Trade in Tasks and the Organization of Firms*

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Abstract

We incorporate trade in tasks a là Grossman and Rossi-Hansberg (2008) into the international trade theory of firm organization of Marin and Verdier (2012) to examine how offshoring affects the way firms organize. We test the predictions of the model based on firm level data of 660 Austrian and German multinational firms with 2200 subsidiaries in Eastern Europe and the former Soviet Union and we show that the data are consistent with the theory. We find that offshoring of production labour leads firms to reorganize to a more decentralized hierarchy improving competitiveness of offshoring firms. We also show that offshoring of skilled managers relaxes the 'war for talent' constraint in the North but toughens competition and thus has an ambiguous impact on the relative wage of skilled managers in the offshoring country. We show, however, that when the North is not too open to foreign competition offshoring of managers unambiguously lowers relative CEO wages and leads to more centralized firms in the North.

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1 Introduction

In the last two decades the nature of international trade has been changing. Modern economic commerce involves movements across international boundaries – but often within the boundaries

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of the firm. It is often characterized by a “war for talent” rather than a “war for market shares”. Firms engaged in international trade have met these challenges of the new features of world trade by organizing production in an international value chain, by decentralizing their system of command in flatter corporate hierarchies, by making human capital to the new stakeholder of the firm, and by compensating their CEOs with skyrocket earnings. Thus, we ask: have offshoring and 'trade in tasks' been the driving forces behind these observed changes in the corporation? [1]

In an international value chain or 'trade in tasks' firms separate geographically different production stages across the world economy to exploit differences in production costs. Trade in tasks is also discussed in the literature under the heading ‘slicing the value chain’, ‘vertical specialization’, 'fragmentation', or ‘offshoring’. According to an estimate such vertical specialization accounts for a third of the increase in world trade since 1970 (see Hummels et al. (2001)) and intra-firm imports account between 22 to 69 percent of total imports between old and new Europe (see Marin (2010)). World investment outflows increased 4,5 times between 1990 and 2005 from 202 billion US$ to 916 billion US$ (see World Investment Report (2006), UNCTAD).[2]

Data on the changing nature of the corporation have become available only recently. Rajan and Wulf (2006) and Marin and Verdier (2010) document that firms in the US, Germany, and Austria shifted to a more decentralized organization over time. Marin (2009) and Marin and Verdier (2010) show that firms in the larger economy, Germany, are more decentralized compared to firms in the smaller economy, Austria. Bloom, Van Reenen, and Sadun (2010) report that firms in the US, UK, and Northern Europe have firms with the most decentralized organization, while firms in Asian countries are most centralized.

The literature on organization and trade has sofar examined how international trade in final goods affects the internal organization of firms. Marin and Verdier (2008) consider a Krugman (1980) model, Marin and Verdier (2010) a Melitz and Ottaviano model (2008), and Caliendo and Rossi-Hansberg (2012) a Melitz (2003) model, respectively, of North-North trade and they show that international trade leads to more decentralized firms. Marin and Verdier (2012)

[1] For the new corporation, see The Economist (2006) and Marin (2008).

[2] For the new features of globalization see Hummels et al. (2001), Feenstra (1998), and Grossman and Rossi-Hansberg (2008), for the new international division labour in Europe see Marin (2006), for a recent estimate on global value added chains, see Johnson and Noguera (2012).

examine the organizational implications of trade integration within a framework of a Helpman and Krugman model of North-South trade in which countries differ in factor endowments and they show that North-South trade leads to the emergence of the talent firm in which human capital becomes the new stakeholder in firms. All these models have in common that they do not consider how offshoring or trade in tasks affects the firm organization of offshoring firms. As the above figures show, however, trade in tasks and intra-firm trade have increased much stronger than final goods trade in the last three decades making offshoring an important candidate as a driver of organizational change. This will be particularly the case if one takes into account that the relocation of firm activities to other countries typically involves a major reorganization of the activity that remains in offshoring firms in the North. Thus, offshoring and the reorganization of firms appear to occur hand in hand.

In this paper we incorporate trade in tasks a là Grossman and Rossi-Hansberg (2008) (GRH) into the international trade theory of the firm of Marin and Verdier (2012) (MV) to explore how offshoring of different types of labour (production workers, managers) affects the internal organization of offshoring firms in a small open economy. By merging these two models our paper contributes in several ways to the recent literature on globalization and the organization of firms. First, we show that offshoring of low-skill tasks by Northern firms to the South induces firms to reorganize to a more decentralized hierarchy in which power is allocated to the skilled manager in Northern firms. In GRH this effect is absent, because they do not consider firms' choice of organizational form. However, relocating tasks to other countries typically involves major reorganization in offshoring firms resulting in productivity gains that go above and beyond the mere discovery of cheap production opportunities in the South. The latter effect is considered by GRH which they call labour-augmenting technological change. [3]

Second, we find that Northern firms gain market shares vis a vis foreign rivals as a result of the productivity gains from offshoring. The improved competitiveness of Northern firms has been an important argument in the empirical literature on the labour market effects of offshoring. This literature argues that offshoring to the South has not led to major job losses in the North, because it has helped Northern firms to gain market shares increasing the demand for labour in

[3] Marin (2010) shows that the discovery of cheap labour in Eastern Europe by German multinational firms has allowed German affiliate firms in Eastern Europe to cut unit labour costs relative to German parent firms by over 70 percent.

Northern firm. Improved competitiveness as a result of offshoring has sofar not been shown in the literature, neither theoretically nor empirically. In GRH such a change in competitiveness in the North cannot arise, because they consider a framework with perfect competition.[4]

Third, Marin and Verdier (2012) show that trade liberalization triggers a 'war for talent' as market entry is constrained by the pool of available managers in the North. Firms compete for the limited amount of skilled managers available in the North pushing up the relative wage for skilled managers. By incorporating 'trade in tasks' into Marin and Verdier (2012) we find that when the country is not too open to foreign competition offshoring of skilled managers to the South makes the 'war for talent' constraint on managers in the North less binding. As a result offshoring leads to lower relative wages for skilled managers and to more centralization in Northern firms.

We consider the skill rich North and the labour rich South with two sectors and two factors of production (workers and managers). Sector Y produces a homogenous good under perfect competition. Sector X is monopolistically competitive a là Helpman and Krugman (1985). In the X-sector firms producing a variety of the differentiated product can choose between three types of organization: the centralized P-organization in which the principal holds formal power in cooperation with the agent, the decentralized A-organization in which the agent has formal power, and the centralized O-organization in which the principal runs the firm without the cooperation of the agent. There is free entry into the industry. Workers (low-skilled labor) are used in production of both products, while managers (high-skilled labor) are only used for entry into the industry. In other words, to operate in the market, a firms need a manager to run the firm.

As a benchmark environment, we consider a small open economy. The price of the homogenous good is equal to the world price and, thereby, exogenous. To model a differentiated sector in a small open economy, we follow Demidova and Rodriguez-Clare (2009). In particular, we assume that the number of imported varieties and their prices are exogenously given. In addition, domestic firms producing varieties of the differentiated product face an exogenous foreign demand for their products.

[4] For the labour market effects of offshoring, see Brainard and Riker (1997), Becker and Muendler (2010), and Marin (2010). For the productivity effect of offshoring, see Amiti and Konings (2007) and Hansen (2010). For Germany's super competitiveness as a result of offshoring to Eastern Europe, see Marin (2010).

We distinguish between offshoring of production workers and managerial labor in the X-sector. We find that offshoring of production labor in a differentiated sector unambiguously increases firm's real profits. As a result, Northern firms become more decentralized. The intuition behind this finding is as follows. Since labor is offshored only in the differentiated sector, the wage level of low-skilled labor does not change (it is pinned down by the world price of the homogenous good). Therefore, we can divide the impact of offshoring on real profits into two effects. First, there is a positive productivity effect on profits associated with a decrease in the marginal cost of production. The increase in productivity of domestic firms allows Northern firms to win market shares from their foreign rivals which increases firms' profits. Second, there is a negative competition effect on profits arising due to the fact that all other domestic Northern firms have also become more productive. However, we show that the positive productivity effect of a gain in foreign market shares is always stronger than the negative profit effect of more domestic competition which makes decentralization in the firm more likely. Profits unambiguously rise in response to offshoring of production workers because we consider an open economy. The more open the economy the larger is the profit increase due to the gain in foreign market shares (foreign rivals' productivity does not change) and the smaller is the profit decline due to stronger domestic competition. In a closed economy these two effects on profits just cancel out.

