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Globalization and the Empowerment of Talent

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GOVERNANCE AND THE EFFICIENCY
OF ECONOMIC SYSTEMS
GESY

Discussion Paper No. 1

**Globalization and the
Empowerment of Talent**

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July 2004

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Globalization and the Empowerment of Talent*

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Abstract

Globalization has been identified by many experts as a new way firms organize their activities and as the emergence of talent as the new stakeholder in the firm. This paper examines the role of trade integration for the changing nature of the corporation. International trade leads to a 'war for talent' which makes it more likely that an organizational equilibrium emerges in the integrated world economy in which control is delegated to lower levels of the firms' hierarchy empowering human capital. Furthermore, trade integration is shown to lead to waves of outsourcing and to convergence in corporate cultures across countries.

JEL Classification: F12, F14, L22, D23

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1 Introduction

In the last two decades the corporate sector in industrialized countries went through a spectacular change. The corporate sector in rich economies has witnessed the break up of conglomerates resulting in more specialized and 'down-sized' firms. The corporate sector sold unrelated businesses and expanded into related businesses. At the same time firms eliminated layers of middle management by introducing more decentralized decision making inside the corporation and by empowering workers at lower levels of the firm's hierarchy. This has resulted in flatter hierarchies inside the corporation.¹

But perhaps the most dramatic change in the last decade is that the nature of the corporation itself is changing. Human capital has become the new stakeholder in the firm. The enterprise of the past was well defined by the ownership of physical assets. These physical assets required huge amounts of investments which went beyond the capacity of management. As a result, the enterprise of the past came to be owned by shareholders. The resulting separation of ownership and control made the agency problem between top management and shareholders the central focus of corporate governance. In contrast, in the enterprise today human capital and talent rather than its plants and machines are the critical assets. Improvements in financial markets have made it easier to finance large investments, so the capital intensity is no longer the critical asset of the firm. In today's enterprise, specialized human capital has to create ideas how to do things differently to survive an increasingly competitive environment. Innovative and customized deals are the source of profits today. Thus, the enterprise's talented workforce has become an important source of value to the firm. But this raises new problems of corporate governance. Today's enterprise is no longer a stable entity. In contrast to its machines the firm cannot own its talented workforce. Human capital is mobile and can leave taking with it the firms' value. Thus, the central focus of corporate governance today is how to preserve and protect the boundaries of the firm. The big challenge is how can the firm obtain power over its human capital when it cannot own it.²

What accounts for these changes in the nature of the corporation? Can the increased integration of rich countries into the world economy explain some of the described changes in corporate organization? Why has human capital become so important recently? There are two traditional explanations for the increased importance of human capital in the literature: skill-biased technical change and

¹For empirical evidence see Holmstrom and Kaplan 2001, Rajan and Wulf 2003.

²For an argument along this line see Rajan and Zingales (2000), for empirical evidence see Blair and Kochan 2000.

trade integration with low wage countries. Computerization and related technologies have caused firms to switch towards production techniques that are biased in favor of skilled workers (Lawrence and Slaughter 1993). The increase in import competition from low wage countries has shifted resources towards industries that use skilled labor relatively intensive (Leamer 1993). We offer a novel explanation for the increased importance of human capital based on changes in the organization of the firm. Due to the increase in trade integration human capital has now more options where to go and it can leave the firm. The improved opportunities for human capital outside the firm happens at the same time as talent becomes the new source of value to the firm. As a result, the organization of the corporation responds to this outside changes by giving power and decision control to talent to prevent it from leaving the firm.^{3 4}

In this paper we combine the trade explanation for the increased importance of human capital with an explanation based on the theory of the firm to examine how competition for talent can affect the firm's organization on the one hand and how the firm's mode of organization feeds back to the market for talent on the other. We develop a general equilibrium model that combines a variant of the Aghion-Tirole (1997) theory of the firm with elements of the Helpman-Krugman (1985) theory of international trade. The AT- theory of the firm describes the power struggle inside a single firm but neglects the market environment in which firms operate, in particular competition with other firms for talent. The HK-theory of international trade describes the market environment in which firms operate, but the firm remains a black box. The integration of the two models will allow us to examine the interaction between trade integration on the one hand and changes in corporate organization on the other. We show that trade integration leads to a 'war for talent' which may induce firms to change their organization empowering human capital. The resulting shift in the organizational mix in the economy towards skill intensive firms, in turn, raises the relative demand for human capital in industrialized countries. This increase in the demand for skills is distinct and goes beyond the well known relative increase for skilled workers due to a shift in the output mix towards more skill intensive sectors that typically comes with trade integration with low wage countries.

As in Helpman and Krugman we develop a 2 x 2 x 2 (i.e., two factors, skilled and unskilled labor, two sectors, and two countries) model, in which one of the sectors (the unskilled intensive one) is perfectly competitive, while the other sector

³Peter Drucker, a well known author of managerial books, argues in his article "The Future of the Company" in the The Economist December 2001 that giving more freedom to what he calls today's prized "knowledge workers" is essential. He cites McKinsey, a consultancy, as arguing that the key battle of this century is the 'war for talent'.

⁴We abstract in this paper from pecuniary incentives schemes as an alternative way to attract talented workers in order to keep things simple and tractable in a general equilibrium model of international trade.

features product differentiation and monopolistic competition. On the demand side, preferences are homothetic and identical everywhere. The homogenous, unskilled-intensive good is produced under standard CRS technology.

Production of the different varieties in the skilled-intensive sector is as in Aghion and Tirole. Two agents are involved in production: a principal and a skilled division manager. There are m potential methods of production, of which one maximizes profits (which accrue to the principal) and another one maximizes a private benefit for the manager. The principal hires unskilled workers to (i) gather information on which of the m methods is the one that maximizes profits, and to (ii) manufacture the good once the method of production has been decided. The manager also spends resources to try to find out which of the m ways of running the firm maximizes the private benefit. If none of the two agents find out which is their preferred project, production does not take place (the other $m-2$ projects yield large negative payoffs). If both agents find out which are their preferred projects, the decision rights reside in the agent with *formal authority* (the allocation of these rights is ex-ante contractible). If only one of the agents learns which his/her preferred project is, the uninformed agent always rubber-stamps this project. In this case, the informed party has *real authority*. In choosing between keeping formal authority or delegating power to the manager, the principal trades off the benefit from control against the manager's loss of initiative.

The first result of the paper (Proposition 2.1) states that the principal will find it optimal to give the manager formal authority only when the ratio of profits to the unskilled wage takes intermediate values. When this ratio is very low, the principal's stakes are low and he invests little on information acquisition. This in turn implies that the manager is more likely to have real authority ex-post, and so it becomes unnecessary to give him also formal authority ex-ante. On the other hand, when profits are high, the principal's investment in information acquisition will also tend to be high, and the manager's initiative will be killed even when he is given formal authority. In such a case, the principal is indifferent between keeping formal authority or giving it away, so there is no gain in assigning formal authority to the manager. Finally depending on parameter values, there may exist intermediate levels of profits for which the principal finds it optimal to delegate formal power to the manager to induce him to invest in information acquisition and avoid no production.

We then solve for the industry equilibrium (imposing free entry) and for the general equilibrium of the closed economy (imposing factor market clearing). Interestingly, we find that relative factor endowments are important determinants of the equilibrium mode of organization. In countries where skilled labor is relatively scarce (high L/H), the wage of unskilled workers will tend to be low, while

the fixed costs of production (which consist of the wage of the skilled worker) will tend to be high, thus making entry more costly. These forces tend to make the ratio of profits to the unskilled wage high in skill-scarce countries and low in skill-abundant countries. It follows that countries with very high or very low ratios of skilled workers to unskilled workers will tend to have firms in which principals keep formal authority, while in countries with intermediate levels of L/H , organization modes in which power is delegated to skilled managers might prevail.

Our model delivers further interesting results. First, in the general equilibrium of the closed economy, there exist a range of relative factor endowments for which there are multiple equilibria, with *all* principals in the monopolistically competitive sector either delegating or not delegating power. Second, there also exist a range of L/H for which there exists a unique mixed equilibrium, with *some* principals delegating formal power and *some* principals keeping it to themselves. In this range, factor prices are independent of L/H : factor market clearing comes about through a relocation of resources from one organization mode to the other (in equilibrium, different organization modes differ in their factor intensity). Third, when two countries with different relative factor endowments open up to trade, their factor prices will tend to converge and this could induce convergence of corporate cultures leading all principals in both countries to delegate power (even when no principal in any of the two countries was delegating in autarky).

The paper contributes to an emerging literature on general equilibrium models with endogenous organizations (e.g, Grossman and Helpman 2002, Legros and Newman 2000, Marin and Verdier 2002, Antras 2003, Antras and Helpman 2004). We contribute to this literature in several respects. First, we incorporate into trade theory the interesting view of the firm of Aghion and Tirole (1997). By doing so our focus is on the internal organization of the firm rather than on firm boundaries as is the case in previous work on international trade and organizations (e.g, Antras 2003, Antras and Helpman 2004). Second, we provide the first model (of which we are aware) in which the mode of organization is a function of relative factor prices, and therefore, in general equilibrium, of relative factor endowments. This is an important result, because it illustrates the type of new insights that one can gain from putting partial equilibrium theories of the firm in general equilibrium. Third, we derive a series of non-trivial, general equilibrium results that should stimulate further empirical work in this area.

In a previous paper (Marin and Verdier MV 2002) we examine the interaction between goods market competition and the allocation of power inside the corporation. We find that market competition increases the stakes of the firm which makes delegation of power inside the firm more costly. We also show that identical countries may have different corporate cultures depending on the mode

of organization other firms choose. In MV (2002) international trade leads to organizational convergence across countries. The organizational equilibrium to which the world economy converges remains, however, undetermined. In the present paper we allow countries to differ in factor endowments which enables us to predict to which organizational equilibrium the integrated world economy will converge. The present paper is also related to Rajan and Zingales (2001) who develop a model of firm organization in which the numbers of hierarchical layers in the corporation act as a wall of protection against the threat of talent leaving and stealing the firm's assets. However, they focus on a single firm and ignore interactions from goods and factor markets.

The paper is organized in the following sections. In section 2 we develop a two sector general equilibrium model of a closed economy in which firms endogenously choose the mode of organization. The model generates an organizational mix of heterogeneous firms which differ with respect to their power allocation inside the corporation. In section 3 we examine how factor markets interact with firms' optimal choice of organization. We show that the mode of firm organization matters for incentives inside the firm at intermediate start up costs of a firm only. Furthermore, we show in this section how the scarcity of human capital in the economy leads to a 'war for talent' which, in turn, determines the mode of organization firms choose. We also present in this section what we call the Rybczynski Theorem of Firm Organization' with a novel feature of the old theorem that arises when firms' mode of organization is endogenous. Section 4 then examines how international trade is affecting corporate organization in two dissimilar countries. We show that international trade may lead to the emergence of the 'talent firm' and to convergence in corporate cultures across countries. Finally, we explore in this section how corporate organization determines the pattern of trade. Section 5 concludes.

2 A Model with Endogenous Firm Organizations

Consider an economy which produces the two goods X and Y with the two factors of production labor L and human capital H . Good X is assumed to be more skill intensive than good Y . Consumers preferences over the two goods X and Y are

$$U(X, Y) = X^a Y^{1-a} \quad \text{with} \quad X = \left[\int_0^n x(i)^\gamma di \right]^{\frac{1}{\gamma}} \quad \text{and} \quad 0 \leq \gamma \leq 1 \quad (1)$$

where $x(i)$ is consumption of variety i of good X with γ as the degree of product differentiation between different varieties of X . Sector Y consists of homogenous goods produced under perfect competition with a constant returns to

scale technology given by the unit production costs $c_Y(w, q)$ where w and q are the wage rates for unskilled and skilled labor, respectively. Sector X consists of n horizontally differentiated goods produced under monopolistic competition with free entry of the Dixit and Stiglitz type.

