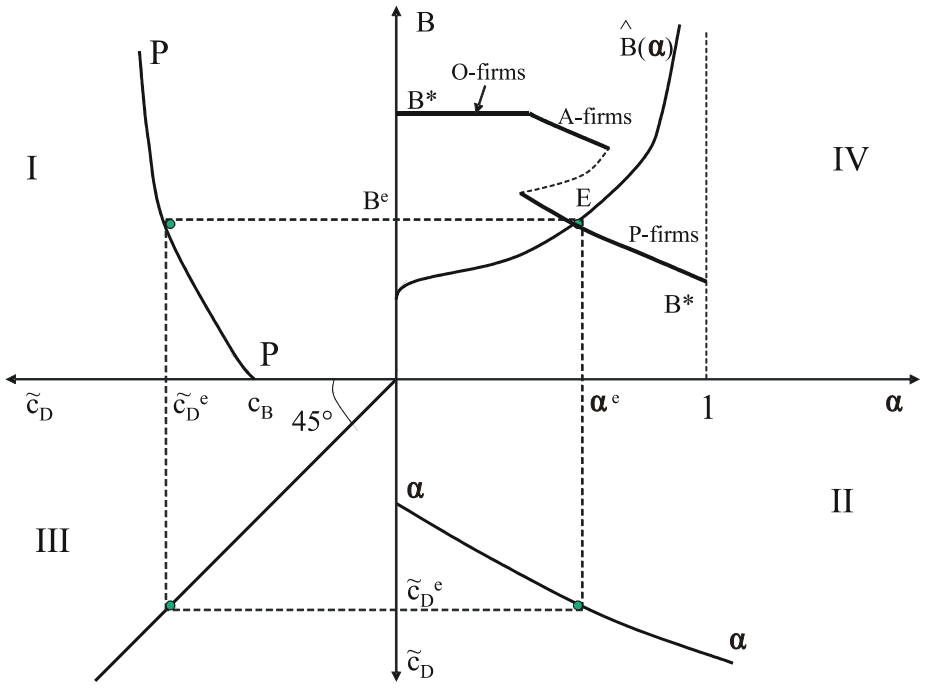


Figure 7: Market Competition and Firm Organization

With the help of Figure 7 we can examine the effect of changes in the toughness of competition on corporate organization. Market competition becomes more intense with a downward move along the $\widehat{B}(\alpha)$ curve (with a decrease in $\widetilde{c}_D$). When $\widetilde{c}_D$ declines, the economy shifts from the single managed O-organization, to the A-organization in which power is delegated to the division manager, and finally to the P-organization in which power is centralized at the top of the organization. Initially, at large levels of $\widetilde{c}_D$ profits B are so large when competition is weak that principals in firms monitor intensively and kill the initiative of the agents inspite of little conflict in the firm α. Thus, the O-firm is the optimal organization. When $\widetilde{c}_D$ keeps declining and competition becomes more intense, profits B are declining and principals start to monitor less inspite of an increase in the power struggle α. At some point the firm finds it profitable to delegate power to the agent to encourage his initiative and the A-organization emerges as the optimal organization. When $\widetilde{c}_D$ keeps declining further and competition becomes even more intense, profits become low enough that principals in firms care little and do not destroy the initiative of agents even under the P-organization when the principal keeps formal control. Hence, the P-firm becomes the optimal organization. Note that this happens inspite of the fact that the power struggle in the firm becomes larger with a further decline in α. This is summarized in the following statement

Statement 1: When the toughness of competition increases, the corporate equilibrium moves from the single managed O-organization to the decentralized A-organization and finally to the centralized P-organization. Within each organizational regime (O, A or P), the conflict in the firm rises with the toughness of competition.

4 Market Size and Power Struggle

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

The effect of a change in market size L is illustrated in Figure 8. We know from (12) 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 8. At the same time a change in L does not affect the conflict curve ($\alpha\alpha$) in quadrant II. Given that profits of high costs and low costs firms are both directly proportional to market size, a change in L has no direct effect on the conflict of interest α, everything else being equal. Thus, an increase in L shifts up the curve $\widehat{B}(\alpha)$ in quadrant IV of Figure 8. 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 divisonal level, to finally a single managed O-equilibrium regime without internal hierarchies. Note also that with an increase in market size, α is moving leftward along the B^*B^* curve. Hence, the conflict of interest in the firm increases with an increase in L. Finally, in quadrant II of Figure 8, an increase in L is increasing the toughness of competition in the market (decreases $\widetilde{c}_D$)

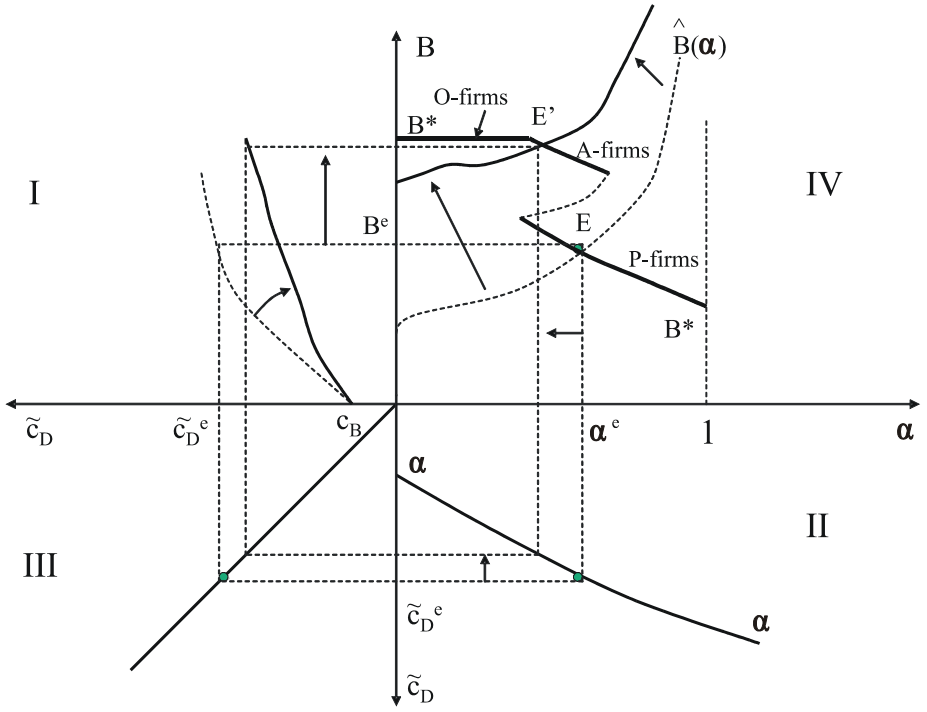


Figure 8: A Change in Market Size

Intuitively, an increase in market size makes firms' outputs and profits bigger, inducing entry, increased competition and smaller markups. With increased competition, in order to maintain market shares, high cost firms reduce their markups by more than low cost firms. This makes delegation inside the firm more costly and tends to increase conflict between firms and managers (lower α). A larger conflict of interest in the firm and bigger profits, in turn stimulate monitoring by the firm (increased effort E), making it more likely that the agent's initiative is crowded out under a centralized P-organization. Initially, when the market is small, profits and the conflict of interest in the firm is small. Therefore, principals in firms monitor only little and do not kill the initiative of their agents under the P-organization. There is no trade-off between control and initiative. Hence,