We also explore how offshoring of skilled managers to the South affects the firm organization of Northern firms. Offshoring of managerial tasks affects the allocation of power in the firm and relative CEO wages via the following channels. First, offshoring of managers to the South makes more managers available in the North which makes it easier for firms to find a manager. This relaxes the 'war for talent' constraint in the North lowering the relative wage of the skilled manager relative to production workers. The 'war for talent' constraint describes firms' competition for managers in order to start a firm. Second, lower start-up costs of a firm (each firm has to hire a manager to start a firm) makes domestic firms require lower free entry profits to enter the market. Lower costs of market entry, in turn, induce more domestic firms to enter the market increasing competition among domestic firms lowering profits. We show in the proposition that when the number of foreign competitors (which are exogenous) is sufficiently large the negative competition effect on profits is dominated by the positive 'war for talent effect' on profits making profits unambiguously to rise and with it making it more likely that the firm reorganizes to a more decentralizes hierarchy. Here again, the degree of openness of the Northern economy is decisive whether or not Northern firms stay centralized and pay their CEOs lower relative wages. Offshoring of managers to the South has two opposing effects on the demand for managers in the North. First, offshoring of managers lowers the demand for managers in the North via the 'war for talent' constraint resulting in lower relative manager wages. Second, market entry by domestic firms increases the demand for managers which pushes up relative CEO pay. When foreign competition is small in the North the increased demand for managers via firm entry is outweighed by the decline in the demand for managers via offshoring and relative manager wages and profits unambiguously decline.

We test the predictions of the model based on original firm level data we designed and collected of 660 Austrian and German multinational firms with 2200 subsidiaries in Eastern Europe and we show that the data are consistent with the theory.

The paper is organized in the following sections. Section 2 describes the model. Section 3 examines how offshoring of production workers and managerial labour affects the way firms organize. Section 4 describes the firm survey and the empirical results. Section 5 concludes.

2 The Model

We consider a small open economy with two goods and two factors of production: skilled and unskilled labor. The utility function of a representative consumer is given by

$$U(X,Y) = X^a Y^{1-a}, \ a \in (0,1), \tag{1}$$

where Y is a homogenous good and X is a differentiated good:

$$X = \left[\int_{i \in \Omega} x(i)^\rho di + \int_{i' \in \Omega_m} x_m(i')^\rho di' \right]^{1/\rho} \text{ and } 0 < \rho < 1.$$

Here Ω and Ω_m represent the set of domestic and foreign varieties, respectively.

The homogenous good is produced in a perfectly competitive environment with a linear technology that requires only unskilled labor. Domestic varieties of the differentiated good are produced under monopolistic competition with free entry.

2.1 Firm Organization

In modeling the internal organization of a firm producing a variety of the differentiated product, we follow Aghion and Tirole (1997) and Marin and Verdier (2012). We assume that the firm consists of an owner (the principal P) and a manager (the agent A). In particular, in each firm the principal hires a skilled manager to start a firm and employs unskilled workers to produce.

We assume that there are a number of alternative ways to run the firm that differ in terms of production costs and, therefore, payoffs. However, only two of them are worth doing from the perspective of the principal and the manager. One project has the lowest cost of production and, thereby, yields the highest possible profit B. The other project is the "best project" for the manager yielding the highest possible non pecuniary benefit b for the manager. Thus, there is a potential conflict of interest between the principal and the manager. The best project for the principal is not the best project for the manager. Here B and b are supposed to be known ex ante, but the parties do not know ex ante which project yields such payoff.

To gather information on the payoffs of the projects, the principal uses a low skilled labor monitoring technology. Specifically, by investing some amount of unskilled labor L, the principal learns all the payoffs with probability $E = \min(1, \sqrt{L})$ and remains uninformed with probability $1 - E$.[5] Similarly, by exerting some effort ke ($k < b$), the agent learns the payoff of all projects with probability $e \in [0, \bar{e}]$ and remains uninformed with probability $1 - e$. We assume that the principal is risk neutral and that the agent is infinitely risk averse with respect to income. As a result, the agent is not responsive to monetary incentives and receives a fixed wage q.

We also assume that, among available projects, there are some with very high negative payoffs to both the principal and the agent. This assumption implies that choosing a random project without being informed is not profitable. In particular, if the principal and the agent do not know the payoffs, there is no production. Thus, private information about the payoffs gives decision control to the informed party that, in this case, has "real power" rather than "formal power" in the firm.

We distinguish between three types of the internal organization of a firm: a P-organization, an A-organization, and an O-organization. In the P-organization, the principal has formal power. In the A-organization, the principal delegates formal power to the manager. Finally,

[5] The idea behind using unskilled labor to monitor the payoffs is explained by that the principal has managerial overload and there is a conflict of interest between the principal and the manager.

in the O-organization, the principal also has formal power, but the manager puts zero effort into learning the payoffs of the available projects (one can think of the O-organization as the P-organization with zero effort put in by the manager). Thus, the principal chooses between the three modes of firm organization to maximize her utility.

We introduce the following notation in the paper. We denote c_B as the marginal cost of production when the best project for the principal is implemented. Similarly, c_b is the marginal cost when the best project for the manager is chosen. An assumption that $c_B < c_b$ creates a conflict of interest in the model. We also denote αB ($\alpha \in [0,1]$) as the principal's benefit when the best for the manager project is implemented and βb ($\beta \in [0,1]$) as the manager's benefit when the best for the principal project is implemented. Here α and β capture the degree of conflict between the principal and the manager.

2.1.1 The P-organization

Under the P-organization, the principal has formal power. In this case, if the principal is fully informed about the payoffs, then the best for the principal project is implemented and the principal's monetary payoff is B, while the manager receives βb. If the principal is uninformed and the manager is informed, then the manager has real power and suggests her best project (which is accepted by the principal). The principal receives a monetary payoff αB and the manager receives private benefit b. If both the parties remain uninformed, there is no production.

Hence, the expected payoffs of the principal and the agent are given by

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

Here w is the wage rate of unskilled labor (wE^2 is the principal's cost of learning the project payoffs). The first order conditions of the parties with respect to efforts E and e are

$$\begin{aligned} \text{Principal} &: \quad B(1-\alpha e) = 2wE, \\ \text{Agent} &: \quad \begin{cases} e = \bar{e} & \text{if } k \leq b(1-E), \\ e = 0 & \text{otherwise.} \end{cases} \end{aligned}$$

As can be seen, the principal invests in monitoring more the higher the monetary payoff of the best for her project, the larger the conflict of interest between the principal and the manager (the lower α), and the lower the manager's effort e. The agent puts in more effort the higher the benefit from the best for her project and the lower the principal's interference (the lower E). Thus, the principal's control over the firm comes at cost of lower agent's initiative.

Marin and Verdier (2012) show that the equilibrium levels of effort under the P-organization are

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

where

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

Note that the case with zero effort put in by the manager corresponds to the O-organization.[6] Thus, it is straightforward to show that the expected utility of the principal under the P-organization is

$$u_P^* = w\,(E_P^*)^2 + e_P^*\alpha B. \tag{3}$$

2.1.2 The A-organization

Under the A-organization, the principal delegates formal power to the manager. In this case, if both the parties are informed, then the best for the manager project is implemented. When the principal is informed and the agent is uninformed, the principal suggests her preferred project and, thereby, has real power. The expected payoffs of the principal and the agent are

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

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

$$\begin{aligned} &\text{Principal:} \quad B(1-e) = 2wE, \\ &\text{Agent:} \quad \begin{cases} e = \bar{e} & \text{if } k \leq b(1-E\beta), \\ e = 0 & \text{otherwise.} \end{cases} \end{aligned}$$

As can be seen, the advantage of delegating formal power to the manager is that the manager has more incentives to become informed. In contrast, the principal has fewer incentives to invest

[6] The 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.

in monitoring the projects and, as a result, the principal looses not only formal power, but also real power. The equilibrium values of E and e are

$$\begin{aligned} E_A^* &= \frac{B(1-\bar{e})}{2w},\ e_A^* = \bar{e} \quad \text{if } B/w \leq \tilde{B}_A \\ E_A^* &= \frac{B}{2w},\ e_A^* = 0 \qquad\quad \text{if } B/w > \tilde{B}_A, \end{aligned}$$

where

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

Hence, the expected utility of the principal under the A-organization is

$$v_P^* = w\,(E_A^*)^2 + e_A^* \alpha B. \tag{4}$$

2.1.3 The Choice of Firm Organization

We now explore how the decision whether to delegate formal power to the manager or not depends on the firm's real payoff B/w. In particular, the following proposition holds (see Marin and Verdier (2012) for details).