2.1 'Formal' and 'Real' Power in the Firm

In the X -sector there are n firms with a simple hierarchy consisting of a firm (the principal P) and a skilled division manager (the agent A). In each firm the CEO/owner hires a skilled manager to start a firm and employs unskilled workers to produce. There are ex ante m alternative ways to run the firm which differ in terms of production costs. We assume that among these projects only two are worth doing from the perspective of both parties. One project has marginal cost of production c_B in terms of unskilled labor and is the "best project" for the CEO/owner in the sense that it yields the highest possible profit B among the m alternatives.⁵ The other project has marginal costs of production c_b in terms of unskilled labor and is the "best project" for the agent yielding the highest possible non pecuniary benefit b for the agent. To make things interesting, we assume that the firm produces with lower costs when the principal's best project is implemented $c_B < c_b = \varphi c_B$ with $\varphi > 1$ so that there is a potential conflict of interest between the firm and her agent. The idea here is that when the agent's best project is implemented he may not choose the cost minimizing project but rather one with high perks for him.

Both parties may acquire information on possible ways to run the firm. However, we assume that the CEO has managerial overload. By spending some unskilled labor resource L , the principal learns the payoffs of all projects with probability $E = \text{Min}\left(1, L^{\frac{1}{2}}\right)$ and remains uninformed with probability $1 - E$.⁶ This generates convex costs of information collection $g_P(E) = wE^2$. The more information the CEO collects, the higher is the marginal costs of further information. Similarly, by exerting some effort $g_A(e) = ke$ with $e \in [0, \bar{e}]$, and $k < b$ the skilled agent learns the payoff of all projects with probability e and remains uninformed with probability $1 - e$.⁷ We suppose 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 receives a fixed wage q equal

⁵In later sections B is endogenized and shown to be decreasing in variable cost (wages of unskilled workers).

⁶The idea here is that the principal/owner of the firm becomes an owner of the firm not because of her skills but rather because of luck to happen to be born in a family with wealth. A dynamic interpretation of the low skill assumption is that the principal has become an owner of the firm because of her skills in the past which have become obsolete in times of rapid technological change. She then has to hire a young agent equipped with skills compatible with today's technology.

⁷For convex rather than linear manager's cost of information collection see footnote 11.

to his opportunity costs. All his incentives to gather information on projects will be directly related to the private non pecuniary benefit b he gets from his "best" project.

We turn now to the distinction between *formal* and *real power* in the firm. The payoffs of both parties depend on which party's project is implemented. We denote αB with $(0 \leq \alpha \leq 1)$ as the principal/owner's expected benefit when the agent's preferred project is implemented and βb with $(0 \leq \beta \leq 1)$ as the agent's expected benefit when the principal's preferred project is implemented. α and β are congruence parameters capturing the degree of conflict between the principal and her agent. The lower α or β , the more is each party's respective benefit reduced when the other party's project is implemented. B and b are supposed to be known ex ante though the parties do not know ex ante which project yields such payoff. We assume also that, among the m projects, there are some with very high negative payoffs to both parties, implying that choosing randomly a project without being informed is not profitable to both agents who instead prefer to do nothing (project 0). This aspect, together with the fact that each uninformed party prefers to rubber-stamp the other informed's party suggestion to do nothing, implies that private information about payoffs gives decision control to the informed party. In this case, the informed party has "*real power*" 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*".

In the X-sector, the principal chooses between three modes of organizations to maximize her utility: the P-organization in which she has formal power, the A-organization in which the CEO/owner delegates formal power to the skilled division manager, and the single managed O-organization in which the CEO/owner has formal power without an internal hierarchy (in which the agent exerts minimum effort).⁸

We first compute the Nash equilibrium in information collection and the corresponding payoffs under the P-organization and under the A-organization, respectively.⁹ Then we examine which of these organizations yields higher utility to the principal and is preferred by her.

2.1.1 P- Organization

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

⁸The single managed O-firm corresponds to the Dixit and Stiglitz firm.

⁹We postpone the analysis of the O-organization to the next section.

$$\begin{aligned}
u_P &= EB + (1 - E)e\alpha B - wE^2 \\
u_A &= E\beta b + (1 - E)eb - ke
\end{aligned}$$

With probability E , the CEO/owner becomes fully informed about her payoffs and picks her preferred project with monetary payoff B , while the agent receives only the expected private benefit βb . With probability $1 - E$, the principal remains uninformed about payoffs. The agent may then learn the payoff with probability e and suggest his best project to the principal (who accepts it). The principal receives a monetary payoff αB while the agent gets his best private benefit b . In this case the informed agent has *real authority*. If none of the two agents finds out which is their preferred project, production does not take place (the other $m - 2$ projects yield large negative payoffs). If both agents engage in information collection, the decision rights reside in the agent with *formal authority* (the allocation of those rights is ex-ante contractible). wE^2 and ke are the costs of information collection of the principal and the agent, respectively.

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

$$\text{Principal: } B(1 - e\alpha) = 2wE$$

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

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

There are three possible Nash equilibria in effort levels. We select the equilibrium with the highest agent's effort which is also the one preferred by the principal.

The Nash equilibrium level of efforts under the P-organization is

$$\begin{aligned}
\text{a) } e_P^* &= \bar{e}, \text{ and } E_P^* = \frac{B(1 - \bar{e}\alpha)}{2w} && \text{when } B/w \leq \tilde{B}_P(\alpha) \\
\text{b) } e_P^* &= 0, \text{ and } E_P^* = \frac{B}{2w} && \text{when } B/w > \tilde{B}_P(\alpha)
\end{aligned}$$

with

$$\tilde{B}_P = \frac{2(1 - k/b)}{1 - \bar{e}\alpha}$$

$\tilde{B}_P$ is the threshold level of profits at which the agent's initiative is killed under the P-organization. For profit levels in terms of unskilled wages B/w above this threshold level, the principal exerts the effort level E_P^* which kills the initiative of the agent to acquire information.

The equilibrium expected utility of the principal under the P-organization is

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

2.1.2 A-Organization

Consider now the A-organization. Under this organization the principal delegates *formal power* to the agent. Both parties' expected payoffs are then

$$\begin{aligned} v_P &= e\alpha B + (1 - e)EB - wE^2 \\ v_A &= eb + (1 - e)E\beta b - ke \end{aligned}$$

Now the agent chooses his preferred project when informed. Under this organization the principal is prevented from overruling the agent's decision when both have acquired information. When the principal is informed and the agent is uninformed, the principal suggests her preferred project, which is then implemented by the agent. In this case the principal has *real power* in the firm.

The Nash equilibrium effort levels under the A-organization are

$$\begin{aligned} \text{a) } e_A^* &= \bar{e} \text{ and } E_A^* = \frac{B(1 - \bar{e})}{2w} \text{ when } B/w \leq \tilde{B}_A \\ \text{b) } e_A^* &= 0 \text{ and } E_A^* = \frac{B}{2w} \text{ when } B/w > \tilde{B}_A \end{aligned}$$

with

$$\tilde{B}_A = \frac{2(1 - k/b)}{\beta(1 - \bar{e})}$$

$\tilde{B}_A$ is the critical profit level at which the agent's initiative is killed under the A-organization.

The equilibrium expected utility of the principal under the A-organization is

$$\begin{aligned} \nu_P^* &= e_A^*\alpha B + (1 - e_A^*)E_A^*B - w(E_A^*)^2 \\ &= w(E_A^*)^2 + e_A^*\alpha B \end{aligned}$$

2.2 The Choice of Firm Organization

We now ask how the principal's control efforts and the agent's initiative in the firm respond to exogenous changes in the firm's real payoff in terms of unskilled labor B/w under the P-organization and under the A-organization, respectively. We solve for the subgame perfect equilibrium in effort levels E^*, e^* under each mode of organization to examine how effort incentives respond when real profits gradually increase from low levels $B/w < \tilde{B}_P$, to intermediate levels $\tilde{B}_P < B/w < \bar{B}$, to large levels $\bar{B} \leq B/w$.

Three cases can be distinguished.

Case 1: $B/w \leq \tilde{B}_P(\alpha)$ (*low profits*)

At this profit level both firm organizations keep the agent's initiative alive. The utility levels of the principal under the two forms of organization are simply

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

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

Case 2: $\tilde{B}_P(\alpha) < B/w \leq \tilde{B}_A$ (*intermediate profits*)

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

$$u_P^* = \frac{B^2}{4w} \quad \text{and} \quad v_P^* = \frac{(1 - \bar{e})^2 B^2}{4w} + \bar{e} \alpha B$$

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

$$B/w > \bar{B} = \frac{4\alpha}{2 - \bar{e}}$$

$\bar{B}$ is the threshold level of profits at which the principal is indifferent between loosing control in the firm while keeping the agent's initiative as in the A-organization and keeping control in the firm but loosing the agent's initiative.

Case 3: $\tilde{B}_A < B/w$ (*high profits*)

At this profit level both firm organizations kill the agent's initiative and provide the same level of control to the principal. Hence, they are just equivalent. However, if we allow for the lowest agent's effort e to be in the interval $[\underline{e}, \bar{e}]$ with $\underline{e}$ small but strictly positive, then the principal prefers the P-organization over the A-organization. We call the P-organization with minimum agent's effort the O-organization.¹⁰

We summarize the preceeding discussion in the following proposition.

Proposition 1 *Assume that*

$$\frac{2(1 - k/b)}{1 - \bar{e}\alpha} < \frac{4\alpha}{2 - \bar{e}} < \frac{2(1 - k/b)}{\beta(1 - \bar{e})}$$

and let

$$\begin{aligned}\tilde{B}_P &= \frac{2(1 - k/b)}{1 - \bar{e}\alpha} \\ \bar{B} &= \frac{4\alpha}{2 - \bar{e}}\end{aligned}$$

For $B/w < \tilde{B}_P$, the P-organization yields higher utility to the principal than the A-organization with $e_P^* = \bar{e}$ and $E_P^* = \frac{B(1-\alpha\bar{e})}{w}$. For $\tilde{B}_P < B/w < \bar{B}$, the principal prefers the A-organization over the P-organization with $e_A^* = \bar{e}$ and $E_A^* = \frac{B(1-\bar{e})}{w}$. Finally, for $\bar{B} \leq B/w$, the O-organization (P-organization without agent's effort) yields higher utility to the principal compared to the A-organization with $e_P^* = 0$ and $E_P^* = \frac{B}{2w}$.¹¹

Intuitively, the mode of organization matters for incentives inside the firm at intermediate levels of profits only. At low and high profit levels, there is no trade-off between control and initiative as is the case in a single AT-firm when the market environment is ignored. At low levels of B/w , the principal monitors and

¹⁰The O-organization can be thought of as a single managed P-firm (run by the principal) without an internal hierarchy. The skilled agent is employed but is not doing anything useful, since the agent's effort is assumed not to be contractible.