firms choose the latter. However, when market size keeps increasing and takes intermediate levels, profits, competition and the conflict in the firm become sufficiently large to kill the initiative of the agent unter the P-organization. There is a trade-off between control and initiative for the firm. Principals delegate power to their agents to prevent the loss of their initiatives and the A-organization emerges as a free entry corporate equilibrium. When market size keeps increasing even further profits, competition, and the conflict in the firm become so large that the principal in firms wants control no matter what. There is again no trade-off between control and initiative, since even under the A-organization the principal in firms destroys the agent's initiative and the single managed O-firm without the agent's initiative emerges as the equilibrium organization.

Note that when the market is neither too small nor too large there are more than one equilibrium mode of organization. One equilibrium is the P-organization with high agent's effort and another is the A-organization. These multiple equilibria arise due to a "strategic complementarity " among firms at the decision stage of optimal firm organization. At an intermediate level of market size the attractiveness between the two modes of organization depends on the organizational decisions taken by other firms in the market. Each firm individually would choose the A-organization at this size of the market, since in between the curves $\tilde{B}_P(\alpha)$ and $\overline{B}(\alpha)$ 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 the profit and cost level in the market will be low as well. Recall that formal P-firms have on average lower costs and thus require a lower profit level for market entry. Thus, the firm anticipates that it will be hard for her to survive competition with a formal 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. Similarly, when the firm anticipates that all the other firms will choose the A-organization, then she expects to be a viable competitor in the market with an A-organization. Thus, the firm also opts for an A-organization after market entry. The multiplicity of organizational equilibria arises due to a coordination problem among firms which comes from the fact that the firm's choice of organization depends on her profits and the conflict in the firm as well as on profits and the conflict in firms of competitors in the market. The competitors profit level and conflict, in turn, depend on what firm organization they have chosen. [14]

[14]Note that the coordination problem among firms disappears in small and large markets. When the market is small the firm's organizational choice does not depend on competitors' organizational decisions, because market competition is weak and conflict in the firm is small and thus firms' costs do not matter too much for how well they are doing in the market. When the market is large and competition and conflict in the firm are tough the option for firms to choose a P-organization with high agent's effort disappears altogether and thus, as our firm, all the other firms in the market will choose the A-organization as well and they will not find

Moreover, when the organizational equilbrium shifts from P to A with an increase in market size, the degree of conflict between the firm and her agent may decline rather than increase. In fact, in an A-organizational equilibrium, firms have on average higher costs of production than in a P-equilibrium. Agents are more likely to have real power in an A-equilibrium and to implement their best "high cost" project. This in turn reduces the toughness of competition in the economy and therefore reduces the conflict of interest inside the firm. This is illustrated in Figure 9 which shows how α is affected by a change in L. For low values of L, a P-organizational equilibrium prevails and an increase in market size tends to reduce the value of α within that regime. When L becomes big enough, an A-equilibrium becomes feasable and the conflict in the firm declines as α jumps upwards to a higher value. A further increase in L in the A-regime again toughens competition and increases the conflict in the firm (α continues to decline). Finally, when L is increasing even further, the O-firm emerges as the new equilibrium and α keeps declining[15]. This discussion can be summarized in the following statement:

Statement 2: When the size of the market increases, the equilibrium firm organization moves from the centralized P-organization to the decentralized A-organization and finally to the single managed O-firm. Within each organizational regime (P, A or O), the conflict of interest inside the firm increases with market size. A shift in organizational regime from P to A at first reduces the power struggle in the firm.

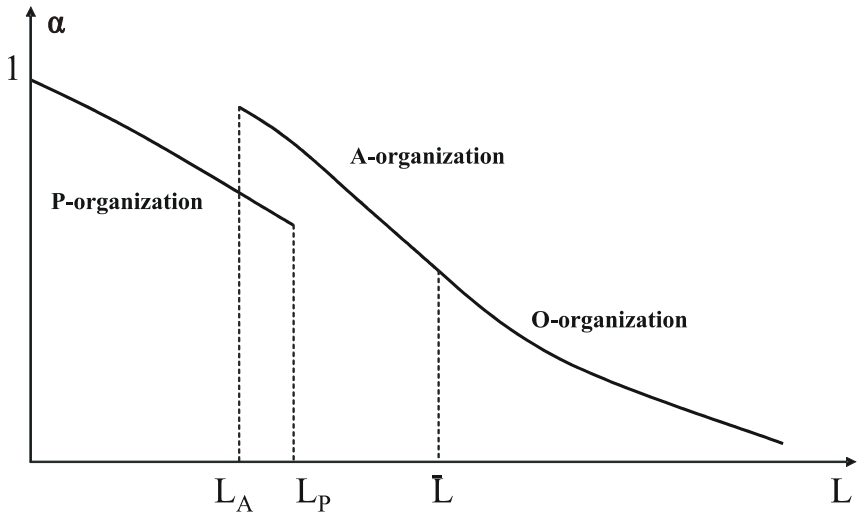


Figure 9: Market Size and Conflict in the Firm

it profitable to enter as P-firms. Thus, in either case, in small and large markets, there is no need to coordinate actions among firms.

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

5 Firm Heterogeneity

The model generates an ex-post endogenous pattern of heterogeneity across firms, as the number of low cost "real-P-firms" and high cost "real-A-firms" is endogenous and depends crucially on the organizational equilibrium. More specifically, consider the pattern of market competition. By the law of large numbers, given a number of entrants M in the industry, only $M[E+(1-E)e]$ of them have information on how to produce in which principals or agents are successfull at collecting information about possible projects for the firm. Hence average marginal costs $\overline{c}$ can be expressed as a function of the "organizational mix" of firms (as a share of real P-firms and real A-firms in the industry, respectively) which in turn depends on the formal organizational regime emerging in equilibrium.[16] More precisely, in a formal P-organizational equilibrium in which firms choose the P-organization as the optimal organization average marginal costs of the industry can be expressed as

$$\overline{c}^P(E) = \frac{ME}{M[E+(1-E)e]}c_B + \frac{M(1-E)e}{M[E+(1-E)e]}c_b = \frac{[E+(1-E)e\varphi]}{[E+(1-E)e]}c_B \quad (18)$$