Proposition 1 *Assume that*

$$\tilde{B}_P = \frac{2(1-k/b)}{1-\alpha\bar{e}} < \bar{B} = \frac{4\alpha}{2-\bar{e}} < \tilde{B}_A = \frac{2(1-k/b)}{\beta\,(1-\bar{e})}.$$

It follows that, for $B/w < \tilde{B}_P$, the principal chooses the P-organization. For $\tilde{B}_P \leq B/w < \bar{B}$, the principal prefers the A-organization. Finally, for $B/w \geq \bar{B}$, the O-organization (the P-organization with zero effort put in by the manager) yields the highest utility.

As can be seen, a trade-off between control and initiative arises at intermediate levels of profits. In this case, the principal delegates formal power to the manager to keep her initiative. At high levels of profits, the principal's stakes are so high that she puts a lot effort in monitoring the projects, which in turn leads to zero effort put in by the manager under any type of firm organization. As a result, the O-organization is optimal. At low levels of profits, the principal's stakes are small and, therefore, she monitors and intervenes little. The manager puts in the maximum effort and the P-organization is optimal (as there is no need to keep the manager's initiative by delegating her formal power).

2.2 Product Markets and Trade Environment

We now introduce product market competition and trade in the model. In particular, we consider a small open economy where the number and the prices of foreign varieties are taken as given. In addition, we assume that there is some exogenous foreign demand for domestic varieties, which is given by $A_m/p(i)^\sigma$ (where A_m is some parameter).[7]

Domestic demand for home and foreign varieties of the differentiated good X is

$$\begin{aligned} x(i) &= \frac{aRP^{\sigma-1}}{(p(i))^\sigma}, \\ x_m(i') &= \frac{aRP^{\sigma-1}}{(p_m(i'))^\sigma}, \end{aligned}$$

where R is the total expenditure in the economy, $p_m(i')$ is the price of an imported variety i', and P is the CES price index given by

$$P^{1-\sigma} = \int_{i\in\Omega} p(i)^{1-\sigma} di + \int_{i'\in\Omega_m} p_m(i')^{1-\sigma} di'.$$

Here σ is the elasticity of substitution. Without loss of generality, we assume that $p_m(i') = p_m$ for any i'. Then,

$$P^{1-\sigma} = \int_{i\in\Omega} p(i)^{1-\sigma} di + n^* (p_m)^{1-\sigma}, \tag{5}$$

where n^* is the number of foreign varieties in the market (which is exogenous).

Demand for the homogenous product is

$$Y = \frac{(1-a)R}{p_Y},$$

where p_Y is the world price of the good. It is assumed that the homogeneous good is produced with a linear one-to-one technology (requiring only unskilled labor). Hence, the wage rate of unskilled labor is pinned down by the world price:

$$w = p_Y.$$

We assume that the marginal cost of production of a firm producing variety i is $wc(i)/Z_X$, where $c(i)$ stands for the part of the cost that depends on which project is implemented. If the best for the principal project is implemented, then $c(i) = c_B$, otherwise, $c(i) = c_b$ (recall that $c_b > c_B$). The variable Z_X, in turn, describes the "productivity" gains from offshoring

[7] In fact, here we adopt the framework in Demidova and Rodriguez-Clare (2009), who introduce trade in a small economy with heterogenous firms.

some production tasks abroad. Specifically, Z_X is strictly more than one, if some part of the production is offshored, and equal to one, if the firm does not offshore (we specify Z_X in the next section). Thus, given the demand for domestic varieties, the price of variety i is

$$p(i) = \frac{\sigma}{\sigma - 1} \frac{w}{Z_X} c(i),$$

This implies that the firm's total profits (taking into account sales abroad) are

$$\pi(i) = C \left(aRP^{\sigma-1} + A_m \right) \left(\frac{w}{Z_X} c(i) \right)^{1-\sigma},$$

where $C = \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma} \right)^{\sigma-1}$.

2.2.1 Trade in Tasks

To model offshoring, we adopt the framework in Grossman and Rossi-Hansberg (2008). In particular, we assume that production in the differentiated sector involves a continuum of tasks (of measure one) and performing each task requires $c(i)$ units of labor. Production of each task can be offshored abroad. The cost of offshoring task $j \in [0, 1]$ is $\gamma t(j)$, where $t(j)$ is increasing and continuously differentiable, implying that it is more costly to offshore high-indexed tasks.

It is profitable to offshore task j if and only if the cost of producing it domestically is higher than the cost of offshoring. That is,

$$wc(i) > \gamma t(j) w^* c(i),$$

where w^* is the cost of unskilled labor abroad. The latter implies that tasks with index $j \in [0, I_X]$ are offshored, while the other tasks are performed domestically. Here I_X solves[8]

$$w = \gamma t(I_X) w^*. \tag{6}$$

Given the possibility of offshoring, the marginal cost of a firm producing variety i is

$$MC_i = wc(i) \left(1 - I_X\right) + w^* c(i) \int_0^{I_X} \gamma t(j) dj.$$

[8] Note that to guarantee the interior solution of (6), we need to assume that

$$\frac{1}{t(1)} < \gamma \frac{w^*}{w} < \frac{1}{t(0)}.$$

The condition states that the cost of offshoring of tasks with lower indexes should be sufficiently low, while the cost of offshoring of tasks with higher indexes should be sufficiently high. In this case, only a certain positive fraction of tasks is offshored.

Taking into account (6), we have

$$MC_i = wc(i)\left(1 - I_X + \left(\int_0^{I_X} t(j)dj\right)/t(I_X)\right).$$

From the definition of Z_X,

$$MC_i = \frac{w}{Z_X}c(i).$$

This means that the productivity gains from offshoring represented by Z_X are

$$Z_X = \frac{1}{1 - I_X + \left(\int_0^{I_X} t(j)dj\right)/t(I_X)} < 1.$$

As can be seen, Z_X is increasing in I_X. The more tasks are offshored, the more productive the firms. If there is no offshoring ($I_X = 0$), then Z_X is equal to one and the marginal cost is $wc(i)$.

2.3 The Equilibrium

Recall that the profits of a firm producing variety i are

$$\pi(i) = C\left(aRP^{\sigma-1} + A_m\right)\left(\frac{w}{Z_X}c(i)\right)^{1-\sigma}.$$

If the implemented project is the best project for the principal, the marginal cost of production is c_B. This implies that the highest possible principal's benefit is

$$B = C\left(aRP^{\sigma-1} + A_m\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}. \tag{7}$$

Moreover, it is straightforward to see that

$$\alpha = \left(\frac{c_b}{c_B}\right)^{1-\sigma} < 1.$$

Depending on the parameters in the model, there are three types of equilibria (with the P-organizations, the A-organizations, and the O-organizations). Each equilibrium is characterized by the free entry condition and the factor markets clearing conditions. In the next subsection, we consider the equilibrium with the P-organizations.