¹¹When the principal and the agent both have convex costs of information collection then it is difficult to get specific results. However, it is still the case that for a sufficiently large conflict of interest between the principal and her agent (for small α and β) the P-organization yields a higher utility to the principal for low levels of B/w and the O-organization yields a higher utility to the principal for high levels of B/w compared to the A-organization. A relevant trade-off between the P-organization and the A-organization can occur only at intermediate values of B/w . The specification on information costs we take in the paper provides then a simple parametric example where such a trade-off between control and initiative can be spelled out clearly and can be embedded in a general equilibrium trade framework.

intervenes little because her stakes are small and she cares little. Therefore, the principal chooses the P-organization as it gives sufficient initiative to her agent. At high levels of B/w , the principal's stakes are so large that she intervenes even under the A-organization leading to minimum effort by the agent also in the A-organization when the principal delegates formal control to her agent. Therefore, she might as well keep control by choosing the O-organization. At intermediate levels of B/w there is a trade-off between control and initiative and the principal delegates formal power to her agent to keep his initiative and the A-firm emerges as the optimal mode of organization.

2.3 Product Markets

In this section we endogenize the firm's profits B by product market competition of the Dixit and Stiglitz type. Given preferences as expressed in (1), demand for goods X and Y can be written as

$$Y^D = \frac{a}{p_Y} R \quad \text{and} \quad x(i) = \frac{(1-a)R}{\int_0^n p(j)^{-\frac{\gamma}{1-\gamma}}} p(i)^{-\frac{1}{1-\gamma}} = A p(i)^{-\frac{1}{1-\gamma}} \quad (2)$$

with p_Y the price of good Y , $p(i)$ the price of variety i of good X , R is total income, and A is a convenient constant reflecting general equilibrium effects.

Perfect competition in sector Y provides the standard price equals marginal cost relationship

$$p_Y = c_Y(w, q)$$

For product varieties in sector X with marginal cost of production $w.c(i)$ monopolistic profit maximization results in the standard mark-up relationship

$$p(i) = \frac{w.c(i)}{\gamma} \quad (3)$$

with firm's profits as

$$\pi(i) = (1-\gamma)\gamma^{\frac{\gamma}{1-\gamma}} A [w.c(i)]^{-\frac{\gamma}{1-\gamma}}$$

We can express the firm's/principal's profits as before in the partial equilibrium setting by

$$\alpha = \varphi^{-\frac{\gamma}{1-\gamma}} \quad \text{and} \quad B = (1-\gamma)\gamma^{\frac{\gamma}{1-\gamma}} A [w.c_B]^{-\frac{\gamma}{1-\gamma}} \quad (4)$$

The congruence parameter α is now related to the two parameters φ and γ . $\varphi = c_b/c_B$ gives the cost differential of power in the firm. It measures by how

much production costs of the firm $wc(i)$ go up when the agent has control in the firm rather than the principal, $\varphi > 1$. The larger φ the less cost efficient is the firm under the A-organization compared to the P-organization and thus the more it matters for profits who runs the firm.

2.3.1 Free Entry

Firms enter the X-sector until profits are driven down to cover the fixed start up costs of a firm. The free entry conditions for the three possible organizational equilibria are

P-organization with $e_P^ = \bar{e}$*

$$u_P^* = w(E_P^*)^2 + \bar{e}\alpha B - q = 0$$

The first two terms are the equilibrium expected current profits of the firm. q is the start-up cost of a firm. To start a firm the principal has to hire a skilled agent as a manager. After substituting the condition can be restated as

$$\frac{(1 - \bar{e}\alpha)^2}{4} \left(\frac{B}{w}\right)^2 + \bar{e}\alpha \left(\frac{B}{w}\right) = \frac{q}{w} \quad (5)$$

A-organization with $e_A^ = \bar{e}$*

$$u_A^* = w(E_A^*)^2 + \bar{e}\alpha B - q = 0$$

which can be rewritten to

$$\frac{(1 - \bar{e})^2}{4} \left(\frac{B}{w}\right)^2 + \bar{e}\alpha \left(\frac{B}{w}\right) = \frac{q}{w} \quad (6)$$

O-organization with $e_0^ = 0$*

$$u_0^* = w(E_0^*)^2 - q = 0$$

which can be rewritten to

$$\frac{1}{4} \left(\frac{B}{w}\right)^2 = \frac{q}{w} \quad (7)$$

2.3.2 Factor Markets

We turn now to factor markets. The factor demand depends on which organizational equilibrium firms choose. To save space we focus here on factor markets in a P-organizational equilibrium and refer to the appendix for the factor markets for the A- and O-organizational equilibria.

In the perfect competitive Y sector the demand for unskilled and skilled labor, respectively are given by $a_Y^L Y$ and $a_Y^H Y$. a_Y^L and a_Y^H are the unit input requirements in sector Y and are given by shepard's lemma

$$a_Y^L(w, q) = \frac{\partial c_Y(w, q)}{\partial w} \quad \text{and} \quad a_Y^H(w, q) = \frac{\partial c_Y(w, q)}{\partial q}$$

Denote $\theta_L(w, q)$ and $\theta_H(w, q)$ as the unskilled and skilled labor share cost in the Y sector

$$\theta_L(w, q) = \frac{w a_Y^L(w, q)}{p_Y} \quad \text{and} \quad \theta_H(w, q) = 1 - \theta_L(w, q) = \frac{q a_Y^H(w, q)}{p_Y}$$

Firms in the X sector hire a skilled manager to find and supervise a production project and employ unskilled workers to produce. The firm's output in the monopolistic competitive X sector is given by

$$x(i) = \gamma^{\frac{1}{1-\gamma}} A [w c(i)]^{-\frac{1}{1-\gamma}} \quad (8)$$

From this, we may derive the total demand for unskilled labor in the X sector for each organizational equilibrium (depending on whether firms will choose the P-organization, A-organization, or the O-organization) using the law of large numbers and the fact that the probability for a firm to run a production project with unit costs of unskilled labor $c(i)$ is also the fraction of firms having such a cost structure.

Consider the aggregate labor demand for unskilled labor under the formal P-organization. It can be written as

$$L_P^D = n [E_P^* c_B x_B + (1 - E_P^*) e_P^* c_b x_b] + n (E_P^*)^2 + a_Y^L Y$$

The demand for unskilled labor has three components, the labor demand from the monopolistic X-sector given by $n [\dots]$, the labor demand from the competitive Y-sector given by $a_Y^L Y$, and the labor demand from the principal's unskilled monitoring activity $n (E_P^*)^2$. The first term in the first bracket is the demand for unskilled labor from P-firms for which the principal's preferred project is implemented. Their fraction is (by the law of large numbers) E_P^* under the P-organization with the firm's individual labor demand $c_B x_B$. Similarly, the second

term in the first bracket is the demand for unskilled labor from *real* A-firms for which the agent's preferred project is implemented. Their fraction is $(1 - E_P^*)e_P^*$ under the P-organization with the firm's individual labor demand $c_b x_b$. Note that even under a *formal* P-organizational equilibrium there will be a share of *real A-firms* in the X-sector, when the principal in these firms decides not to get informed in which case the agent has real power (a *real A-firm*). We denote the mix of P-firms and *real* A-firms as the 'organizational mix' of firms in the X-sector in a P-organizational equilibrium. In the second bracket of the RHS, the term E_P^{*2} captures the unskilled labor of direct monitoring by the principal. We assume here that the principal can use a monitoring technology produced with unskilled labor to supervise projects. Substituting x_B , x_b and c_b and rearranging gives

$$L_P^D = n \frac{\gamma}{1-\gamma} \left(\frac{B}{w} \right) [E_P^* + (1 - E_P^*)\alpha e_P^*] + n(E_P^*)^2 + a_Y^L Y \quad (9)$$

Similarly, the aggregate demand for human capital under the P-organization is given by

$$H_P^D = n + a_Y^H Y \quad (10)$$

The first term n reflects the fact that each monopolistic firm hires a skilled agent to run the firm. The second term is the demand for skilled labor from sector Y .¹²

Using the goods market equilibrium for sector Y and (2) we get

$$Y = \frac{a}{p_Y} \quad R = \frac{a}{1-a} \frac{\int_0^n p(j)^{-\frac{\gamma}{1-\gamma}}}{p_Y} \quad A = \frac{a}{1-a} \left(\frac{B}{p_Y} \right) \frac{n}{1-\gamma} [E_P^* + (1 - E_P^*)\alpha e_P^*]$$

Denote $\nu_P = E_P^* + (1 - E_P^*)\alpha e_P^*$ as the 'organizational mix' of firms in the X sector.

The labor demand functions hold for regions of profit levels B/w for which the P-organization is an equilibrium. Using Proposition 1 from the previous section (9) and (10) hold for

$$B/w < \tilde{B}_P(\alpha) \text{ and } E_P^* = \frac{(1 - \bar{e}\alpha)}{2} \frac{B}{w}, \quad e_P^* = \bar{e} \quad (11)$$

Substituting (11) in (9), finally results in the following aggregate demand for labor and human capital

¹²We assume here that skilled workers behave somewhat myopic when considering to which of the two sectors to move. They compare the monetary wage in the X - and Y -sector and ignore the non-pecuniary benefits they receive when employed as a manager in the X -sector. We assume here that skilled workers learn about the non-pecuniary benefit as managers only ex-post after being hired in the firm. This assumption simplifies the analysis considerably without being central to our argument.

$$\begin{aligned}
L_P^D &= n \frac{\nu_P}{1-\gamma} \left(\frac{B}{w} \right) \left[\gamma + \frac{a}{1-a} \theta_L(w, q) \right] + n \left(\frac{B}{w} \right)^2 \frac{(1-\bar{e}\alpha)^2}{4} \\
H_P^D &= n + n \frac{\nu_P}{1-\gamma} \left(\frac{B}{w} \right) \frac{a}{1-a} \theta_H(w, q) \frac{w}{q}
\end{aligned} \tag{12}$$

with the 'organizational mix' as

$$\nu_P = \frac{(1-\bar{e}\alpha)^2}{2} \left(\frac{B}{w} \right) + \bar{e}\alpha \tag{13}$$

As can be seen aggregate factor demand depends on the number of firms in the X-sector n , on the organizational mix of firms in the X-sector ν_P , and on profits B/w determining the size of the Y-sector and the principal's monitoring activity inside firms in the X-sector.

The market clearing conditions for unskilled and skilled labor can then be generally stated as

$$L_i^D = L \text{ for } i \in \{P, A, 0\}$$

$$H_i^D = H \text{ for } i \in \{P, A, 0\}$$

3 Corporate Organization and the Scarcity of Talent

We are now in a position to describe the equilibrium under autarky. The analysis proceeds in three stages. First, we analyze the factor market clearing free entry equilibria treating firms' organizational choice as given. Then we derive how the factor endowment of a country affects its firms' mode of organization. Finally, we determine how international trade is affecting these organizational equilibria.

3.1 Equilibrium in a Closed Economy

We start now to describe the equilibrium under autarky contingent on the organizational equilibrium which will emerge inside the firm.