With probability E the principal gets informed and chooses the project with low costs c_B. With probability $(1-E)e$ the principal does not get informed and the agent gets informed in which case he chooses the project with high costs c_b. Under the law of large numbers $\frac{E_P}{[E_P+(1-E_P)e]}$ and $\frac{(1-E_P)\overline{e}}{[E_P+(1-E_P)e]}$ equal the fraction of low cost 'real P-firms' and high cost 'real A-firms' in the economy. Call these shares the 'organizational mix' of firms in an industry. Similarly, in a formal A-organizational equilibrium in which the A-organization maximizes profits of firms average marginal costs are

$$\overline{c}^A(E) = \frac{Me}{M[e+(1-e)E]}c_b + \frac{M(1-e)E\ c_B}{M[e+(1-e)E]}c_B = \frac{[E+(\varphi-E)e]}{[E+(1-E)e]}c_B \quad (19)$$

with $\frac{\overline{e}}{[E_A+(1-E_A)e]}$ and $\frac{E(1-\overline{e})}{[E+(1-E_A)e]}$ as the fraction of high cost real A-firms and low cost real P-firms in the economy.

Hence, the cut-off level $\widetilde{c}_D$ (reflecting the toughness of competition in the market), depends on the equilibrium organization chosen by firms

$$\widetilde{c}_D^P = \widetilde{c}_D^P(E,N) = \frac{2\beta\gamma/c_B}{2\gamma+N\eta} + \frac{N\eta}{2\gamma+N\eta}\ \frac{[E+(1-E)e\varphi]}{[E+(1-E)e]}$$

[16] Recall that even under a formal P-organizational regime in which the principal has formal power in the firm, there will be a share of 'real A-firms' in the economy when the principal decides not to get informed and when she follows the suggestion of her informed agent.

and

$$\widetilde{c}_D^A = \widetilde{c}_D^A(E,N) = \frac{2\beta\gamma/c_B}{2\gamma+N\eta} + \frac{N\eta}{2\gamma+N\eta}\,\frac{[E+(\varphi-E)e]}{[E+(1-E)e]}$$

with $N = M[E+(1-E)e]$, as the "effective" number of varieties produced. As can be seen, the toughness of competition increases (ie. $\widetilde{c}_D^P$ and $\widetilde{c}_D^A$ decline) with the number of varieties N and with the amount of information collection by the principal E (with the share of low cost real P-firms). In fact, an increase in E affects the organizational mix between real P-firms (low cost firms) and real A-firms (high cost firms) with the composition of firms being biased towards the low cost firms. As average costs $\overline{c}^P(E)$ and $\overline{c}^A(E)$ decline the degree of market competition in the economy increases.

6 Market Size and Productivity

Given the described pattern of ex-post heterogeneity among firms, a change in market size L affects the productivity of the economy via two channels. First, a change in L affects the distribution between high and low cost firms. Second, a change in L affects the optimal choice of organization. Hence, we have an inter firm reallocation effects *within* a given organizational equilibrium (P or A)[17] and *across* organizational equilibria when an increase in market size induces firms to change their equilibrium organization. We now examine each effect in turn.

6.1 Reallocation to low cost firms

Consider first the reallocation effect associated with an increase in L within an organizational equilibrium. As discussed in Figure 8, an increase in L within an organizational regime tends to increase equilibrium profits B and to increase conflict (reduce α). This is associated with an increase in the toughness of competition, (ie. the zero profit cost level $\widetilde{c}_D$ goes down in quadrant II)

The effect on average productivity or equivalently on average costs can be illustrated with the help of Figure 10. The figure plots how average costs $\overline{c}^P(E)$ and $\overline{c}^A(E)$ are affected by a change in E (which affects the fraction of low cost real P-firms in the economy). Three things are noteworthy. First, for a given value of E, average costs in a P-organizational equilibrium $\overline{c}^P(E)$ are always below average costs $\overline{c}^A(E)$ in the A-organizational equilibrium. The reason is simply that the fraction of low cost firms is larger in a P-equilibrium than in

[17]Note that in an O-organizational equilibrium, there is no firm heterogeneity. In this equilibrium only projects discovered by the firm/principal are implemented and thus all active firms have the same cost minimizing technology with production cost c_B.

an A-equilibrium. Second, both $\overline{c}^P(E)$ and $\overline{c}^A(E)$ are declining with E, as an increase in E is directly related to an increase in the fraction of low cost firms in both regimes. Third, $\overline{c}^P(E)$ declines more sharply with an increase in E than $\overline{c}^A(E)$ (ie. $\overline{c}^P(E)$ is steeper than $\overline{c}^A(E)$), because the fraction of low cost firms is larger in a P-regime than in an A-regime. Formally, this can be seen from differentiating (18) and (19) with respect to E

$$\frac{d\overline{c}^P(E)}{dE} == -\frac{(\varphi-1)e}{[E+(1-E)e]^2}c_B \quad \text{and} \quad \frac{d\overline{c}^A(E)}{dE} = -\frac{(\varphi-1)e(1-e)}{[E+(1-E)e]^2}c_B \quad (20)$$

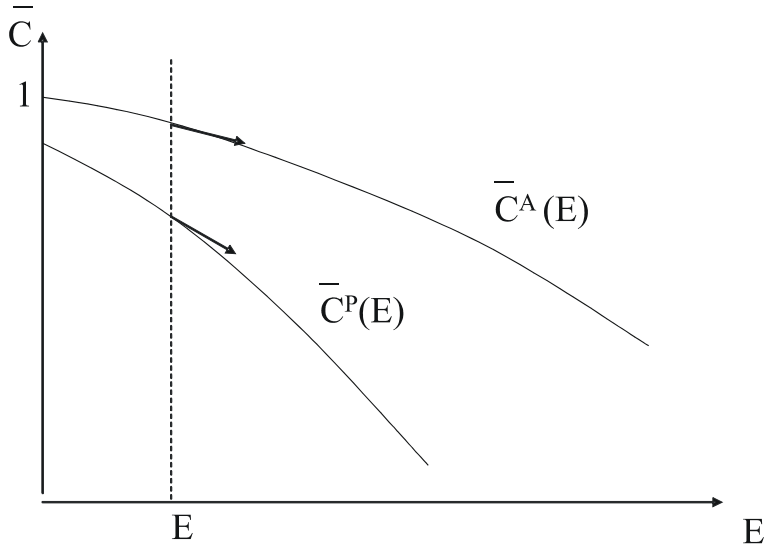


Figure 10: Average Productivity and the Organizational Mix of Firms

A change in market size L first increases equilibrium profits B within an organizational regime.This promotes more monitoring E_P or E_A by the firm inside the organization. As a result the population of active firms is biased towards "real P-firms" at the expense of "real A-firms". This reallocation from high cost firms to low cost firms reduces average production costs within each organizational regime. Second, an increase in L increases the conflict of interest inside the firm and reduces congruence between the firm and its manager. Within the P-regime, as can be seen from (10) the increase in conflict of interest in the firm also increases monitoring E_P by the principal, reducing even further average production costs $\overline{c}^P(E)$ within this regime. From this discussion we may conclude

Statement 3: An increase in market size L increases average productivity by increasing the fraction of low cost "real P-firms" at the expense of high cost "real A-firms". Average productivity increases more in a formal P-organizational equilibrium than in a formal A- organizational equilibrium.