2.3.1 Equilibrium with P-organizations

The free entry condition means that the expected principal's benefits are equal to the cost of starting a firm. To start a firm, the principal has to hire a skilled worker as a manager. Therefore, in the case of the P-organization, the free entry condition implies that

$$w\left(E_P^*\right)^2 + e_P^*\alpha B = q,$$

where q is the wage rate of the manager and the left-hand side is the principal's benefits (see (3)). Taking into account the expressions for E_P^* and e_P^* (see (2)), the free entry condition can be rewritten in the following way:

$$\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}=\frac{q}{w}. \tag{8}$$

Let us denote n as the number of firms entering the market. Then, under the P-organization, $E_P^* n$ firms implement projects that are best for principals, $(1-E_P^*)\, e_P^* n$ firms implement projects that are best for managers, and the rest leave the market (as both the principal and the manager remain uninformed). Hence, taking into account that some tasks are offshored abroad (specifically, only $1-I_X$ tasks are performed domestically), demand for unskilled labor in the differentiated sector is

$$L_X = n(1-I_X)\left[E_P^* c_B x_B + (1-E_P^*) e_P^* c_b x_b\right],$$

where x_B and x_b are outputs of firms with marginal cost c_B and c_b, respectively. Then, the unskilled labor market clearing condition is

$$L_X + Y^S + n(E_P^*)^2 = L, \tag{9}$$

where Y^S is the production of good Y, $n(E_p^*)^2$ is labor used by principals to monitor the payoffs of projects, and L is the total endowment of unskilled labor.

The demand for skilled labor is equal to the number of firms entering the market. Thus, the market clearing condition for skilled labor is

$$H = n, \tag{10}$$

where H is the endowment of skilled labor in the economy. As the wage rate of unskilled labor w is pinned down by the world price of the homogenous good and Z_X is exactly determined by the relative wage w/w^* and the cost of offshoring $t(j)$, the equilibrium values of q and B can be found from (8) and (7). Finally, the amount produced in the homogenous sector is determined by (9). Thus, we can find all the endogenous variables in the model.

Note that to avoid specialization, the parameters in the model must be such that Y^S is positive in the equilibrium. Moreover, to be consistent with the P-organization equilibrium, the equilibrium value of B/w must be less than $\tilde{B}_P$ (see *Proposition* 1).

The equilibria with A- and O-organizations can be described in an exactly similar way.

3 Firm Organization and Offshoring

We now explore the relationship between offshoring of production tasks and the type of firm organization chosen by the principal. In particular, we examine how a uniform decrease in the cost of offshoring (lower γ) affects the real profits B/w. The idea behind this exercise is the relationship between the type of firm organization and the real profits stated in *Proposition 1*. *Proposition 1* suggests that the level of firm decentralization (the level of formal power delegated to a manager) has a hump shape as a function of the real profits. Thus, understanding of the relationship between the cost of offshoring and real profits sheds a light on the connection between offshoring and firm organization.

Since the results we formulate below hold for any type of firm organization, without loss of generality, we consider the equilibrium with the P-organizations described in the previous section. Recall that from (7), the highest principal's benefits are

$$B = C\left(aRP^{\sigma-1} + A_m\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma},$$

where R is the total expenditure the economy given by $wL + qH$. The latter implies that

$$\frac{B}{w} = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(aP^{\sigma-1}\left(L + \frac{q}{w}H\right) + \frac{A_m}{w}\right).$$

The price index is

$$P^{1-\sigma} = \int_{i\in\Omega} p(i)^{1-\sigma}di + n^*\left(p_m\right)^{1-\sigma}.$$

As in the P-equilibrium $E_P^* n$ domestic firms implement projects with cost c_B and $\left(1 - E_P^*\right)e_P^* n$ firms implement projects with cost c_b, the price index can be written as follows:

$$P^{1-\sigma} = n\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(E_P^* + \left(1 - E_P^*\right)e_P^*\alpha\right) + n^*\left(p_m\right)^{1-\sigma},$$

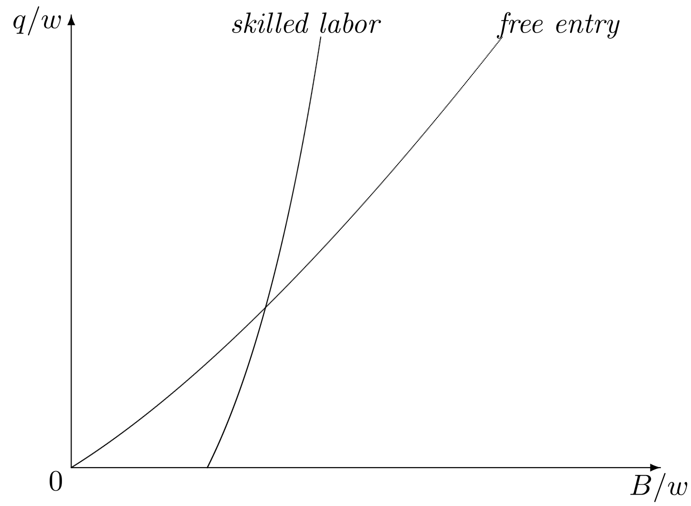
where $\rho = (\sigma-1)/\sigma$. Moreover, using the expressions for E_P^* and e_P^* in (2), it is straightforward to show that

$$E_P^* + (1 - E_P^*)e_P^*\alpha = \bar{e}\alpha + \frac{\left(1-\bar{e}\alpha\right)^2}{2}\frac{B}{w}.$$

Thus, the price index is equal to

$$P^{1-\sigma} = n\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\bar{e}\alpha + \frac{\left(1-\bar{e}\alpha\right)^2}{2}\frac{B}{w}\right) + n^*\left(p_m\right)^{1-\sigma}.$$

Figure 1: Equilibrium



Taking into account that the supply of skilled labor is equal to H, the skilled labor market clearing condition can be written as follows:

$$B/w = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{a\left(L+\frac{q}{w}H\right)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right)+n^*\left(p_m\right)^{1-\sigma}}+\frac{A_m}{w}\right).$$

Thus, we have two conditions that determine the equilibrium values of B/w and q/w: the free entry condition and the skilled labor market clearing condition. Specifically, B/w and q/w solve the following system of equations:

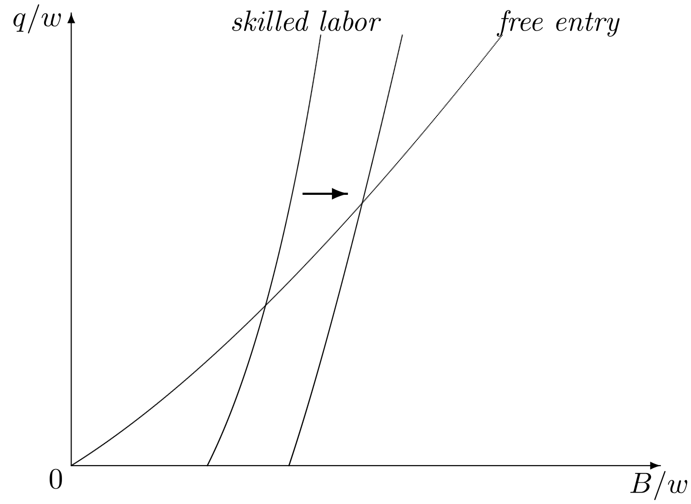
$$\left\{\begin{array}{c} \frac{q}{w}=\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}, \\ \\ B/w = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{a\left(L+\frac{q}{w}H\right)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right)+n^*\left(p_m\right)^{1-\sigma}}+\frac{A_m}{w}\right). \end{array}\right. \tag{11}$$

As w is pinned down by the world price p_Y and Z_X depends only on the relative wage of unskilled labor, w/w^*, and the cost of offshoring, the system of equations (11) is sufficient to find the equilibrium values of the real profits B/w and the real wage of skilled labor q/w. In the Appendix, we show that the solution of (11) exists and is unique. Figure 1 illustrates the equilibrium.

Notice that in the closed economy (when $A_m = 0$ and $n^* = 0$), we have

$$B/w = \frac{Ca\rho^{1-\sigma}\left(\frac{L}{H}+\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}\right)}{\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right]}, \tag{12}$$

Figure 2: Offshoring of Production Tasks



which can be treated as a special case of the model in Marin and Verdier (2012). In this case, the real profits do not depend on the marginal cost of production and, thereby, on the cost of offshoring.

3.1 Offshoring of Production Tasks

We then explore how changes in γ affect the equilibrium value of B/w. Recall that

$$Z_X = \frac{1}{1 - I_X + \left(\int_0^{I_X} t(j)dj\right)/t(I_X)},$$

where I_X is determined from $w = \gamma t(I_X)w^*$. As w is exogenous, the only effect of γ on B/w is through changes in Z_X. In particular, lower offshoring cost γ results in higher productivity gains Z_X. Thus, we need to explore how a rise in Z_X affects the real profits. The following proposition holds.