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

The endogenous variables determining the equilibrium in the P-regime are the stakes of the firm B/w , the "organizational mix" of firms in the X-sector

ν_P , the number of monopolistic firms n , and the wage gap between skilled and unskilled labor q/w . Using the two factor market clearing conditions (12), the condition determining the organizational mix (13), and the free entry condition (5) and accounting for the fact that because of the homogeneity property of the cost functions, the unskilled and skilled labor cost shares $\theta_L(w, q) = 1 - \theta_H(w, q)$ depend on the relative wage q/w only, we get

$$\frac{L}{H} = \frac{\frac{\nu_P}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L(q/w)\right] + \left(\frac{B}{w}\right)^2 \frac{(1-\bar{e}\alpha)^2}{4}}{\frac{\nu_P}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \frac{[1-\theta_L(q/w)]}{q/w} + 1}$$

which can be simplified to

$$\frac{L}{H} = \bar{\Theta}_P\left(\frac{B}{w}\right)$$

with $\bar{\Theta}_P(\frac{B}{w})$ as the required real profit level which guarantees factor market clearing. $\bar{\Theta}_P$ will be upward sloping under the following assumptions.

$$\text{Assumption A.1 : } \quad \gamma + \frac{a}{1-a}(2\theta_L - 1) > 0$$

Good Y is sufficient unskilled labor intensive, ie θ_L is large enough.

$$\text{Assumption A.2: } \quad \theta_L \text{ is weakly increasing in } q/w$$

Assumption A.2 says that the cost share of unskilled labor for good Y θ_L is increasing in q/w . This will be the case when the elasticity of substitution σ_Y between skilled and unskilled labor for good Y is larger than 1.

We show in the appendix that under assumptions A.1 and A.2, $\bar{\Theta}_P$ is increasing in B/w . Note also that $\lim_{B/w \rightarrow \infty} \bar{\Theta}_P(B/w) = +\infty$ and $\bar{\Theta}_P(0) = 0$

- *Equilibrium with A-organization and $e_P^* = \bar{e}$*

Similarly, with the same procedure as before using the two factor market clearing conditions (18), the condition for the organizational mix (19), and the free entry condition (6), we get the free entry organizational A-equilibrium as

$$\frac{L}{H} = \frac{\frac{\nu_A}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{(1-\bar{e})^2}{4}}{\frac{\nu_A}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \frac{[1-\theta_L]}{q/w} + 1}$$

which simplifies to

$$\frac{L}{H} = \bar{\Theta}_A\left(\frac{B}{w}\right)$$

$\bar{\Theta}_A$ is again upward sloping in B/w under assumptions A.1 and A.2. Furthermore, $\lim_{B/w \rightarrow \infty} \bar{\Theta}_A(B/w) = +\infty$ and $\bar{\Theta}_A(0) = 0$. Also, because of $\nu_A < \nu_P$, $\bar{\Theta}_A(\frac{B}{w}) < \bar{\Theta}_P(\frac{B}{w})$ for all values of $B/w > 0$.

- *Equilibrium with O-organization and $e_0^* = 0$*

Analogously, the free entry organizational O-equilibrium is given by

$$\frac{L}{H} = \frac{\frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{1}{4}}{\frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \frac{[1-\theta_L]}{q/w} + 1}$$

which can be restated as

$$\frac{L}{H} = \bar{\Theta}_0\left(\frac{B}{w}\right)$$

with the same properties as before for $\bar{\Theta}_0$.

Finally, for small values of B/w , the $\bar{\Theta}$ schedules can be ranked as $\bar{\Theta}_0(B/w) < \bar{\Theta}_A(B/w) < \bar{\Theta}_P(B/w)$. For large values of B/w , it holds that $\bar{\Theta}_0(B/w) > \bar{\Theta}_A(B/w)$. Hence, there is a least one value of B/w such that the two curves $\bar{\Theta}_0(B/w)$ and $\bar{\Theta}_A(B/w)$ cross each other. For expositional ease, we will assume that they only cross once. A typical example that satisfies such a case is when $\theta_L = 1$ and the competitive sector Y uses unskilled labor only.

3.2 Factor Endowment and Firm Organization

Next, we want to examine how a country's relative factor endowment $\frac{L}{H}$ determines the mode of organization its firms choose. This is done in Figure 1. The three schedules P , A and O on the right side of Figure 1 correspond to $\bar{\Theta}_P(B/w) = L/H$, $\bar{\Theta}_A(B/w) = L/H$ and $\bar{\Theta}_0(B/w) = L/H$ that we have just derived. They give the real operating profits in terms of unskilled labor consistent with factor market clearing under a P-, A-, and O-organizational equilibrium, respectively. The three schedules are upward sloping in $\frac{L}{H}$, because as the country becomes more unskilled labor rich there is an excess supply of labor and real profits B/w have to increase to restore factor market equilibrium. An increase in real profits increases the demand for unskilled labor for two reasons. First, production in the X- and Y-sector expands, and this expansion is biased towards the less skill intensive Y-sector. This is a standard Rybczynski effect on the output mix. Second, the firm controls more as her stakes rise with an increase in profits. Recall, that the principal's monitoring activity is assumed to be low skill intensive. Via this channel the factor endowment of a country has a direct influence on the behavior inside the firm.

The A-schedule lies above the P-schedule, since A-firms in which the skilled agent runs the firm, are more skill intensive organizations than P-firms. Thus, it requires larger real profits to clear factor markets in an A-equilibrium compared to a P-equilibrium. The relative demand for unskilled labor is lower in an A-equilibrium, because in A-firms the principal monitors less and firms' output is lower compared to P-firms. Thus, for a given relaxation in the resource constraint real profits have to increase by more in the A-equilibrium compared to the P-equilibrium to still satisfy the factor market clearing condition.

O-firms and A-firms cannot be ranked unambiguously in terms of factor intensity. The O-curve is above the A-curve for low levels of $\frac{L}{H}$ and below the A-curve for high levels of $\frac{L}{H}$. There are two conflicting effects. At low levels of $\frac{L}{H}$, the stakes of the firm are low and thus the principal exerts little control in the O-firm. This in turn generates few opportunities for profitable production projects compared to A-firms. As production is using unskilled labor, the demand for unskilled labor is then smaller in the O-equilibrium compared to the A-equilibrium. Thus, a relatively larger increase in real profits is required to absorb the relative excess supply of unskilled labor in the O-equilibrium. At large levels of $\frac{L}{H}$, the stakes of the firm are large and the relative demand for unskilled labor is larger in the O-equilibrium than in the A-equilibrium both because output per firm and information collection by the principal are larger in O-firms compared to A-firms. Therefore, real profits need to increase by less in the O-equilibrium compared to the A-equilibrium to clear the factor market.

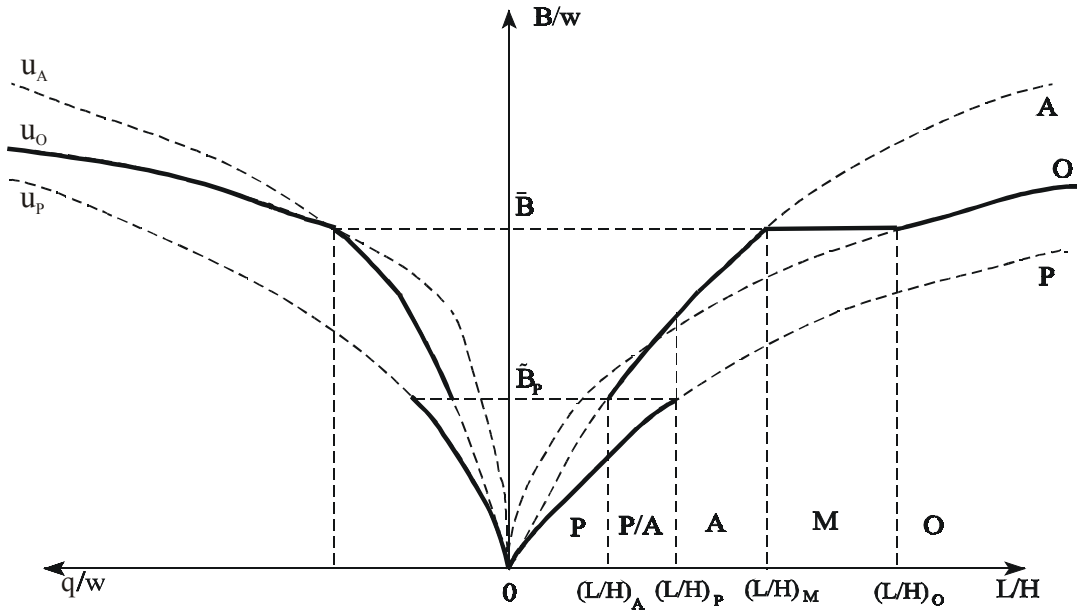


Figure 1: Factor Endowment and Organizational Equilibrium

The left side diagram of Figure 1 gives the free entry conditions u_P^* , u_A^* , and u_0^* for P-, A-, and O-firms, respectively from (5), (6), and (7) which relate the firms' operating profits B/w to their fixed costs of market entry. u_P^* , u_A^* , and u_0^* may be called the "war for talent" curves. Starting a firm involves hiring a skilled agent for information collection who is paid a wage q . Thus, the firm's start up costs in terms of unskilled labor are given by the wage gap q/w . The wage gap q/w increases with B/w , because when real operating profits increase new firms want to enter the market. Firms can enter and run a firm only by hiring a skilled agent. Thus, market entry is constraint by the amount of available human capital in the country. Firms compete for the scarce talent of agents available in the economy to start new firms. As the resource constraint for human capital binds, market entry cannot happen and the relative wage for talent q/w increases to meet the demand for skilled agents.

Returning to the right side diagram of Figure 1 we turn now to the firms' optimal choice of organization which from Proposition 1 is determined by the two horizontal lines $\tilde{B}_P$ and $\bar{B}$. The $\tilde{B}_P$ -line captures the cost of having control in the firm in terms of the loss of the agent's initiative. The $\bar{B}$ -line captures the gain of having control in the firm in terms of the firm's profits. From Proposition 1 we know that for profit levels below the $\tilde{B}_P$ -line the benefit of control outweighs its costs and firms choose the P-organization. In fact, at these levels of profits there are no costs of control, since the agent's initiative can be kept alive under the P-organization. For profit levels B/w inbetween the $\tilde{B}_P$ - and $\bar{B}$ -lines, the cost of control outweighs the benefit and firms go for the A-organization. For profit levels above the $\bar{B}$ -line, the benefit of control again outweighs its costs and firms choose the O-organization. There is again no trade-off between control and initiative. Profits are so large that the principal wants control and kills the initiative of the agent.

Clearly, an organizational equilibrium has to be both consistent with factor market clearing and consistent with the firm's optimal choice of organization. Hence, building on Proposition 1, we derive the pattern of symmetric organizational equilibria in the following proposition.

Proposition 2 *Let the following factor endowments $(L/H)_P$, $(L/H)_A$, $(L/H)_M$, and $(L/H)_O$ be given by $(L/H)_P = \bar{\Theta}_P(\tilde{B}_P(\alpha))$, $(L/H)_A = \bar{\Theta}_A(\tilde{B}_P(\alpha))$, $(L/H)_M = \bar{\Theta}_M(\bar{B}(\alpha))$ and $(L/H)_O = \bar{\Theta}_0(\bar{B}(\alpha))$. Then, for $L/H < (L/H)_A$, all firms adopt a P-organization;*

for $L/H \in [(L/H)_A, (L/H)_P]$, there are multiple equilibria, firms either adopt a P-organization or an A-organization;

for $L/H \in [(L/H)_P, (L/H)_M]$, all firms adopt an A-organization;

for $L/H \geq (L/H)_O$, all firms adopt an O-organization.