6.2 A Change in Corporate Organization

Consider now a change in corporate organization induced by a change in L. To assess its effect on productivity consider Figure 11. A change in organizational regime from P to A occurs where the $\widehat{B}(\alpha)$ curve crosses the B^*B^* curve twice at point P in the P-equilibrium and at point A in the A-equilibrium. As $\widehat{B}(\alpha)$ is upward sloping, profits B_A and congruence α_A at point A are larger than profits B_P and congruence α_P at point P. The induced change in average productivity or average costs (ie the value of $\overline{c}^P$ at point P versus the value of $\overline{c}^A$ at point A) typically depends on comparing three effects which are illustrated in Figure 12. Quadrant I reproduces Figure 10, while quadrant II plots the monitoring efforts by the firm $E_P(B)$ and $E_A(B)$ under the two organizational equilibria as a function of profits B.

The first effect is the *composition effect* between low cost and high cost firms across organizational regimes P and A. In fact, for a given value of monitoring E by the firm, an A-organizational equilibrium is more likely to provide the agent with real power in the firm than a P-organizational equilibrium. Hence, at a given value of E, an A-regime has a larger fraction of high cost "real A-firms" than low costs "real P-firms". This is reflected in quadrant I by the fact that curve $\overline{c}^A(E)$ is always above curve $\overline{c}^P(E)$.

The second effect is the *monitoring effect* across organizational regimes P and A. At a given profit level B, a "formal P-firm" monitors more than a "formal A-firm" (ie. $E_P(B) > E_A(B)$ as can be seen from (10) and (11)). This is reflected in quadrant II of Figure 12 by the fact that the $E_P(B)$ curve is always above the $E_A(B)$ curve.

Finally, the last effect is the *profit effect*. As required profits under free entry $B_A = B_A^*(\alpha_A)$ are larger in the A-regime at point A than in the P-regime at point P $B_P = B_P^*(\alpha_P)$ (see Figure 11), the value of monitoring $E_A = (1-e)B_A/g$ in "formal A-firms" is larger than in "formal P-firms" $E_P = (1-e\alpha_P)B_P/g$. This is reflected in quadrant II of Figure 12 by the fact that B_A is above B_P on the vertical axis

Now we are ready to see how the three effects together influence average costs across organizational regimes from P to A. We simply need to compare the values of $\overline{c}^A(E_A)$ corresponding to point A in Figure 11 with $\overline{c}^P(E_P)$ corresponding to point P in Figure 11. Average costs at points A and P are described by the same letters in Figure 12.

The *composition effect* is visualized in quadrant I by a vertical move from point P on $\overline{c}^P(E)$ to point Q on $\overline{c}^A(E)$ for the same value of monitoring E_P. This effect clearly contributes to an increase in average costs when the corporate

equilibrium shifts from a P-organization to an A-organization. The *monitoring effect* is illustrated in quadrant II by a horizontal move from point F_P with coordinates (E_P, B_P) on the curve $E_P(B)$ to point F_A on the curve $E_A(B)$ with coordinates $(E_A(B_P), B_P)$. This effect is visualized in quadrant I by a move from Q to F along $\overline{c}^A(E)$. This effect also increases average costs across organizational equilibria from P to A. Finally, the *profit effect* is illustrated in quadrant II by a move from F_A to point K_A along the curve $E_A(B)$ increasing profits from B_P to B_A. This effect is shown in quadrant I by a move from point F to K along the $\overline{c}^A(E)$ curve. The profit effect reduces average costs when the industry shifts from a P-organization to an A-organization and thus works in opposite direction to the two other effects. The final effect on productivity is ambiguous and depends on the relative size of each of the three effects. Note that the profit effect has to be strong enough to compensate the first two. When the profit effect is not too large[18], it is likely that a shift in corporate organization from a P-equilibrium to an A-equilibrium due to an increase in market size will increase average costs in the economy. This discussion can be summarized by the following statement

Statement 4: *Across corporate organizational equilibria (from P to A), the impact of market size on average productivity can be decomposed into three effects: the composition effect, the monitoring effect, and the profit effect. The composition and monitoring effect both tend to decrease average productivity with an increase in market size L and the profit effect tends to increase average productivity. When the profit effect is not too large, a move from a P-organizational equilibrium to an A-organizational equilibrium is likely to reduce average productivity initially.*

Statement 3 and 4 can be summarized in Figure 13 which describes the evolution of average costs in the economy as a function of market size L. The curve has three parts $\overline{c}^P(L)$, $\overline{c}^A(L)$ and $\overline{c}^O(L)$ depending on the equilibrium organizational regime P, A or O. From statement 2, we know that average costs are declining within an organizational equilibrium and the curves $\overline{c}^P(L)$ and $\overline{c}^A(L)$ are de-

[18]Whether the shift in equilibrium profits across regimes is large or small depends on how efficient the agent is in collecting information. The less efficient the agent is in information collection (ie $e \ll 1$), the smaller is the gap between the free entre profit curves B_P^* and B_A^* under the two regimes P and A. Intuitively when the agent is not too efficient at getting information on projects, he is not having a lot of real power inside the firm. Hence, it is not too costly to give him formal power inside the firm either. In such a case, the shift in equilibrium profits across regimes is small and therefore, that average costs are likely to increase with a move from a P to a A organizational equilibrium.

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clining with market size. In the O-equilibrium the average cost curve becomes $\overline{c}^{O}(L) = c_B$, as all active firms are low cost "real P- firms". At some threshold value of $L = \widehat{L}$, the A-organization emerges as a new equilibrium and the economy shifts from a P-organization to an A-organization. This shift introduces a discontinuity in average costs. When the composition and the monitoring effect are strong enough compared to the profit effect, average costs jump upwards (and productivity declines) as is illustrated in Figure 13. Hence, average costs (or productivity) are not necessarily a decreasing monotonic function of market size, since firms may find it optimal to shift from a low cost corporate organization (formal P-firm) to a high cost corporate organization (formal A-firm) with an increase in average costs and less intense competition.