Proposition 2 *In the P-equilibrium, a rise in Z_X leads to a higher value of the real profits in equilibrium.*

Proof. The proof is directly followed from (11). Specifically, it is straightforward to see that a rise in Z_X shifts the skilled labor curve to the right, while the free entry curve does not change (see Figure 2). This implies that the equilibrium values of B/w and q/w rise. ∎

The intuition behind this finding is as follows. There are two effects of a rise in Z_X on the real profits. The direct productivity effect is a decrease in the marginal cost (lower $wc(i)/Z_X$)

that increases firm's real profits. The indirect effect is a decrease in the domestic market size (lower $RP^{\sigma-1}$) caused by that all other domestic firms become more productive. This in turn reduces firm's real profits. As can be seen from the proposition, the positive direct effect is stronger than the negative indirect effect. This is due to that we consider an open economy. In the case of an open economy, the effect of lower marginal cost on the profits is enhanced by the presence of the foreign market (characterized by A_m). Moreover, the market size effect is weakened by the presence of foreign firms whose productivity does not change: i.e., more productive domestic firms take some share of the market from foreign firms. As can be seen from (12), in the closed economy the two effects are exactly cancelled out.

As B/w rises and becomes closer the cutoff $\tilde{B}_P$ (see *Proposition* 1), the P-equilibrium becomes "closer" to the A-equilibrium and, to some extent, firms become less centralized. In particular, if B/w exceeds the cutoff $\tilde{B}_P$, firms switch from the P-organization to the A-organization where the manager has formal power. Similarly, in the equilibrium with the A-organizations, lower cost of offshoring implies that the A-equilibrium becomes closer to the O-equilibrium and, therefore, firms become more centralized. Hence, the theory suggests a hump-shaped relationship between offshoring and firm organization.

3.2 Offshoring of Managerial Tasks

In this section, we ask whether offshoring of different types of labor leads to the same implications for firm organization. In particular, we examine how offshoring of managerial labor affects the firm's real profits and, thereby, the level of firm's decentralization. We assume that, to start a firm, a continuum of tasks (of measure one) performed by a manager is involved and some of these tasks can be offshored abroad. Performing each task requires one unit of managerial labor. Tasks that are not offshored are performed by a domestic manager who is paid according to the number of performed tasks. As before, the domestic manager also monitors the payoffs from available projects, as she receives non pecuniary benefits from implemented projects. It is assumed that the "foreign" manager does not receive any benefits from implemented projects and, therefore, does not have incentives to monitor the payoffs. That is, the foreign manager only performs some offshored tasks that are necessary to start a firm.

As in the previous section, we analyze the P-equilibrium in the model. We assume that the fraction of tasks that can be offshored is exogenously given by $I_S < 1$. Endogenizing I_S leads to unnecessary complexity of the analysis and does not substantially change the qualitative results. The cost of managerial labor abroad is q^*. Note that offshoring is profitable only if the cost of foreign labor is cheaper than the cost of domestic labor: i.e., $q > q^*$. We assume that q^* is sufficiently low that the constraint on the number of tasks that can be offshored is binding: domestic firms find it profitable to offshore all the tasks they can offshore. Specifically, we assume that q^* is such that

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w} > 2\frac{\sqrt{(\bar{e}\alpha)^2+\frac{q^*}{w}(1-\bar{e}\alpha)^2}-\bar{e}\alpha}{(1-\bar{e}\alpha)^2}. \tag{13}$$

The latter inequality guarantees that q is strictly greater than q^* in equilibrium where all the tasks are offshored (see details in the Appendix).

When some managerial tasks are offshored abroad, the cost of entry is equal to $q(1-I_S)+q^*I_S$. Hence, the free entry condition can be written as follows

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

which implies that

$$\frac{q}{w}=\frac{1}{1-I_S}\left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}-\frac{q^*I_S}{w}\right). \tag{14}$$

The market clearing condition for skilled labor is now given by

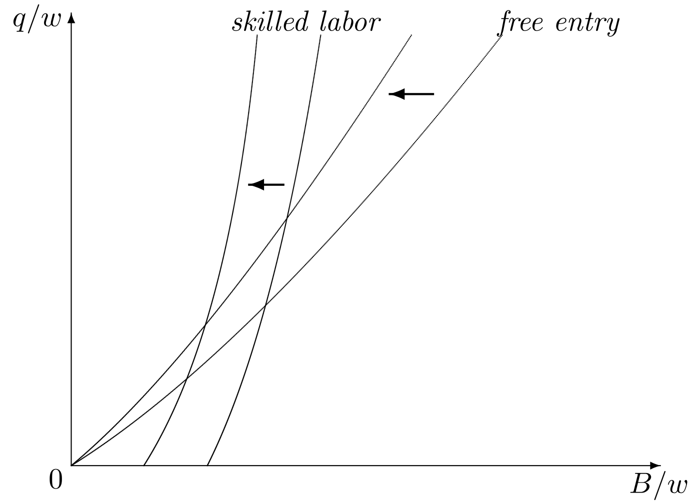
$$n(1-I_S)=H \iff n=\frac{H}{1-I_S}. \tag{15}$$

To simplify the notation, we denote the level of foreign competition $n^*(p_m)^{1-\sigma}$ by IM. Hence, taking into account (14) and (15), the equilibrium values of B/w and q/w are determined by the following system of equation:

$$\begin{cases} \frac{q}{w}=\frac{1}{1-I_S}\left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}-\frac{q^*I_S}{w}\right), \\ B/w=C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w}+\frac{a\left(L(1-I_S)+\frac{q}{w}H\right)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right]+(1-I_S)IM}\right). \end{cases} \tag{16}$$

We then examine how changes in the number of managerial tasks that can be offshored affect the real profits. The system of equations (16) results in a certain implicit relationship between B/w and I_S in equilibrium. In particular, the following proposition holds.

Figure 3: Offshoring of Managerial Tasks



Proposition 3 *There exists such a value of IM denoted by IM_P that, in the P-equilibrium, B/w is increasing in I_S if and only if*

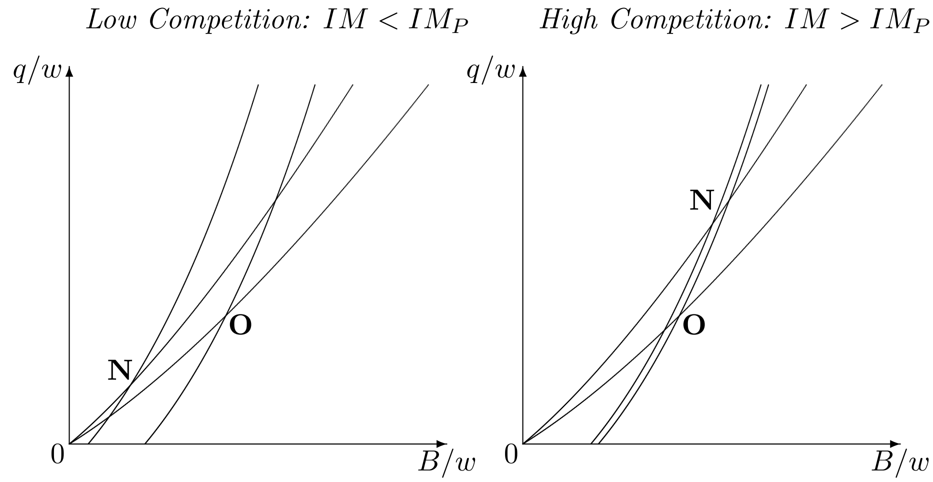
$$IM > IM_P. \tag{17}$$

Proof. In the Appendix. ■

Offshoring of managerial tasks has two effects on the real profits. First, a rise in I_S turns the free entry curve to the left, which, all else equal, increases the relative cost of managerial labor q/w. This effect is reminiscent of the productivity effect in Grossman and Rossi-Hansberg (2008). A rise in q/w, in turn, raises firm's real profits through a rise in the real total expenditure (given by $L + qH/w$). Second, higher I_S reduces the cost of entry into the market and, thereby, increases the number of domestic firms n. This decreases the price index in the economy, which reduces firm's real profits. Moreover, greater offshoring of managerial labor reduces the demand for skilled labor and, therefore, the skill premium q/w. These effects on B/w and q/w are represented by a shift of the skilled labor curve to the left. Figure 3 depicts these changes in the curves.