These organizational equilibria are depicted in bold in Figure 1. The right diagram of Figure 1 illustrates how factor market clearing interacts with the firm's optimal choice of organization. The bold line in the right diagram describes the nature of the factor market clearing organizational equilibria as a function of a country's factor endowment. The left diagram of Figure 1 gives the free entry conditions and the firm's start up costs which correspond to these equilibria. With an increase in L/H , the equilibrium firm organization moves from the P-firm in which power is concentrated at the top of the corporate hierarchy, to the A-firm in which the talented manager runs the firm, and finally to the single managed O-firm in which the firm is run without her manager's cooperation.¹³ As the country becomes more unskilled labor rich, the fixed costs of market entry increase and thus firms require larger operating profits to enter the market. With the increase in the relative wage for skilled labor q/w , it becomes more expensive to start a firm. This means that the stakes of the firm rise with an increase in L/H . As the stakes rise the principal's incentive to take control in the firm increases.¹⁴

Initially, at a low ratio of L/H , the start up costs of a firm are not too large. Therefore, the principal monitors only little and does not kill the initiative of the agent under the P-organization. Hence, firms choose the latter. However, when the ratio of L/H keeps increasing and takes intermediate levels in the region of $[(L/H)_A, (L/H)_M]$, the relative wage for manager talent and thus firms' required stakes to enter the market are high enough to kill the initiative of the agent under the P-organization. The principal delegates power to the skilled agent to prevent the loss of his enthusiasm and the A-organization emerges as a free entry factor market clearing equilibrium. The empowerment of talent stops to work as an incentive device for initiative, however, when the ratio of L/H keeps increasing further in the region of $[(L/H)_0, \infty]$. The start-up costs and stakes of the firm are now so large that the firm wants control no matter what and the single managed O-firm without the agent's initiative emerges as the equilibrium organization.

Note that in the range of factor endowments of $[(L/H)_A, (L/H)_P]$ the model produces multiple organizational equilibria with *all* principals in the monopolistically competitive sector either delegating (A-organizational equilibrium) or not delegating power (P-organizational equilibrium). At this region of factor endowments the attractiveness between these two modes of organizations depends on

¹³A move from the P-organization to the A-organization in which the skilled manager runs the firm can be thought of as the firm outsourcing the division to her manager.

¹⁴The monotone increasing function between the relative factor endowment of a country L/H and the free entry profit level B^*/w shows how the AT model of the firm speaks to the HK theory of international trade. With an increase in the ratio L/H the required profits to enter the market and thus the free entry stakes of the firm rise. Via this channel the factor endowment of a country affects the behavior inside the firm.

the organizational decision taken by other firms in the market. Each firm individually would choose the A-organization at this range of L/H , since in between the two horizontal lines $\tilde{B}_P$ and $\bar{B}$ the A-organization is optimal. However, when the firm anticipates that all other firms will choose the P-organization, then she also anticipates that the equilibrium relative wage for skilled labor q/w will be lower as well. Thus, an individual A-firm with larger marginal costs of production $c_b > c_B$ compared to P-firms will then have to pay a larger wage to its unskilled workers w . As a result, the firm anticipates that with production costs $w.c_b$ it will not be profitable to enter with an A-organization. Thus, the firm's best choice will be to choose a P-organization as well. Similarly, when the firm anticipates that all other firms will choose the A-organization, then she expects a larger equilibrium relative wage for skilled labor and thus the firm can profitably enter with an A-organization as well.

Note further, that the multiplicity of equilibria disappears for low and large values of L/H because in each of these cases the start up costs and thus the entry stakes of the firm are either so low or so large that all firms will find it profitable to either choose the P-organization at levels of L/H below $(L/H)_A$ or to opt for the A-organization at levels of L/H above $(L/H)_P$ whatever the other firms' organizational modes. There is no need to coordinate actions among firms in these cases.

Finally, note that for L/H in the region of $[(L/H)_M, (L/H)_O]$ unique mixed equilibria exist with *some* principals delegating formal power (A-organizational equilibrium) and *some* principals keeping it to themselves (O-organizational equilibrium). If a pure equilibrium with A-organizations existed in this range, it had to be consistent both with factor market clearing (ie. B/w on the A-curve with $\bar{\Theta}_A(\bar{B}/w) = L/H$) and with the optimal choice of firm organization (ie. B/w below $\bar{B}$). As can be seen from Figure 1, this is clearly impossible as $\bar{\Theta}_A(.)$ is increasing in B/w and $\bar{\Theta}_A(B/w) = L/H > (L/H)_M = \bar{\Theta}_A(\bar{B})$. Similarly, if a pure equilibrium with O-organizations existed, it had to be consistent both with factor market clearing (ie. B/w on the O-curve with $\bar{\Theta}_O(B/w) = L/H$) and with the optimal firm organization (ie. B/w above $\bar{B}$). Again, this is clearly impossible as $\bar{\Theta}_O(.)$ is increasing in B/w and $\bar{\Theta}_O(B/w) = L/H < (L/H)_O = \bar{\Theta}_O(\bar{B})$. Hence, for factor endowments in this region a mixed equilibrium with A- and O-organizations exist. We explore these mixed organizational equilibria in more detail in the next section.

3.3 Rybczynski and Mixed Organizational Equilibria

By definition, in a mixed organizational equilibrium firms are indifferent between different modes of organizations. We know from Proposition 1 that whenever it is feasible (at sufficiently low real profit levels of $B/w \leq \tilde{B}_P$) the P-organization

is preferred over the other two organizations. Therefore, a real profit level at which firms are indifferent between the P-organization and the A-organization does not exist. Hence, the only candidate mixed equilibrium is between A-firms and O-firms. Firms will be indifferent between these two modes of organizations when they lead to the same operating profits given by $B/w = \bar{B}$.

Denote then λ as the fraction of firms choosing an A-organization in such a candidate mixed equilibrium. Using the law of large numbers aggregate factor demand is then

$$\begin{aligned} L_M^D &= \lambda L_A^D + (1 - \lambda) L_0^D \\ H_M^D &= \lambda H_A^D + (1 - \lambda) H_0^D \end{aligned}$$

with L_A^D and L_0^D as given in (18) and H_A^D and H_0^D as given in (23) and calculated for the indifference profit level $B/w = \bar{B}$.

The free entry condition for both A-firms and O-firms for the indifference profit level $\bar{B}$ is

$$\frac{(1 - \bar{e})^2}{4} (\bar{B}(\alpha))^2 + \bar{e} \alpha(\bar{B}) = \frac{1}{4} (\bar{B}(\alpha))^2 = \frac{q}{w} \quad (14)$$

which pins down uniquely the wage gap q/w in a mixed organizational equilibrium. $B/w = \bar{B}$ fixes uniquely the organizational mix of firms under the two organizations ν_A and ν_0 given in (19) and (24). Finally, since $\theta_L(w, q)$ is a function of the wage gap q/w only, it follows that the aggregate factor demands L_A^D , H_A^D , L_0^D , and H_0^D from A-firm and O-firms, respectively in such a mixed organizational equilibrium are also constant. The factor market clearing conditions can then be written as

$$\begin{aligned} \frac{L}{H} &= \mu \bar{\Theta}_A(\bar{B}) + (1 - \mu) \bar{\Theta}_0(\bar{B}) \\ &= \mu \left(\frac{L}{H} \right)_M + (1 - \mu) \left(\frac{L}{H} \right)_O \end{aligned}$$

with

$$\mu = \frac{\lambda H_A^D}{\lambda H_A^D + (1 - \lambda) H_0^D} \in]0, 1[$$

The following proposition summarizes the previous discussion and describes the nature of the mixed organizational equilibria.

Proposition 3 *The Rybczynski Theorem of Firm Organization*

- i) For each $L/H \in [(L/H)_M, (L/H)_O]$, there exists a unique mixed equilibrium with A-organizations and O-organizations with the following properties
- ii) Factor prices are fixed and do not depend on factor endowments.
- iii) The fraction of firms choosing an A-organization is given by

$$\lambda^* = \frac{\mu H_0^D}{(1 - \mu)H_A^D + \mu H_0^D}$$

with

$$\mu = \mu\left(\frac{L}{H}\right) = \frac{\left(\frac{L}{H}\right)_O - \frac{L}{H}}{\left(\frac{L}{H}\right)_O - \left(\frac{L}{H}\right)_M}$$

- iv) For all L/H outside the interval $[(L/H)_M, (L/H)_O]$ a mixed organizational equilibrium does not exist.
- v) For each $L/H \in [(L/H)_M, (L/H)_O]$, we have the Rybczynski Theorem of Firm Organization

$$\frac{d(1 - \lambda^*)}{1 - \lambda^*} > \frac{d\left(\frac{L}{H}\right)}{\frac{L}{H}} > 0 > \frac{d\lambda^*}{\lambda^*}$$

Proof in the Appendix

The intuition for Proposition 3 can again be illustrated with the help of Figure 1. The mixed equilibrium with A-organizations and O-organizations is in the region $[(L/H)_M, (L/H)_O]$ in which the $\bar{\Theta}_M$ -curve becomes horizontal at the profit level $\bar{B}$ at which the A-organization and the O-organization both lead to the same level of profits. As the relative supply of unskilled labor increases in this range, factor prices q/w remain fixed. To understand why this is happening, we turn to the positively sloped part of the A-curve at a profit level just below $\bar{B}$. As we move up along the A-curve in this range, production in the X-sector and Y-sector expands with an increase in L/H . Output becomes less skill intensive as the expansion is biased toward the unskilled intensive Y-sector. This is a standard Rybczynski effect on the output mix. Relative demand for unskilled labor increases as a result and factor prices q/w adjust along the u_A -curve in the left side diagram of Figure 1.

This sectoral reallocation along the A-curve takes place until we reach the indifference profit level $\bar{B}$. At this profit level a shift in the organizational mode takes place with an increase in L/H . Firms change their organization from A to O. This organizational change makes both production as well as monitoring activity less skill intensive. As a result, relative demand for unskilled labor increases. We move from a skill intensive organization in which the skilled agent runs the firm to an unskilled labor intensive organization in which the principal runs the firm.

Moreover, the organizational shift from A to O leads to an increase in output per firm in the X-sector which uses unskilled labor. If all firms would switch to the O-organization at once, there would be an excess demand for unskilled labor. In order for factor markets to clear, a fraction of firms λ remains with the skill intensive A-organization easing the demand for unskilled labor. The relative resource constraint μ captures the relative excess demand for unskilled labor when all firms switch to the O-organization which, in turn, determines the required fraction of firms staying with the A-organization to obtain factor market equilibrium. Rather than factor prices, the fraction of firms with an A-organization adjusts to guarantee factor market clearing. Thus, as we move along the flat part of the $\bar{\Theta}_M$ -curve, factor prices remain fixed and the organizational mix changes rather than the output mix as is the case along a movement on the A-curve. The organizational mix of firms is biased toward the unskilled intensive O-organization. This is a Rybczynski effect on the organizational mix rather than on the output mix as is usual in a standard Heckscher-Ohlin model in which the firm organization is exogenous.

4 Trade and the Emergence of the Talent Firm

We can now proceed to analyze how international trade is affecting a country's corporate organization. Suppose two countries North N and South S which differ in their factor endowments open trade with one another at zero transportation cost. N is endowed with L_N and H_N and S with L_S and H_S . Suppose that North is human capital rich and South is labor rich with $L_N/H_N < L_S/H_S$. Denote $L = L_N + L_S$ and $H = H_N + H_S$ as the world factor endowments.