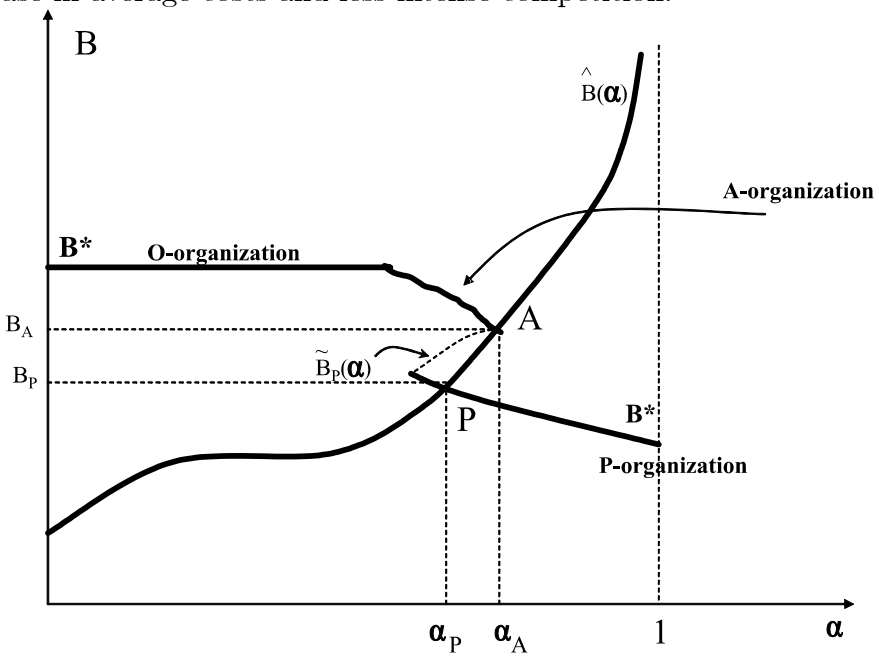

Figure 11: A Shift in Corporate Organization

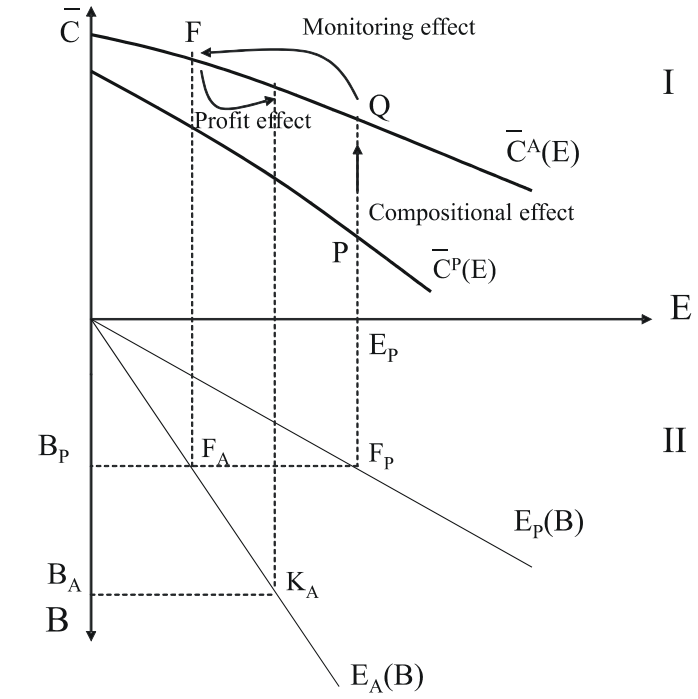

Figure 12: Average Production Across Organizational Equilibria

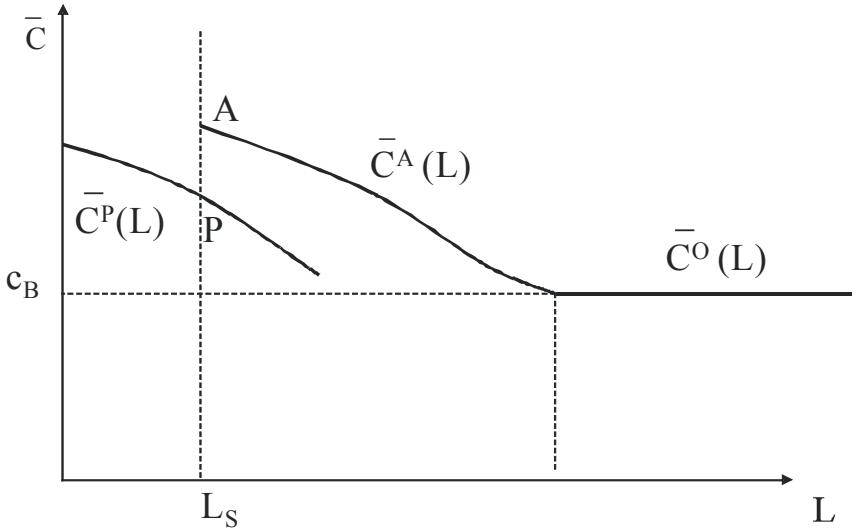

Figure 13: Average Productivity and Market Size

6.3 Number of Varieties and Market Size.

How is the number of varieties N (number of "effectively producing firms") affected by a change in market size? In a Krugman model with exogenous firm

organizations an increase in market size always leads to an increase in the number of varieties. In our model with endogenous organizations and endogenous toughness of competition this is not always the case anymore. There are different opposing forces operating with a change in market size which we turn to discuss now. From (8) we can relate the toughness of competition (reflected by $\widetilde{c}_D$) in a given organizational regime i to the number of varieties N_i in that regime by

$$\widetilde{c}_D^i = \widetilde{c}_D^i(E_i, N_i) = \frac{2\beta\gamma/c_B}{2\gamma + N_i\eta} + \frac{N_i\eta}{2\gamma + N_i\eta}\,\frac{\overline{c}^i(E_i)}{c_B}$$

Total differentiation with respect to market size L gives

$$c_B\frac{d\widetilde{c}_D^i}{dL} = \frac{N_i\eta}{2\gamma + N_i\eta}\left(\frac{d\overline{c}^i(E)}{dE}\right)\left(\frac{dE_i}{dB}\right)\left(\frac{dB_i}{dL}\right) - \frac{2\gamma\left(\beta - \overline{c}^i(E_i)\right)}{\left[2\gamma + N_i\eta\right]^2}\frac{dN_i}{dL}$$

Given that $\beta - \overline{c}^i(E_i) > 0$[19], it follows that

$$\frac{dN_i}{dL} \text{ has the sign of } -c_B\frac{d\widetilde{c}_D^i}{dL} + \frac{N_i\eta}{2\gamma + N_i\eta}\left(\frac{d\overline{c}^i(E)}{dE}\right)\left(\frac{dE_i}{dB}\right)\left(\frac{dB_i}{dL}\right) \qquad (21)$$