It appears that the overall effect on the real profits (and the skill premium) is ambiguous in general. However, the effect on the price index is weaker (and, therefore, the magnitude of the shift of the skilled labor curve is smaller), the higher is the competition from abroad (measured by IM). Thus, it can be shown that if IM is sufficiently high, the positive effect prevails over the negative and the real profits rise (see Figure 4).

Figure 4: Offshoring of Managerial Tasks: Low and High Foreign Competition ("O" and "N" mean the old and new equilibrium, respectively)



Proposition 3 suggests that the impact of offshoring of managerial labor on firm organization depends on the level of foreign competition. If the foreign competition is sufficiently tough, then offshoring of managerial labor results in firm decentralization (the P-equilibrium becomes "closer" to the A-equilibrium). Otherwise, offshoring of managerial labor leads to even more centralized firms. Note that the analogue of *Proposition* 3 can be formulated in the case of A- and O-equilibria as well.

4 Empirical Analysis

In this section, we test the predictions of the model using firm level data of Austrian and German firms with subsidiaries in Eastern Europe and the former Soviet Union. We start with the description of the data set. Then, we formulate the testable predictions of our theory regarding the relationship between firm organization and offshoring of different types of tasks that are then tested in the data.

4.1 The Data

The data are based on a survey among multinational firms in Austria and Germany with their affiliate firms in Eastern Europe including Russia and Ukraine and other former Soviet Republics. The sample comprises 2123 investment projects carried out by 660 Austrian and German firms during the period 1990 - 2001 (the actual numbers are from the years 1997-2000 in Germany and 1999-2000 in Austria). It represents 80% of total German investment and 100% of total Austrian investment in Eastern Europe. The questionnaire of the survey consists of three parts: information on parent firms, information on the actual investment project, and information on affiliates and their environment.

In our empirical analysis, we focus on firm organization within a parental firm. That is, a parental firm in the data corresponds to a firm in the theory. To construct the measure of the level of firm decentralization, we use simple means from the available scores of a number of corporate decisions within a parental firm with values between 1 (decisions are completely made at the CEO/owner level) and 5 (decisions are completely made at the divisional level). The decisions include acquisitions, finance, strategy, transfer prices, new products, R&D expenditures, budget, hiring >10% of current personnel, change of a supplier, product pricing, wage increase, etc. The average level of decentralization in the sample is 2.97.

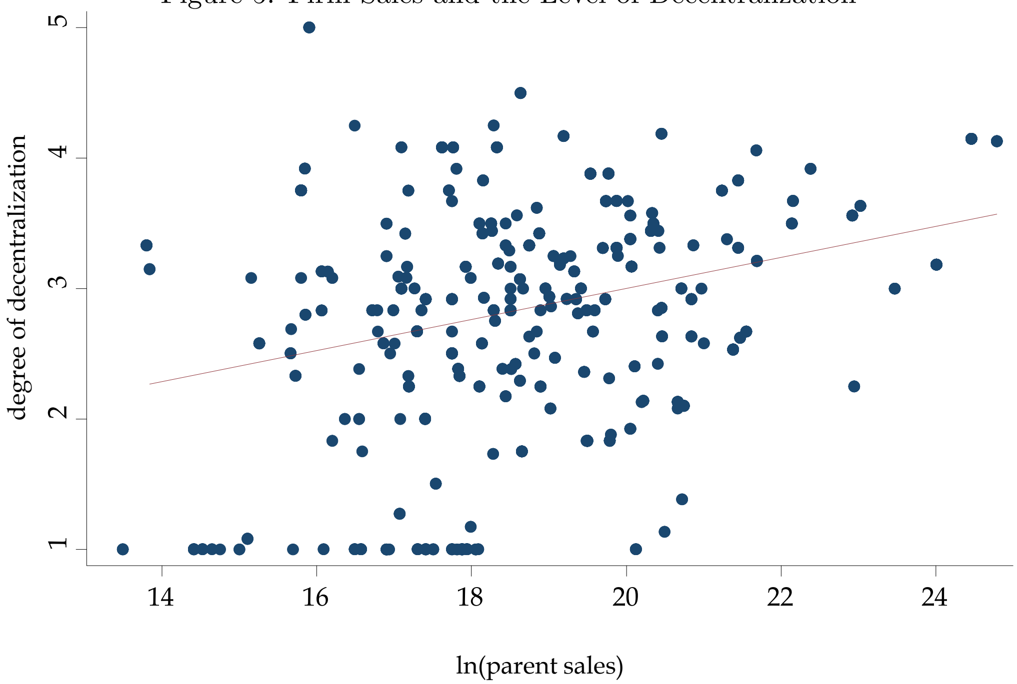
As the measure of the intensity of offshoring of production tasks we take the sum over all intra-firm trade between a parental firm and all its affiliates weighted by the parent's sales in its home country. In the survey, there is information on whether a parental firm sends a manager to its affiliate. We assume that if a manager is not sent, then she is hired directly from within the host country of the affiliate, i.e. offshored. This allows us to construct a dummy variable representing offshoring of managerial tasks, which is equal to 1 if the parent firm offshores one or more managers to a certain affiliate.

From the firm survey we also obtain a subjective firm level measure of the level of foreign competition. Specifically, we construct a dummy variable that indicates whether a parental firm faces a high level of competition on the global market (which means that there are a lot of world competitors). The dummy takes the value of 1 if the competition is intense. We also use a number of controls such as the parent's home sales, the distance to the technological frontier, etc. The descriptive statistics are presented in Table 3.

4.2 Testable Predictions

According to the theory, there is a positive relationship between the level of decentralization in decision making and real profits if firms have the P- organization (see *Proposition* 1). If we look at the relationship between the level of decentralization of a firm and its sales in the data (see Figure 5), we will clearly see a positive correlation (an additional term for the squared log of the sales appears not to be significant). This suggests that most observations in the sample lie on the part of the curve (that describes the relationship between real profits and the level of decentralization) between the P- and the A-organization. This in turn allows us to formulate two testable predictions of the theory.

Figure 5: Firm Sales and the Level of Decentralization



Testable Prediction 1: *A more intensive offshoring of production tasks leads firms to reorganize to more decentralized decision making.*

Indeed, a larger scale of offshoring of production tasks increases firm's real profits (see *Proposition* 2) and, therefore, according to *Proposition* 1 leads a more decentralized hierarchy.

Testable Prediction 2: *A more intensive offshoring of managerial tasks leads to to more decentralized decision making, if the exposure to foreign competition is sufficiently high, and to less decentralized decision making, otherwise.*

The second testable prediction is the corollary of *Proposition* 1 and *Proposition* 3. Remember that *Proposition* 3 states that the impact of offshoring of managerial tasks on firm's real profits depends on the level of foreign competition.

4.3 Econometric Specifications and Results

To test the first prediction, we consider the following econometric specification:

$$dec_i = \partial_0 + \partial_1 intrf_i + \partial_2 W_i + \varepsilon_i, \tag{18}$$

where dec_i represents the level of decentralization of a parental firm, $intrf_i$ is the measure of offshoring intensity (see the discussion in the previous section), W_i is the set of controls, and ε_i is the error term. We also include the industry and home and host country fixed effects. Note that the unit of observation in the regression is an investment project that comprises a parent and one of its affiliate.[9] This implies that multinational firms that have a higher number of affiliates get a higher weight in the regression and, thereby, have a bigger influence over the parameter estimates.

According to the theory, $\partial_1 > 0$. Table 1 presents the results for the OLS estimator. In all specifications the impact of intra-firm trade on the level of decentralization is positive and significant, which is consistent with the theoretical prediction.