In order to understand how trade is affecting the equilibrium choice of corporate organization, we consider a trading equilibrium with factor price equalization. Hence, the integrated world economy is equivalent to a single economy under autarky with factor endowments $L = L_N + L_S$ and $H = H_N + H_S$. We illustrate the effect of trade with the help of Figure 2 which reproduces Figure 1 for trade integration with factor price equalization. Suppose the factor endowment of North L_N/H_N happens to be below $(L/H)_A$ and that of the South L_S/H_S is above $(L/H)_O$. Thus, under autarky firms in N adopt a hierarchical P-organization in which the CEO has power at the top of the corporate hierarchy, while firms in S choose the single managed O-organization in which the CEO runs the corporation without her talented manager's cooperation. The corresponding relative wages for skilled labor q/w in the two countries are given by points N and S in the left diagram of Figure 2. What happens now when these two economies start to trade?

We know that the factor endowment of the integrated world economy $(L/H)_W$ will be somewhere between that of country N and country S . From Propositions 1 and 2 we also know that depending on which $(L/H)_W$ emerges in the world trading equilibrium, there are various organizational equilibria possible. One such outcome is a factor endowment of the integrated world economy $(L/H)_W$ in the interval $[(L/H)_P, (L/H)_M]$ in Figure 2 in which firms adopt an A-organization in the world trading equilibrium. How is this coming about? In the human capital rich North international trade leads to stronger specialization in the skill intensive monitoring activity resulting in a fall in the relative wage for unskilled labor and an increase in B/w . This, in turn, induces firm entry with competition for talent bidding up the start-up costs of firms with more monitoring by the principal and less initiative by the agent. At some point the principal delegates power to her agent to maintain his engagement. A shift from the P-firm to the A-firm occurs.

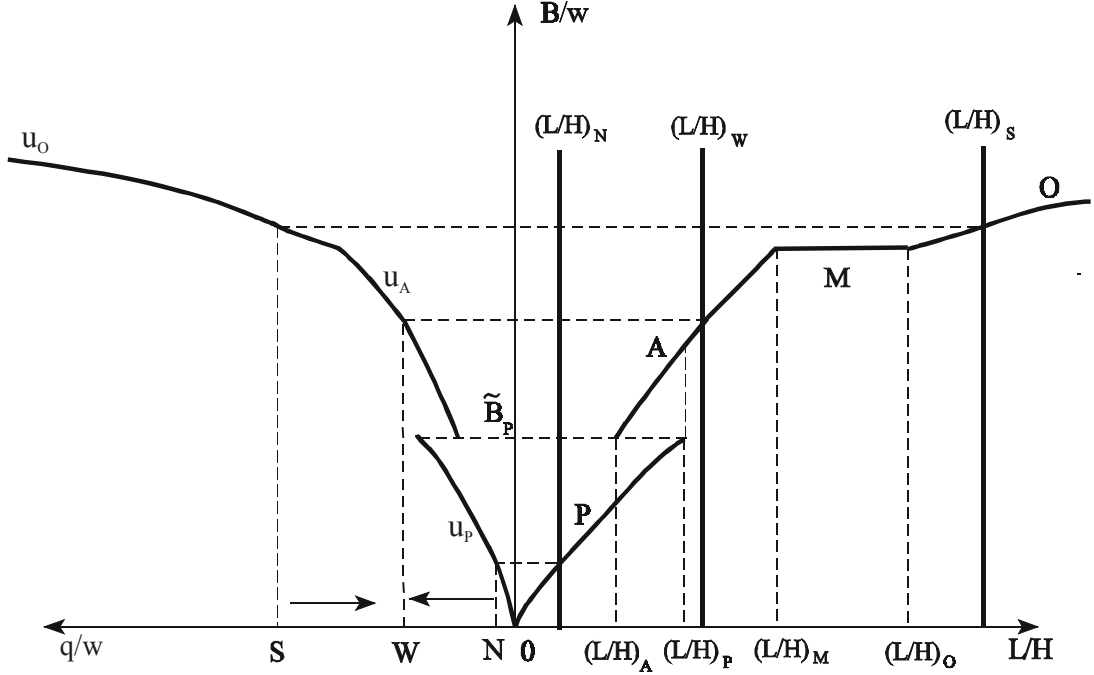


Figure 2: Trade Integration and Organizational Change

In the industrialized North international trade puts pressure on the demand for talent for three distinct reasons: skill-bias sectoral reallocation, the 'war for talent', and skill-bias organizational change. The first effect is the conventional skill bias resource reallocation from the Y- to the X-sector.¹⁵ In the 'war for

¹⁵The resource reallocation effect is degenerated in our model because we assume for simplicity that the X-sector uses no skilled labor in production, but only in monitoring.

talent' effect new firms enter the market and compete with incumbent firms for scarce manager talent in order to start a firm. The organizational change effect involves a shift from a low skill intensive organization to a skill intensive organization. These result in a widening of the wage gap in the North from point N to point W.

In the labor rich South trade leads to a resource reallocation toward the unskilled intensive Y-sector and to a decline in profits with some firms exiting from the X-sector lowering the start-up cost of firms. As there is less at stake, principals in South firms care less about control and more about gaining the talented agent's initiative and delegate power. A shift from the O-firm to the A-firm occurs. In the South, international trade eases the demand for skills because of an unskilled bias resource reallocation and the exit of some firms from the X-sector releasing manager talent. The increase in the relative demand for skills due to the skill bias organizational change from the O-firm to the A-firm is of second order. As a result, in the South the wage gap declines from point S to point W.

4.1 Convergence in Corporate Cultures

We have just seen that the North as well as the South converge to an A-organizational equilibrium in which the skilled manager has power in the corporation when both regions each start with a different corporate organization of a P-firm and an O-firm, respectively. How likely is it that organizational convergence will take place? We answer this question by using the technique of the edgeworth box of world factor endowments applied by Helpman and Krugman (1985). More specifically, for a given size of world factor endowments $L = L_N + L_S$ and $H = H_N + H_S$, the parallelogram in Figure 3 represents the distributions of factor endowments between the two economies which characterize a trade equilibrium with factor price equalization replicating the integrated world economy. We reverse now the question we ask in Figure 2 by starting the analyses with the assumption that in the integrated world economy an equilibrium with A-organizations has emerged. We now ask what distributions of factor endowments between North and South under autarky are consistent with this A-organizational equilibrium of the integrated world economy?

The vector NY of the parallelogram is the employment level of factors L and H in the Y-sector and the vector YS is the employment level of the two factors in the X-sector. Sector Y is less skill intensive than sector X. Because we start with the assumption that in the integrated world economy an equilibrium with A-organizations has emerged, the diagonal NS represents the factor endowment ratios of the integrated world economy $(L/H)_W$ at which both regions choose the

A-organization represented by $\{A; A\}$. The light rays from the origin of North N $(L/H)_A$ and $(L/H)_P$ are the threshold levels of factor endowment ratios at which an organizational change occurs which correspond to those in Figure 2. Similarly, the light rays from the origin of South S $(L/H)_M$ and $(L/H)_O$ are the threshold levels of factor endowment ratios at which an organizational shift occurs which again correspond to those in Figure 2. By symmetry we describe only what happens below the diagonal where the North is human capital rich. Thus, the area between the diagonal and the ray $(L/H)_P$ give distributions of factor endowments consistent with a world trade equilibrium of A-organizations in which firms in the North choose the A-organization under autarky. Similarly, the area between the ray $(L/H)_P$ and the ray $(L/H)_A$ give distributions of factor endowments consistent with a world trade equilibrium of A-organizations in which firms in the North choose either an A-organization or a P-organization. Finally, the area between the ray $(L/H)_A$ and the bold line of the parallelogram give distributions of factor endowments consistent with a world trade equilibrium of A-organization in which firms in the North choose the P-organization. A similar reasoning can be done from the perspective of the South. Thus, $\{P; O\}$ describes the distribution of factor endowments at which N has a P -equilibrium and S has an O -equilibrium under autarky. $\{A/P, O\}$ describes a situation in which North chooses either A-firms or P-firms, and South chooses O-firms.

As the factor content of consumption can be represented by a point on the diagonal, the volume of intersectoral trade increases with the distance to the diagonal. The further away from the diagonal the endowment point of the two countries, the larger the difference between North and South in factor composition and thus the larger the volume of trade (holding country size fixed). Thus, for given country size organizational convergence is the more likely the more dissimilar the two countries and the larger their trade volume.

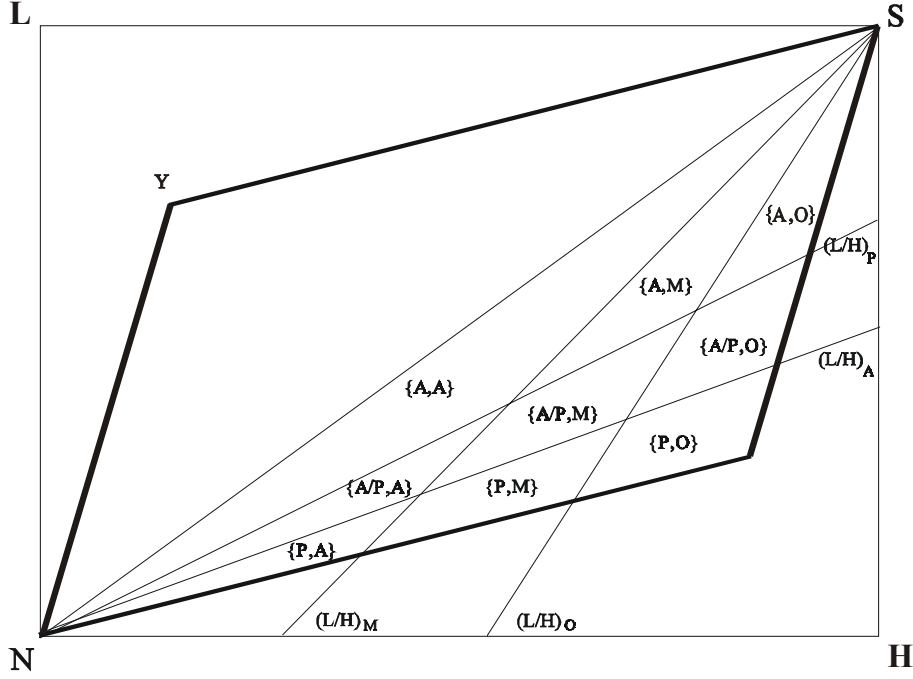


Figure 3: Integrated World Equilibrium and Organizational Convergence

4.2 Corporate Organization and the Pattern of Trade

So far we have examined how international trade is affecting corporate organization in the North and in the South. We turn now to corporate organization as a source of trade. In general, international trade is determined here by differences in factor proportions and by differences in labor productivity between N and S when they happen to start with different corporate organization under autarky like the P -organization and the O -organization, respectively as drawn in Figure 2. The factor endowment of the country determines the mode of organization its firms choose which, in turn, determines the level of productivity in the X -sector.

Consider, however, the case when the countries are endowed with factor endowments that happen to fall in the range of mixed equilibria $[(L/H)_M, (L/H)_O]$. In this range of relative factor endowments N and S will have different factor endowments with the same factor prices. They will, however, still trade with one another because of different corporate organization. The North located in the left region of $[(L/H)_M, (L/H)_O]$ will have a mix of A -firms and O -firms in which A -firms dominate. In the South located in the right region of $[(L/H)_M, (L/H)_O]$ the O -firms will dominate among A -firms and O -firms. When North and South start to trade, North moves to more O -firm in the integrated world economy

and releases some skilled labor. This, in turn, relaxes the resource constraint on talent. More firms find a skilled manager to start a firm and thus more varieties are produced and exported to South. South moves to more A -firms as a result of trade integration thereby releasing unskilled labor which is employed in the Y -sector. As a result, S imports varieties from N which are paid for by exports of Y -goods to N . In the region of mixed equilibria international trade has no effect on goods and factor prices. However, N and S still benefit from trade due to an increased varieties of goods.