We know that an increase in market size L is associated with an increase in the toughness of competition (ie. a decrease in $\widetilde{c}_D^i$). $\frac{d\widetilde{c}_D^i}{dL} < 0$ and the first term of RHS of (21) is positive. The second term however is negative as $\left(\frac{d\overline{c}^i(E)}{dE}\right) < 0$, $\left(\frac{dE_i}{dB}\right) > 0$ and $\left(\frac{dB_i}{dL}\right) > 0$. Thus, the total effect on the number of equilibrium varities is ambiguous. Intuitively, an increase in market size L increases equilibrium free entry profits B. This tends to change the degree of competition through two effects. The first effect is the usual change in the number of firms. In a larger market, profits are larger, which in turn makes entry more profitable. Hence, N_i and the intensity of competition tend to increase. At the same time however, an increase in profits B induces more information collection E_i and more control by principals in firms leading to a change in the organizational mix of firms with a larger fraction of low cost P-firms in which the principal has real power. Through this reallocation from high cost real A-firms to low cost real P-firms competition in the economy becomes even more tough. This second effect in itself reduces the incentive for further entry in the economy. It is reflected in (21) by the second negative term $\frac{N_i\eta}{2\gamma+N_i\eta}\left(\frac{d\overline{c}^i(E)}{dE}\right)\left(\frac{dE_i}{dB}\right)\left(\frac{dB_i}{dL}\right)$. Intuitively, in a larger market, the "size of the pie is larger", but it is a much 'harder' pie to capture due to the reallocation effect on the toughness of competition in the market. If the reallocation effect is not too strong, then the number of varieties increase with market size and $\frac{dN_i}{dL} > 0$ as is typically the case in a Krugman model. This is

[19]We assume that the consumer's willingness β to consume the monopolistic differentiated product is larger than the highest cost c_b, hence larger than average costs $c^i(E_i)$.

most likely to happen when the degree of ex-post heterogeneity is small, and thus $\left(\frac{d\overline{c}^i(E)}{dE}\right)$ is small. From (20) we see that firm heterogeneity is likely to be small in a P-equilibrium when $e \ll 1$ (ie. the agent is not very efficient at collecting information) and is like to be small in an A-equilibrium when $e \approx 1$ (ie. when the agent is very efficient in collecting information). In both cases, the pattern of ex post heterogeneity is weak and consequently the reallocation effect is also weak. Furthermore, the reallocation effect is likely to be small when information collection in the firm E is not too responsive to changes in profits and thus $\left(\frac{dE_i}{dB}\right)$ is small or the effort cost parameter g is large.

7 Empirical Evidence

7.1 The Data

In this section we explore the predictions from the theory with survey data of 660 global corporations in Austria (200 firms) and in Germany (460 firms) in the period 1997-2001. Due to the length of the questionnaire, we personally visited the firms in Austria and Germany, respectively or conducted the interviews by phone. The data include all publicly traded German DAX firms and represent in terms of value 80 percent of German and 100 percent of Austrian firms investing in Eastern Europe. Thus, 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 data sample is unique in several dimensions. It includes detailed information on the internal organization of the corporations including power relations between the CEO and the divisional level, organizational form, incentive system used for its workers, wages and educational qualifications of the firm's workers, detailed data on the financial structure as well as balance sheet information. Appendix A gives summary statistics of the data used in this paper.[20]

7.2 Predictions

We start by examining the relationship between the toughness of competition in the market and the firms' mode of organization. From Figure 7 we can derive this relationship. Recall that the figure examines how the optimal choice of firm organization under free entry given by the B^*B^*curve interacts with the toughness of competition $\widetilde{c}_D$ and the power struggle in the firm α given by the

[20]For more information on the data see Marin (2004).

$\widehat{B}(\alpha)$ curve. Market competition becomes more intense with a downward move along the $\widehat{B}(\alpha)$ curve (with a decrease in $\widetilde{c}_D$). When $\widetilde{c}_D$ declines, the economy shifts from the single managed O-organization, to the A-organization in which power is delegated to the division manager, and finally to the P-organization in which power is centralized at the top of the organization. Thus, we have

Prediction 1: In a cross section of countries or industries, industries with little competition will have corporations with centralized power, while industries with tough competition will see their firms decentralize power to lower levels of the corporate hierarchy. Very competitive industries will again have a centralized power structure. In a cross section of firms, firms facing a few competitors will have centralized organizations (single managed family firms), while firms facing many competitors will decentralize power in the corporation. Firms facing very tough competition will again choose a centralized organization.

Next, we examine the relationship between trade exposure and firm organization. An increased exposure to trade is captured in our model by an increase in market size L. From Figure 8 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 the economy moves from a P-equilibrium with power at the CEO level to an A-equilibrium with power delegated to the division manager, to finally a single managed O-firm. Thus, we have

Prediction 2: In a cross section of countries, larger countries will have larger firms and more decentralized corporations, while smaller countries will have smaller more centralized firms. In a cross section of firms, larger firms will have more decentralized corporate organization than smaller firms.

The model gives predictions in general equilibrium at the economy or sectoral level which can be tested. However, these predictions are hard to confront with data, since we have information on the internal organization of corporations for two countries (Austria and Germany) only. Therefore, we examine the predictions of the partial equilibrium part of the model at the level of the firm.

7.3 Results

We test these predictions in Tables 5 and 6 which report ordinary least squares estimates of the determinants of the level of decision making in Austrian and German corporations. The dependent variable *poweralldecisions* includes 13 (Austrian firms) and 16 (German firms) corporate decisions, respectively ranked by the level of corporate hierarchy. Decisions are ranked between 1 (central decision) and 5 (decentral decisions). For the listing of these decisions and their ranking see Tables A1 and A2. We regress the variable *poweralldecisions* on

firms' $cashflow$ and output level Y, respectively to test whether or not larger and more profitable firms decentralize decisions in corporations. The coefficients on $log\ cashflow$ and $logY$ are positive and significantly different from zero at the 1% significance level in all specifications for both Austrian and German corporations. The estimated elasticities of power in the firm with respect to the cash flow imply that a 10 % increase in firms' cash flow reduces the hierachical level at which corporations carry out their decisions by around 1% in the range of 1 to 5 among Austrian corporations and by around 0.47% among German corporations. An elasticity of similar magnitude is obtained for the firm's output level. These elasticities suggest that Austrian corporations decentralize by more than twice as much in response to the same increase in profits and firm growth compared to German corporations.

Next, we include the variable *worldcompetition* to see whether for given profits and firm size competition has an additional effect on the level of power in corporations. The measure of *worldcompetition* is a subjective measure of competition as perceived by firms. It takes the value of 1 if the firm is the only supplier in world markets, the value of 2 if the world market consists of a few competitors, the value of 3 if the market consists of many competitors. World competition has a positive and insignificant effect on *poweralldecisions* in Austrian corporations and a negative and significant effect (at the 10 percent level) in German corporations. Hence, with an increase in competition Austrian corporations tend to decentralize power to lower levels of the corporate hierarchy, while German corporations centralize power in more competitive environments. The weak significance level of the competition variable on power decisions in Austrian corporations is not surprising, since in a small economy like Austria, profits and the size of firms are correlated with competition in world markets, while this is less so for German corporations operating in a large domestic market.