Table 1: OFFSHORING OF PRODUCTION LABOR

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
sum of intrafirm trade	0.00366***	0.00372***	0.00380***	0.00332***	0.00332***
	[0.167]	[0.171]	[0.173]	[0.152]	[0.154]
ln parent sales	0.143***	0.129***	0.140***	0.139***	0.118**
	[0.343]	[0.307]	[0.332]	[0.334]	[0.281]
foreign competition		0.496**			0.468*
		[0.234]			[0.222]
domestic competition			0.205		0.0687
			[0.122]		[0.0409]
distance to the technological frontier				-3.45e-08 [-0.0303]	-1.01e-07 [-0.0792]
industry dummies	yes	yes	yes	yes	yes
home country dummies	yes	yes	yes	yes	yes
host country dummies	yes	yes	yes	yes	yes
Observations	724	699	713	708	680
Adjusted R-squared	0.118	0.171	0.131	0.119	0.177

The dependent variable is an index that measures the degree of decentralization in decision making with values between 1 (decisions are completely made by the CEO) and 5 (decisions are completely made at the divisional level). Our measure for the degree of offshoring is intrafirm trade weighted by the parent firm's sales. Robust normalized beta coefficients in brackets; *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at the parent level. All regressions additionally include a constant, industry dummies and dummies for the home and host countries. The foreign and domestic competition regressors are dummies obtained from survey data and take the value 1 if the firm faces intense or very intense competition and 0, else. The distance to the technological frontier is measured by the difference between the productivity of the top 95% percentile firm within the firm's industry and the firm's own productivity level.

[9] Therefore, our estimation accounts for clustered standard errors at the parent level.

To test the second prediction, we add in the above regression the dummy variable representing offshoring of managerial tasks and its interaction with the dummy representing the level of foreign competition. In particular, we consider the following specification:

$$dec_i = \partial_0 + \partial_1 intrf_i + \partial_2 ofm_i + \partial_3 ofm_i * forc_i + \partial_4 W_i + \varepsilon_i, \qquad (19)$$

where ofm_i is equal to 1 if the parental firm offshores one or more managers to the affiliate and $forc_i$ is equal to 1 if the parent has many foreign competitors. According to the theoretical predictions, $\partial_1 > 0$ (Prediction 1) , $\partial_2 < 0$, and $\partial_3 > 0$ (Prediction 2). Table 2 describes the results of running simple OLS estimates. Note that the sample size is smaller compared to the previous analysis, as we have relatively few observations on whether a parental firm offshores managers to its affiliate.

The first thing to notice is that in all specifications the impact of intra-firm trade on the level of decentralization remains positive and significant. The average effect of offshoring of managerial tasks on the level of decentralization is positive, but not significant (see the first column in Table 2). Note that this finding does not contradict the theory, as in general the theory predicts an ambiguous impact of offshoring managerial tasks on firm organization. However, if we introduce the interaction term (see the second and third columns), the effects of offshoring managerial tasks are significant and, moreover, exactly those predicted by the model: $\partial_2 < 0$ and $\partial_3 > 0$. In words, offshoring managerial tasks leads to more decentralized hierarchy if the level of foreign competition is high ($forc_i = 1$) and to less decentralized hierarchy otherwise ($forc_i = 0$).

Note also that the explanatory power of the econometric specification (measured by adjusted R^2) substantially rises from 0.25 to 0.32 with the inclusion of the interaction term. It is 0.25 without the interaction term and 0.32 with the interaction term. This suggests that the interplay of offshoring managerial tasks and the level of foreign competition plays an important role in explaining the variation in firm organization across firms.

Table 2: OFFSHORING OF SKILLED MANAGERS

VARIABLES	(1) OLS	(2) OLS	(3) OLS
sum of intrafirm trade	0.00800***	0.00778***	0.00807***
	[0.222]	[0.216]	[0.224]
ln parent sales	0.221***	0.245***	0.284***
	[0.416]	[0.461]	[0.533]
offshoring of managers	0.230	-0.829**	-0.825**
	[0.115]	[-0.416]	[-0.413]
offsh. of man. * foreign comp.		1.374***	1.379***
		[0.696]	[0.697]
foreign competition	0.970**	0.0351	0.0221
	[0.409]	[0.0148]	[0.00931]
distance to the			6.68e-07
technological frontier			[0.259]
industry dummies	yes	yes	yes
home country dummies	yes	yes	yes
host country dummies	yes	yes	yes
Observations	302	302	301
Adjusted R-squared	0.249	0.315	0.323

5 Conclusion

To be written.

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Appendix A

Existence and Uniqueness of the Equilibrium

In this subsection of Appendix, we show that there exists a unique solution of (11) with respect to B/w and q/w. It is straightforward to see from (11) that B/w solves the following equation (we substitute the free entry condition into the skilled labor market clearing condition):

$$B/w = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{a\left(L+\left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}\right)H\right)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right)+n^*\left(p_m\right)^{1-\sigma}}+\frac{A_m}{w}\right). \tag{20}$$

Let us define $F(B/w)$ as the right-hand side of (20). Then, B/w solves

$$B/w = F(B/w).$$

It can be shown that $F(B/w)$ behaves as a linear function (of B/w) when B/w tends to infinity. The slope of this function is equal to $Ca\rho^{1-\sigma}/2$. Remember that $C = \frac{1}{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}$ and $\rho = \frac{\sigma-1}{\sigma}$. Then, the slope of $F(B/w)$ in a neighborhood of infinity is $a/2\sigma$, which is strictly less than one (as $a < 1$ and $\sigma > 1$). Thus, for low values of B/w, $F(B/w) > B/w$ (as $F(0) > 0$), while, for high values of B/w, $F(B/w) < B/w$. This immediately implies that the solution of (20) exists.

Note that equation (20) can be transformed in a quadratic equation of B/w and, therefore, cannot have more than two solutions. Taking into account the properties of function $F(B/w)$, one can see that equation (20) cannot have exactly two solutions as well. As a result, (20) has a unique solution. This in turn implies that (11) has a unique solution.

When Offshoring is Profitable

Notice that $q > q^*$ if and only if

$$\frac{q(1-I_S)+q^*I_S}{w} > \frac{q^*}{w}.$$

The left-hand side of the inequality is the real cost of entry into the market if all the tasks are offshored. That is,

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

Thus, $q > q^*$ if and only if

$$\begin{aligned} \frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2 + \bar{e}\alpha\frac{B}{w} &> \frac{q^*}{w} \iff \\ \frac{B}{w} &> 2\frac{\sqrt{(\bar{e}\alpha)^2 + \frac{q^*}{w}(1-\bar{e}\alpha)^2} - \bar{e}\alpha}{(1-\bar{e}\alpha)^2}. \end{aligned}$$

As can be inferred from the equilibrium condition for B/w (see (11)), B/w is always strictly greater than $C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w}$. Hence,

$$\begin{aligned} C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w} &> 2\frac{\sqrt{(\bar{e}\alpha)^2 + \frac{q^*}{w}(1-\bar{e}\alpha)^2} - \bar{e}\alpha}{(1-\bar{e}\alpha)^2} \implies \\ \frac{B}{w} &> 2\frac{\sqrt{(\bar{e}\alpha)^2 + \frac{q^*}{w}(1-\bar{e}\alpha)^2} - \bar{e}\alpha}{(1-\bar{e}\alpha)^2} \implies \\ q &> q^*. \end{aligned}$$

The Proof of Proposition 3

By substituting the free entry condition into the skilled labor market clearing condition, we derive that B/w solves

$$B/w = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w} + \frac{a\left(L(1-I_S) + \left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2 + \bar{e}\alpha\frac{B}{w} - \frac{q^* I_S}{w}\right)H\right)}{H\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha + \frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right] + (1-I_S)IM}\right),$$

where IM is the measure of foreign competition given by $n^*(p_m)^{1-\sigma}$. Let us denote the right-hand side of the equation as $F(B/w, I_S)$. That is,

$$F(B/w, I_S) \equiv C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w} + \frac{a\left(L(1-I_S) + \left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2 + \bar{e}\alpha\frac{B}{w} - \frac{q^* I_S}{w}\right)H\right)}{H\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha + \frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right] + (1-I_S)IM}\right).$$

Then, the equilibrium value of B/w solves

$$B/w = F(B/w, I_S).$$

It can be shown that

$$F'_{I_S}(B/w, I_S) = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma} aH\frac{G(B/w)}{\left(H\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha + \frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right] + (1-I_S)IM\right)^2},$$

where

$$G(B/w) = -\left(L+\frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right] +IM\left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}-\frac{q^*}{w}\right).$$

Let us denote $(B/w)^*$ as the positive solution of

$$IM\left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2+\bar{e}\alpha\frac{B}{w}-\frac{q^*}{w}\right)=\left(L+\frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right].$$

It is straightforward to see that $G(B/w) > 0$ if and only if $B/w > (B/w)^*$. Hence, we can conclude that a rise in I_S raises $F(B/w, I_S)$ if and only if $B/w > (B/w)^*$. In other words, if the equilibrium value of B/w is greater than $(B/w)^*$, then a further rise in I_S increases $F(B/w, I_S)$ and, thereby, B/w. Otherwise, $F(B/w, I_S)$ and B/w go down with a rise in I_S.