Consider further the case when the countries are endowed with factor endowments that happen to fall in the range of multiple equilibria $[(L/H)_A, (L/H)_P]$. In this range of factor endowments N is only slightly richer in skilled labor compared to S . They may, however, have different corporate organization under autarky because firms' mode of organization depends on the organizational decision taken by other firms in the X -sector. Thus, firms in N might choose the P -organization and firms in S might opt for the A -organization. As a result, firms in the North will be more productive and the North will have a lower relative wage for skilled labor q/w both because it is richer in skills and because of using a more unskilled labor intensive mode of organization. In the South, A -firms will be less productive in production and South's relative wage for skilled labor will be higher both because it is less rich in skills and because it is using a more skill intensive organization. After trade integration different equilibria may occur. With factor price equalization in the two countries, one region will adopt the corporate organization of the other region depending on the coordination of expectations. This may result in merger waves (a shift from an A -organization to a P -organization) when S adopts North's corporate organization or in waves of outsourcing (a move from a P -organization to an A -organization) when N adopts South's mode of organization.¹⁶

4.3 Conclusion

In this paper we have developed a general equilibrium model of trade with differentiated and homogenous goods in which firms endogenously choose their mode of organization. The optimal firm organization is determined by the trade off between control of top management and the initiative of middle management. Depending on who has power in the firm we distinguish between three types of organizations: the P -organization in which power is concentrated at the top of the

¹⁶Note, however, that trade equilibria without factor price equalization may exist as well. Each country may produce varieties of the X -good with its corporate organization under autarky (P -firms in North and A -firms in South) without organizational convergence. Under these circumstances, North firms will be more productive in the X -sector than South firms. The model then generates endogenous differences in productivity levels due to different corporate cultures across countries with Ricardian features of trade.

corporate hierarchy (integration), the A-organization in which the talented division manager runs the firm (outsourcing), and the single managed O-organization without an internal hierarchy in which the firm is run without the talented manager's cooperation. There are two sources of comparative advantage in our model. The factor endowment of a country determines factor prices and with it the production and start-up costs of firms. The mode of organization determines the productivity and the skill intensity of firms. Hence, international trade is driven by differences in factor endowments, differences in the level of productivity, and differences in corporate organization across countries.

By making entry attractive, trade integration leads to a 'war for talent' in which entering firms compete with incumbent firms for scarce manager talent to start a firm. This, in turn, bids up the wage for manager talent and with it the start up costs of firms. As the stakes rise, the CEO of the corporation gets more involved in internal affairs of the firm potentially destroying her manager's initiative. To prevent this from happening the CEO delegates power to her talented manager and the 'talent firm' emerges as an equilibrium. Trade integration puts pressure on the demand for skills in rich economies for two novel reasons. First, because trade creates the 'war for talent'. Second, because trade leads to an economy wide shift in corporate organization from a low skill intensive organization (the *P*-firm in North and the *O*-firm in South) to a skill intensive organization (the *A*-firm). The organizational change towards skill intensive firms raises the relative demand for human capital. Furthermore, trade integration leads to convergence in corporate cultures across countries. The integrated world economy moves to an organizational equilibrium with flatter corporate hierarchies in which human capital has power in the corporation. Waves of outsourcing result as the world economy reorganizes and converges to the organizational equilibrium of the 'talent firm'. For given country size, the described organizational convergence across countries will be the more likely, the more countries differ in factor endowments and thus the more they trade with one another.

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Appendix

• Factor Demand in an A- and O-organizational Equilibrium

- *Labor demand under a formal A-organization*

Consider the aggregate demand for unskilled and skilled labor under the A-organization in which the principal delegates formal power to her skilled agent. It can be written as

$$\begin{aligned} L_A^D &= n [e_A^* c_b x_b + (1 - e_A^*) E_A^* c_B x_B] + n(E_A^*)^2 + a_Y^L Y \\ H_A^D &= n + a_Y^H Y \end{aligned} \quad (15)$$

The first term in the first bracket is the demand for unskilled labor from firms in which the agent has control. Their fraction is e_A^* with the firm's individual labor demand $c_b x_b$. The second term in the first bracket is the demand for unskilled labor from firms in which the principal has real power in the firm under the formal A-organization. Their fraction is $(1 - e_A^*) E_A^*$ with the firm's individual labor demand $c_B x_B$. The term E_A^{*2} is the unskilled labor cost of direct monitoring by the principal and $a_Y^L Y$ is again the demand for unskilled labor from sector Y .

We can rewrite these as

$$\begin{aligned} L_A^D &= n \frac{\nu_A}{1 - \gamma} \left(\frac{B}{w} \right) \left[\gamma + \frac{a}{1 - a} \theta_L(w, q) \right] + n(E_A^*)^2 \\ H_A^D &= n + n \frac{\nu_A}{1 - \gamma} \left(\frac{B}{w} \right) \frac{a}{1 - a} \theta_H(w, q) \frac{w}{q} \end{aligned} \quad (16)$$

with $\nu_A = e_A^* \alpha + (1 - e_A^*) E_A^*$, as the "organizational mix" in an A-equilibrium. These labor demand functions hold for regions of profits B/w for which the A-organization is an equilibrium. Using again Proposition 1, this holds when

$$\tilde{B}_P < B/w < \bar{B} \text{ and } E_A^* = \frac{B(1 - \bar{e})}{2w}, e_A^* = \bar{e} \quad (17)$$

Substituting (17) in (16) gives the following aggregate demand for labour and human capital

$$\begin{aligned} L_A^D &= n \frac{\nu_A}{1 - \gamma} \left(\frac{B}{w} \right) \left[\gamma + \frac{a}{1 - a} \theta_L(w, q) \right] + n \left(\frac{B}{w} \right)^2 \frac{(1 - \bar{e})^2}{4} \\ H_A^D &= n + n \frac{\nu_A}{1 - \gamma} \left(\frac{B}{w} \right) \frac{a}{1 - a} \theta_H(w, q) \frac{w}{q} \end{aligned} \quad (18)$$

with the 'organizational mix' as

$$\nu_A = \frac{(1 - \bar{e})^2}{2} \left(\frac{B}{w} \right) + \bar{e} \alpha \quad (19)$$

- *Labor demand under a formal O-organization*

Finally, we consider the aggregate unskilled and skilled labor demand under the O-organization. Recall that in the O-organization the CEO/principal runs the firm herself without the agent's cooperation. As before, it can be written as

$$\begin{aligned} L_0^D &= n[E_0^* c_B x_B] + n(1 + (E_0^*)^2) + a_Y^L Y \\ H_0^D &= n + a_Y^H Y \end{aligned} \quad (20)$$

with E_0^* as the fraction of firms in which the agent does not do anything useful. $(1 + (E_0^*)^2)$ captures the unskilled labor costs of monitoring of the principal, given that she is the only one that collects information. Again, this can be rewritten to

$$\begin{aligned} L_0^D &= n \frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L(w, q)\right] + n(E_0^*)^2 \\ H_0^D &= n + n \frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \theta_H(w, q) \frac{w}{q} \end{aligned} \quad (21)$$

with $\nu_0 = E_0^*$ as the "organizational mix" in the O-regime. These labor demand functions hold for regions of profits for which the O-organization emerges as an equilibrium given by

$$B/w > \bar{B} \text{ and } E_0^* = \frac{B}{2w}, \quad (22)$$

Again substituting (22) in (21) finally yields the following aggregate demand for labor and human capital

$$\begin{aligned} L_0^D &= n \frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L(w, q)\right] + n \frac{1}{4} \left(\frac{B}{w}\right)^2 \\ H_0^D &= n + n \frac{\nu_0}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \theta_H(w, q) \frac{w}{q} \end{aligned} \quad (23)$$

with

$$\nu_0 = E_0^* = \frac{B}{2w} \quad (24)$$

- **Characteristics of $\bar{\Theta}_P(\frac{B}{w})$, $\bar{\Theta}_A(\frac{B}{w})$ and $\bar{\Theta}_0(\frac{B}{w})$ under assumptions A.1 and A.2.**

Recall that

$$\frac{L}{H} = \frac{\frac{\nu_P}{1-\gamma} \left(\frac{B}{w}\right) \left[\gamma + \frac{a}{1-a} \theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{(1-\alpha\bar{e})^2}{4}}{\frac{\nu_P}{1-\gamma} \left(\frac{B}{w}\right) \frac{a}{1-a} \frac{[1-\theta_L]}{q/w} + 1}$$

which can be rewritten as

$$\frac{L}{H} = \Theta(\nu_P \frac{B}{w}, \left(\frac{B}{w}\right)^2 \frac{(1 - \alpha \bar{e})^2}{4}, \theta_L)$$

Θ is increasing in $\nu_P B/w$ if

$$\left[\gamma + \frac{a}{1-a} \theta_L \right] - \left(\frac{B}{w} \right)^2 \frac{(1 - \bar{e} \alpha)^2}{4} \left[\frac{a}{1-a} \frac{[1 - \theta_L]}{q/w} \right] > 0$$

or using (5)

$$\left[\gamma + \frac{a}{1-a} \theta_L \right] - \frac{a}{1-a} [1 - \theta_L] \frac{\left(\frac{B}{w} \right)^2 \frac{(1 - \bar{e} \alpha)^2}{4}}{\left(\frac{B}{w} \right)^2 \frac{(1 - \bar{e} \alpha)^2}{4} + \bar{e} \alpha \left(\frac{B}{w} \right)} > 0$$

This will hold when $\left[\gamma + \frac{a}{1-a} \theta_L \right] - \frac{a}{1-a} [1 - \theta_L] > 0$. The last inequality will be satisfied when assumption A.1 holds (ie. $\gamma + \frac{a}{1-a} (2\theta_L - 1) > 0$).

Also Θ is clearly increasing in B/w and in θ_L . Because of assumption A.2, the elasticity of substitution σ_Y between skilled and unskilled labor for good Y is larger than 1. This implies that θ_L the cost share of unskilled labor in good Y is increasing in q/w . Clearly $\Theta(\cdot)$ is increasing in $\left(\frac{B}{w}\right)^2$. Further, (13) shows that ν_P is also an increasing function of $\frac{B}{w}$ while (5) shows that q/w is also an increasing function of $\frac{B}{w}$. It follows that $\Theta(\nu_P \frac{B}{w}, \left(\frac{B}{w}\right)^2 \frac{(1 - \alpha \bar{e})^2}{4}, \theta_L)$ can be written as a function $\bar{\Theta}_P(\frac{B}{w})$ with $\bar{\Theta}_P(\cdot)$ increasing in B/w .

The proof is similar for the two other functions $\bar{\Theta}_A(\cdot)$ and $\bar{\Theta}_0(\cdot)$ describing the firm's stakes consistent with factor market equilibrium in an A-equilibrium or an O-equilibrium.