The difference in the sign of the coefficient on *worldcompetition* for Austrian and German corporations can be understood by looking at Figure 8. A downward movement along the $\widehat{B}(\alpha)$ curve (an increase in competition) in the smaller economy reduces profits by more than a movement along the same curve in the larger economy. The slope of the $\widehat{B}(\alpha)$ curve of the smaller economy is steeper than the slope of that curve of the larger economy resulting in an earlier shift from the O-organization to the A-organization in the smaller country compared to the larger country. Hence, the empirical results that Austrian firms decentralize while German firms do not with the same increase in competition are consistent with the theory. They also explain the data given in Table 4 which show that in Austria, the small country, the share of firms with a new organization is almost twice as large than in Germany, the large country.

Next, we include the variable *export ratio* to examine whether or not firms more exposed to trade have a stronger tendency to decentralize power in cor-

porations .The coefficients on *log export ratio* are negative and significant for corporations in both countries. The estimated coefficients suggest that a 10 percent increase in firms' export ratio leads firms to centralize power by 0.2 to 0.3 percent in corporations in both countries. Note, that among Austrian corporations (and to a lesser extent also among German corporations) *log exportratio* becomes insignificant when *wordcompetition* and/or *logY* are included in the regressions suggesting that these variables are somewhat correlated. The correlation between export ratio and firms' sales is negative suggesting that larger firms have smaller export ratios. Hence, smaller firms more exposed to trade tend to organize internal power relations more centrally.

The inclusion of productivity in the regressions in column (6) of Table 6 and in column (7) of Table 5 and of an industry dummy do not overturn any of the qualitative results. The negative coefficient on *log productivity* suggest that firms with centralized power tend to be more productive. This is consistent with the theory as centralized P-firms have smaller costs than decentralized A-firms. The relationship is, however, not significant for German corporations.

In order to examine more closely the response of power relations inside firms to changes in the economic environment, we run separate regressions for three central firm decisions (dependent variable *centraldecisions*) on the one hand and for the R&D decisions (dependent variable *R&Ddecisions*) on the other. Central decisions have more potential to be decentralized in response to changes in market conditions. R&D decisions often depend on ideas of workers involved and thus it may become more important to delegate these decisions. We report the results for the central decisions in columns (8) and (9) of Table 5 for Austrian corporations and in columns (9) - (11) of Table 6 for German corporations. Among Austrian corporations the central decisions (financial decisions, decisions over acquisitions, decisions over a new strategy) appear not to respond to changes in market conditions, while German firms respond strongly to an increase in world competition and decentralize the central decisions in the corporation. Note that in response to an increase in world competition German corporations centralize power in the corporation when all 16 decisions are included, while they decentralize the central decisions (compare the coefficients of *worldcompetition* in columns (1) - (8) with (9) - (11)). Moreover, the central decisions among German corporations appear to follow a non monotonic pattern as is predicted by the theory. Initially, German firms decentralize the central decisions with more competition (the coefficients of *worldcompetition* is positive and highly significant) and later when competition rises further the central decisions become centralized again (the coefficients of $(worldcompetition)^2$ is negative and highly significant)

Columns (10) - (14) of Table 5 and columns (12) and (13) of Table 6 report the results for the R&D decisions. In Germany larger more profitable firms tend to

decentralize the R&D decisions. In Austria, firms respond much stronger by decentralizing R&D decisions to lower levels of the corporate hierarchy. Larger more profitable firms more exposed to trade, foreign direct investment, and world competition decentralize the R&D decisions. Note that the coefficients of *worldcompetition* in the *R&Ddecisions* regressions almost triple in size compared to the coefficients of *worldcompetition* in the *alldecisions* regressions suggesting that competition induces Austrian firms to delegate in particular these decisions. Note further, that multinational firms in Austria decentralize power by more than firms less involved in foreign direct investments (the coefficient of *log FDI ratio* is positive and highly significant), while this form of foreign involvement has no affect on the allocation of power inside German corporations (not reported in Table 6).

Finally, we included the human capital-labor ratio as a proxy for the skill intensity of firms. The coefficient on $log(H/L)$ is not significant in Austrian corporations (not reported in Table 5), while it is positive and significantly different from zero in German corporations (columns (7) and (8) of Table 6). The estimated elasticities suggest that a 10 percent increase in the share of university and college graduates employed by the firm leads it to decentralize power in the corporation by 0.7 percent. [21]

Returning to the stylized facts of corporate organization in Austria and Germany reported in the introduction the following picture emerges from the empirical results. Germany, the large country, has a more decentralized corporate structure compared to Austria (Table 2), because profits and firms are larger and thus German firms decentralize decisions to lower levels to keep the initiative of their workers. However, Austrian corporations respond much stronger to an additional increase in profits and firm size by decentralizing decisions compared to German firms. They also tend to delegate power to lower corporate levels with an increase in competition, while German firms centralize power with more competition. Hence, Austrian firms introduce organizational changes faster compared to German firms (Table 4). This is particularly the case for the corporate R&D decisions. In contrast, German firms have more decentralized organizations to begin with and respond more slowly to changes in the economic environment. Only the very central corporate decisions appear to respond strongly to changes of competition in world markets.

[21] These findings are consistent with Marin and Verdier (2003). In Marin and Verdier (2003) we argue that skill rich countries will have firms with skill intensive organizations which decentralize power to the talented workforce. Marin (2004) shows that Germany is relatively richer endowed with human capital, while Austria is a relatively human capital poor country.

Table 5 Determining the Level of Power in Corporations

Austrian Corporations

dependent variable: log power

	all decisions							central decisions		R&D decisions				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
log cash flow	0.094***	0.097***	0.099***	0.100***			0.110***	0.066**		0.077*	0.088**	0.107**		
	[3.254]	*[3.215]*	*[3.242]*	*[3.346]*			*[3.444]*	*[2.444]*		*[1.727]*	*[2.034]*	*[2.397]*		
log Y					0.082***	0.072**			0.038				0.085**	0.149***
					[3.122]	*[2.607]*			*[1.640]*				*[2.352]*	*[3.724]*
world competition	0.098		0.086	0.126	0.110	0.106	0.129	-0.014		0.289*	0.196	0.275*	0.160	
	[1.073]		*[0.851]*	*[1.232]*	*[1.320]*	*[1.189]*	*[1.308]*	*[0.156]*		*[1.736]*	*[1.246]*	*[1.782]*	*[1.362]*	
log export ratio		-0.022*	-0.019	-0.020		0.004		-0.015	0.006	0.021			0.037***	0.020
		[1.780]	*[1.477]*	*[1.534]*		*[0.387]*		*[1.394]*	*[0.830]*	*[1.041]*			*[2.847]*	*[1.609]*
log productivity							-0.120*		-0.075*			-0.196**		-0.288***
							[1.843]		*[1.921]*			*[2.149]*		*[3.577]*
log FDI ratio											0.118**			
											[2.181]			
industry dummy				-0.172*						0.051	0.099			
				[1.700]						*[0.310]*	*[0.676]*			
constant	-0.787	-0.507	-0.775	-0.813	-0.907*	-0.721	0.355	-0.489	0.660	-1.199	-1.478*	0.832	-1.210	1.642*
	[1.471]	*[1.089]*	*[1.376]*	*[1.469]*	*[1.801]*	*[1.329]*	*[0.419]*	*[0.965]*	*[1.308]*	*[1.371]*	*[1.752]*	*[0.707]*	*[1.640]*	*[1.818]*
Observations	67	57	57	57	120	113	59	65	140	44	49	48	88	87
Adjusted R-squared	0.123	0.171	0.166	0.195	0.081	0.048	0.156	0.073	0.018	0.057	0.124	0.129	0.120	0.218