Substituting (12), (13), and (5) into $\Theta(\nu_P \frac{B}{w}, \left(\frac{B}{w}\right)^2, \theta_L)$ gives

$$\bar{\Theta}_P\left(\frac{B}{w}\right) = \frac{\left[\frac{(1 - \bar{e} \alpha)^2}{2} \left(\frac{B}{w}\right)^2 + \bar{e} \alpha \left(\frac{B}{w}\right) \right] \frac{1}{1 - \gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + \left(\frac{B}{w}\right)^2 \frac{(1 - \alpha \bar{e})^2}{4}}{\left[\frac{(1 - \bar{e} \alpha)^2}{2} \left(\frac{B}{w}\right) + \bar{e} \alpha \right] \frac{a}{1-a} \frac{[1 - \theta_L]}{1 - \gamma} + 1}$$

Similarly, we get

$$\bar{\Theta}_A\left(\frac{B}{w}\right) = \frac{\left[\frac{(1 - \bar{e})^2}{2} \left(\frac{B}{w}\right)^2 + \bar{e} \alpha \left(\frac{B}{w}\right) \right] \frac{1}{1 - \gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + \left(\frac{B}{w}\right)^2 \frac{(1 - \bar{e})^2}{4}}{\left[\frac{(1 - \bar{e})^2}{2} \left(\frac{B}{w}\right) + \bar{e} \alpha \right] \frac{a}{1-a} \frac{[1 - \theta_L]}{1 - \gamma} + 1} \quad (25)$$

and

$$\bar{\Theta}_0\left(\frac{B}{w}\right) = \frac{\frac{1}{2}\left(\frac{B}{w}\right)^2 \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{1}{4}}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \quad (26)$$

- First, as $\nu_P > \nu_A$, it follows that $\bar{\Theta}_P\left(\frac{B}{w}\right) = \Theta\left(\nu_P \frac{B}{w}, \left(\frac{B}{w}\right)^2 \frac{(1-\alpha\bar{e})^2}{4}, \theta_L\right) > \Theta\left(\nu_A \frac{B}{w}, \left(\frac{B}{w}\right)^2 \frac{(1-\bar{e})^2}{4}, \theta_L\right) = \bar{\Theta}_A\left(\frac{B}{w}\right)$ for all values of B/w $\bar{\Theta}_P\left(\frac{B}{w}\right) > \bar{\Theta}_A\left(\frac{B}{w}\right)$.

- Second, for small B/w , q/w is close to 0 (using the free entry conditions (5), (6), and (7)) and

$$\bar{\Theta}_P\left(\frac{B}{w}\right) \approx \frac{\bar{e}\alpha \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L(0)\right] \frac{B}{w}}{\frac{a}{1-a} \frac{[1-\theta_L(0)]}{1-\gamma} + 1}$$

$$\bar{\Theta}_A\left(\frac{B}{w}\right) \approx \frac{\bar{e}\alpha \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L(0)\right] \frac{B}{w}}{\frac{a}{1-a} \frac{[1-\theta_L(0)]}{1-\gamma} + 1}$$

and

$$\bar{\Theta}_0\left(\frac{B}{w}\right) \approx \frac{\frac{1}{2}\frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L\right] + \frac{1}{4}}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \left(\frac{B}{w}\right)^2$$

Hence, $\bar{\Theta}_P\left(\frac{B}{w}\right)$ and $\bar{\Theta}_A\left(\frac{B}{w}\right)$ are first order in B/w , while $\bar{\Theta}_0\left(\frac{B}{w}\right)$ is second order in B/w . Therefore, for small B/w we get that $\bar{\Theta}_0\left(\frac{B}{w}\right) < \bar{\Theta}_A\left(\frac{B}{w}\right) < \bar{\Theta}_P\left(\frac{B}{w}\right)$.

- Third, for large enough B/w , q/w tends to ∞ and θ_L tends to 1. Hence,

$$\bar{\Theta}_A\left(\frac{B}{w}\right) \approx \frac{(1-\bar{e})^2}{2} \left(\frac{B}{w}\right)^2 \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{(1-\bar{e})^2}{4}$$

and

$$\bar{\Theta}_0\left(\frac{B}{w}\right) = \frac{1}{2} \left(\frac{B}{w}\right)^2 \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a}\theta_L\right] + \left(\frac{B}{w}\right)^2 \frac{1}{4}$$

and it follows that $\bar{\Theta}_0\left(\frac{B}{w}\right) > \bar{\Theta}_A\left(\frac{B}{w}\right)$ for B/w large enough. $\bar{\Theta}_0\left(\frac{B}{w}\right)$ crosses $\bar{\Theta}_A\left(\frac{B}{w}\right)$ at least once from below.

• **Proof that $\bar{\Theta}_A(\bar{B}(\alpha)) < \bar{\Theta}_0(\bar{B}(\alpha))$**

Recall that $\bar{B}(\alpha) = \frac{4\alpha}{2-\bar{e}}$ and that at this value the firm is indifferent between the A-organization and the O-organization ie.

$$\frac{(1-\bar{e})^2}{4} (\bar{B}(\alpha))^2 + \bar{e}\alpha (\bar{B}(\alpha)) = \frac{1}{4} (\bar{B}(\alpha))^2 = \frac{q}{w} \quad (27)$$

Using (25) and (27), we get

$$\begin{aligned}\bar{\Theta}_0(\bar{B}(\alpha)) &= \frac{\frac{1}{2}(\bar{B}(\alpha))^2 \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + (\bar{B}(\alpha))^2 \frac{1}{4}}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \\ &= \frac{Z + \bar{e}\alpha(\bar{B}(\alpha)) \left[1 + \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] \right]}{W}\end{aligned}$$

where

$$Z = \left[\frac{1}{2} \frac{(1-\bar{e})^2}{2} (\bar{B}(\alpha))^2 + \bar{e}\alpha(\bar{B}(\alpha)) \right] \frac{1}{1-\gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + \frac{(1-\bar{e})^2}{4} (\bar{B}(\alpha))^2$$

and

$$W = \frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1$$

After substituting $\bar{B}(\alpha) = \frac{4\alpha}{2-\bar{e}}$ in Z and W , a straightforward but tedious computation gives

$$\bar{\Theta}_0(\bar{B}(\alpha)) = \frac{\frac{4\alpha^2}{(2-\bar{e})^2} \frac{2}{1-\gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + 1}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \quad (28)$$

Similarly,

$$\bar{\Theta}_A(\bar{B}(\alpha)) = \frac{Z}{W - \frac{4e\alpha}{\bar{B}(\alpha)} \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma}}$$

which after some computations results again in

$$\bar{\Theta}_A(\bar{B}(\alpha)) = \frac{\frac{4\alpha^2}{(2-\bar{e})^2} \left[\frac{1+(1-\bar{e})^2}{1-\gamma} \left(\gamma + \frac{a}{1-a} \theta_L \right) + (1-\bar{e})^2 \right]}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1 - \bar{e}(2-\bar{e}) \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma}} \quad (29)$$

Comparing (28) to (29) is equivalent to compare

$$\frac{\frac{2}{1-\gamma} \left[\gamma + \frac{a}{1-a} \theta_L \right] + 1}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \text{ to } \frac{\frac{1+(1-\bar{e})^2}{1-\gamma} \left(\gamma + \frac{a}{1-a} \theta_L \right) + (1-\bar{e})^2}{\frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} (1 + (1-\bar{e})^2) + 1}$$

Denote then the function

$$\Psi(y) = \frac{\left[\frac{1+y}{1-\gamma} \left(\gamma + \frac{a}{1-a} \theta_L \right) + y \right]}{\frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} (1+y) + 1}$$

After differentiation $\Psi'(y)$ has the sign of

$$\left(\frac{1}{1-\gamma} \left(\gamma + \frac{a}{1-a} \theta_L \right) + 1 \right) \left(\frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1 \right) - \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} \left(\frac{1}{1-\gamma} \left(\gamma + \frac{a}{1-a} \theta_L \right) \right)$$

or

$$\begin{aligned} & \left(\left(\gamma + \frac{a}{1-a} \theta_L \right) + 1 - \gamma \right) \left(\frac{a}{1-a} [1 - \theta_L] + 1 - \gamma \right) - \frac{a}{1-a} [1 - \theta_L] \left(\gamma + \frac{a}{1-a} \theta_L \right) \\ = & (1 - \gamma) \frac{a}{1-a} [1 - \theta_L] + (1 - \gamma) \left(\gamma + \frac{a}{1-a} \theta_L \right) + (1 - \gamma)^2 > 0 \end{aligned}$$

Hence, $\Psi'(y) > 0$ and

$$\Psi(1) > \Psi((1 - \bar{e})^2)$$

which implies in the end that

$$\left(\frac{L}{H} \right)_O = \bar{\Theta}_0(\bar{B}(\alpha)) > \bar{\Theta}_A(\bar{B}(\alpha)) = \left(\frac{L}{H} \right)_M$$

• Proof of the Rybczynsky Theorem of Firm Organization

$$\frac{d(1 - \lambda^*)}{1 - \lambda^*} > \frac{d(\frac{L}{H})}{\frac{L}{H}} > 0 > \frac{d\lambda^*}{\lambda^*}$$

Denote first

$$\varphi = \frac{H_A^D}{H_0^D}$$

Using the fact that $\frac{(1-\bar{e})^2}{4}(\bar{B}(\alpha)) + \bar{e}\alpha = \frac{1}{4}\bar{B}(\alpha)$, we get

$$\begin{aligned} \varphi &= \frac{\frac{\frac{(1-\bar{e})^2}{2}(\bar{B}(\alpha)) + \bar{e}\alpha}{\frac{(1-\bar{e})^2}{4}(\bar{B}(\alpha)) + \bar{e}\alpha} \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} = \frac{\frac{\frac{1}{2}(\bar{B}(\alpha)) - \bar{e}\alpha}{\frac{1}{4}\bar{B}(\alpha)} \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \\ &= 1 - \frac{\frac{4\bar{e}\alpha}{\bar{B}(\alpha)} \frac{a}{1-a} \frac{[1-\theta_L]}{1-\gamma}}{\frac{2a}{1-a} \frac{[1-\theta_L]}{1-\gamma} + 1} \end{aligned}$$

Thus,

$$\varphi = \frac{H_A^D}{H_0^D} < 1$$

Denote $L/H = x$, $(L/H)_O = x_O$, and $(L/H)_M = x_M$. Then, by definition

$$\mu = \frac{x_O - x}{x_O - x_M} < 1$$

and

$$1 - \lambda^* = \frac{(1 - \mu)H_A^D}{(1 - \mu)H_A^D + \mu H_0^D} = \frac{\varphi(1 - \mu)}{\mu(1 - \varphi) + \varphi}$$

Differentiation results in

$$\begin{aligned}\frac{d(1 - \lambda^*)}{1 - \lambda^*} &= \frac{-d\mu}{1 - \mu} - \frac{(1 - \varphi)d\mu}{\mu(1 - \varphi) + \varphi} \\ &= \frac{-d\mu}{(1 - \mu)[\mu(1 - \varphi) + \varphi]}\end{aligned}$$

while

$$\frac{d\mu}{\mu} = \frac{-dx}{x_O - x}$$

From this follows that

$$\begin{aligned}\frac{d(1 - \lambda^*)}{1 - \lambda^*} &= \frac{\mu dx}{(1 - \mu)[\mu(1 - \varphi) + \varphi](x_O - x)} \\ &= \frac{x_O - x}{x_O - x_M} \frac{x_O - x_M}{(x - x_M)[\mu(1 - \varphi) + \varphi](x_O - x)} dx \\ &= \frac{x}{x - x_M} \frac{1}{(\mu(1 - \varphi) + \varphi)} \frac{dx}{x}\end{aligned}$$

Given that $\mu(1 - \varphi) + \varphi < 1$, it follows that

$$\frac{d(1 - \lambda^*)}{1 - \lambda^*} > \frac{dx}{x} > 0 > \frac{d\lambda^*}{\lambda^*}$$

which proves part iii) of proposition 3.