t-values in brackets

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

power: firm decisions ranked by level of corporate hierarchy. Decisions are ranked between 1 (central decision) and 5 (decentral decision). For the listing of the 13 decisions and their ranking see Table A1.

all decisions include 13 firm decisions; for the listing see Table A1.

central decisions include 3 firm decisions (financial decisions, decisions over acquisitions, and decisions over a new strategy), which have been ranked above 2 on average.

R&D decisions include decision of R&D expenditures and the introduction of a new product. For the ranking of these decisions see Table A1.

For the data description of the other variables in the table see Table A3.

Table 6 Determining the Level of Power in Corporations

German Corporations

dependent variable: log power

	all decisions								central decisions			R&D decisions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
log cash flow	0.044**	0.049**	0.046**	0.040*								0.075**	
	[2.503]	*[2.464]*	*[2.201]*	*[1.788]*								*[2.305]*	
log Y					0.060***	0.053***	0.054**	0.071***	0.030	0.032	0.030*		0.068**
					[3.238]	*[3.349]*	*[2.603]*	*[3.256]*	*[1.486]*	*[1.614]*	*[1.684]*		*[2.029]*
world competition	-0.108		-0.182*	-0.105	-0.124*	-0.102*	-0.124	-0.185**	1.121***	0.948**	0.993***		
	[1.401]		*[1.784]*	*[0.740]*	*[1.780]*	*[1.747]*	*[1.406]*	*[2.040]*	*[2.884]*	*[2.355]*	*[2.761]*		
world competition ^{2}									-0.196***	-0.172**	-0.171***		
									[2.898]	*[2.512]*	*[2.697]*		
log export ratio		-0.017*	-0.020*	-0.031*	-0.009				-0.013	-0.003		-0.012	-0.008
		[1.743]	*[1.889]*	*[1.726]*	*[1.127]*				*[1.492]*	*[0.229]*		*[0.688]*	*[0.517]*
log productivity						-0.002							
						[0.064]							
log H / L							0.071**	0.065*			0.003		
							[2.057]	*[1.959]*			*[0.081]*		
industry dummy				-0.167				0.201*		0.168			
				[0.778]				*[1.975]*		*[1.461]*			
constant	0.710*	0.288	0.862*	0.792	0.197	0.307	0.130	-0.105	-1.648**	-1.461**	-1.517*	-0.257	-0.489
	[2.015]	*[0.876]*	*[1.902]*	*[1.704]*	*[0.443]*	*[0.615]*	*[0.258]*	*[0.209]*	*[2.361]*	*[2.081]*	*[1.951]*	*[0.475]*	*[0.750]*
Observations	44	34	30	30	60	73	45	45	58	58	70	30	53
Adjusted R-squared	0.120	0.244	0.271	0.260	0.179	0.167	0.208	0.261	0.108	0.127	0.094	0.154	0.039

t-values in brackets

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

power: firm decisions ranked by level of corporate hierarchy. Decisions are ranked between 1 (central decision) and 5 (decentral decision). For the listing of the 16 decisions and their ranking see Table A2.

all decisions include 16 firm decisions; for the listing see Table A2.

central decisions include 3 firm decisions (financial decisions, decisions over acquisitions, and decisions over a new strategy), which have been ranked above 2 on average.

R&D decisions include decision of R&D expenditures and the introduction of a new product. For the ranking of these decisions see Table A2.

For the data description of the other variables in the table see Table A3.

8 Conclusion

To be completed

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Appendix A: The Data

Table A1 Decisions Ranked by Level of Corporate Hierarchy

Austrian Corporations

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

Table A2 Decisions Ranked by Level of Corporate Hierarchy

German Corporations

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

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

Variable	obser-vations	description	mean	minimum	maximum	stand. dev.
power: all decisions	256	Decisions are ranked between 1 and 5 with 1 as the decision taken by the CEO in the firm (central decision) and 5 as the decision taken at the divisional level (decentral decision). The numbers are averages over 16 decisions. A firm with a mean at 1 is centralized and a firm with a mean of 5 is decentralized. All decisions include: decision over acquisitions, financial decisions, new strategy, finding acquisitions, transfer prices, introduction of new products, R&D expenditures, budget, hiring more than 10% of current personnel, hiring two workers, change of supplier, price increase of of product, decision over product price, moderate wage increase, firing of personnel, hiring a secretary. For the ranking of these decisions see Tables A1 and A2.	2.81	1.00	5.00	0.89
power: central decisions	283	A decision is defined as central when it has been ranked above 2 on average in the range of 1 (central decision) and 5 (decentral decision). Central decisions include: financial decisions, decisions over acquisitions, and decisions over a new strategy. For the ranking of these decisions see Tables A1 and A2.	1.70	1.00	5.00	0.64
power: R&D decisions	207	R&D decisions include: decisions over R&D expenditures and the introduction of a new product. For the ranking of these decisions see Tables A1 and A2.	2.67	1.00	5.00	1.22
cash flow	322	firms' cash flow in million EUR	51	-66	5,930	360
Y	583	firms' sales in million EUR	729	0	58,000	3,690
world competition	608	worldwide competition as perceived by firms: 1 one firm, 2 a few competitors, 3 many competitiors, and 4 no supplier	2.89	1.00	4.00	0.51
export ratio	502	firms' exports in percent of firms' sales	35.53	0.00	1,500	80.02
FDI ratio	555	affiliates' sales in percent of parent sales	128	0	25,284	1,303
H / L	242	firms' employees with a college or university degree in percent of total employment	15.52	0.00	90.00	27.26
productivity	588	firms' sales per worker in EUR	429,907	0.00	9,689,711	1,023,543
industry dummy	656	dummy variable equal to 1 if the sector is services and 0 if it is industry		D = 1,	286 observations	

Appendix B