A direct implication of these findings is that B/w is increasing in I_S on $[0, 1)$ if and only if $(B/w)^0 > (B/w)^*$, where $(B/w)^0$ is the solution of

$$B/w = F(B/w, 0).$$

That is, $(B/w)^0$ is the equilibrium value of B/w when $I_S = 0$ (there is no offshoring of managerial labor). Next, we find the condition when $(B/w)^0 > (B/w)^*$.

Using the definition of $(B/w)^0$, it is straightforward to show that $(B/w)^0 > (B/w)^*$ if and only if $F((B/w)^*, 0) > (B/w)^*$. We have that

$$F((B/w)^*,0)=C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w}+\frac{a\left(L+\left(\frac{(1-\bar{e}\alpha)^2}{4}\left((B/w)^*\right)^2+\bar{e}\alpha\left(B/w\right)^*\right)H\right)}{H\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\left(B/w\right)^*\right]+IM}\right).$$

As $G((B/w)^*) = 0$,

$$\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\left[\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\left(B/w\right)^*\right]=\frac{IM\left(\frac{(1-\bar{e}\alpha)^2}{4}\left((B/w)^*\right)^2+\bar{e}\alpha\left(B/w\right)^*-\frac{q^*}{w}\right)}{\left(L+\frac{q^*}{w}H\right)}.$$

Hence, we derive that

$$F((B/w)^*,0)=C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w}+\frac{a\left(L+\frac{q^*}{w}H\right)}{IM}\right).$$

Thus, B/w is increasing in I_S on $[0, 1)$ if and only if

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w}+\frac{a\left(L+\frac{q^*}{w}H\right)}{IM}\right)>(B/w)^*. \tag{21}$$

The next step is to consider an explicit expression for $(B/w)^*$. We introduce the following notation:

$$\begin{aligned}
D_0 &= IM\frac{(1-\bar{e}\alpha)^2}{4}, \\
D_1 &= IM\bar{e}\alpha - \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\frac{(1-\bar{e}\alpha)^2}{2}, \\
D_2 &= \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\bar{e}\alpha + IM\frac{q^*}{w}.
\end{aligned}$$

Then, $(B/w)^*$ solves

$$D_0\left((B/w)^*\right)^2 + D_1\left(B/w\right)^* - D_2 = 0,$$

which implies that

$$(B/w)^* = \frac{\sqrt{D_1^2 + 4D_0D_2} - D_1}{2D_0} > 0.$$

Thus, inequality (21) is equivalent to

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w} + \frac{a\left(L + \frac{q^*}{w}H\right)}{IM}\right) > \frac{\sqrt{D_1^2 + 4D_0D_2} - D_1}{2D_0} \iff$$

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w} > \frac{1}{IM}\left(2\frac{\sqrt{D_1^2 + 4D_0D_2} - D_1}{(1-\bar{e}\alpha)^2} - Ca\left(L + \frac{q^*}{w}H\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\right). \quad (22)$$

Let us denote the right-hand side of inequality (22) as $K(z)$ where z is $\frac{1}{IM}$. Then,

$$K(z) = 2\frac{\sqrt{(\bar{e}\alpha - K_1z)^2 + \left(K_2z + \frac{q^*}{w}\right)(1-\bar{e}\alpha)^2} - (\bar{e}\alpha - K_1z)}{(1-\bar{e}\alpha)^2} - K_3z,$$

where

$$\begin{aligned}
K_1 &= \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\frac{(1-\bar{e}\alpha)^2}{2}, \\
K_2 &= \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\bar{e}\alpha, \\
K_3 &= Ca\left(L + \frac{q^*}{w}H\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}.
\end{aligned}$$

Next, we explore the properties of the function $K(z)$. It is straightforward to see that $K(0) > 0$. The derivative of $K(z)$ with respect to z is given by

$$K'(z) = \frac{-2K_1(\bar{e}\alpha - K_1z) + K_2(1-\bar{e}\alpha)^2}{(1-\bar{e}\alpha)^2\sqrt{(\bar{e}\alpha - K_1z)^2 + \left(K_2z + \frac{q^*}{w}\right)(1-\bar{e}\alpha)^2}} + \frac{2K_1}{(1-\bar{e}\alpha)^2} - K_3.$$

Hence,

$$K'(0)=\frac{-2K_1\bar{e}\alpha+K_2\left(1-\bar{e}\alpha\right)^2}{\left(1-\bar{e}\alpha\right)^2\sqrt{\left(\bar{e}\alpha\right)^2+\frac{q^*}{w}\left(1-\bar{e}\alpha\right)^2}}+\frac{2K_1}{\left(1-\bar{e}\alpha\right)^2}-K_3.$$

Since $-2K_1\bar{e}\alpha+K_2\left(1-\bar{e}\alpha\right)^2=0$,

$$K'(0)=\frac{2K_1}{\left(1-\bar{e}\alpha\right)^2}-K_3>0,$$

as $Ca\rho^{1-\sigma}<1$. Thus, $K(z)$ is increasing in the neighborhood of zero. Moreover, $K'(\infty)$ is also positive, implying that $K(\infty)=\infty$. As, for any constant A, the equation $K(z)=A$ has at most two solutions and $K(\infty)=\infty$, we can conclude that $K(z)$ is an increasing function in z.

This in turn means that the right-hand side of inequality (22) is always positive and decreasing in IM with the value at infinity being equal to

$$K(0)=2\frac{\sqrt{\left(\bar{e}\alpha\right)^2+\frac{q^*}{w}\left(1-\bar{e}\alpha\right)^2}-\bar{e}\alpha}{\left(1-\bar{e}\alpha\right)^2}.$$

As we assume that $C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w}>2\frac{\sqrt{(\bar{e}\alpha)^2+\frac{q^*}{w}(1-\bar{e}\alpha)^2}-\bar{e}\alpha}{(1-\bar{e}\alpha)^2}$ (see (13)), there exists such a value of IM (we denote it as IM_P) that inequality (22) holds if and only if $IM>IM_P$.

Table 3: Definition of Variables and Descriptive Statistics

Variable	Observations	Descriptions	Mean	Minimum	Maximum	Std. Dev.
		Firm Level Measures				
average level of decentralization in decision making	899	An index that measures the degree of decentralization in corporate decision making with values between 1 (decisions are completely made by the CEO) and 5 (decisions are completely made at the divisional level). Decisions include decisions over acquisitions, finance, strategy, transfer prices, new products, R&D expenditures, budget, hiring >10% of current personell, hiring 2 workers, change of a supplier, product pricing, wage increase, firing personell and hiring a secretery.	2.97	1	5	0.82
sum of intrafirm trade	1591	Sum over all intra-firm trade between a parent and their subsidiaries weighted by the parent's turnover in its home country	7.85	0	600	35.5
offshoring of managers	516	Dummy is 1 if the parent firm offshored one or more managers	0.5	0	1	0.5
ln parent sales	1247	LN of parent-level sales (in Mio. EUR)	19.05	13.84	24.78	1.96
ln affiliate sales	1269	LN of affiliate-level sales (in Mio. EUR)	15.53	9.54	21.86	1.8
distance to the technological frontier	1236	difference in productivity (measured by labour productivity) between the top 95 percentile firm of the industry and the current firm	583461.6	-7442632	1775145	800927.6
parent country	1591	Parent country dummy	0.61	0	1	0.49
affiliate country category 1	1591	Dummy for subsidiaries in one or more of the following countries: H, PL, SLO, SK, CZ, EST, LV, LT	0.74	0	1	0.44
affiliate country category 2	1591	Dummy for subsidiaries in one or more of the following countries: BG, RO, ALB, CRO, BIH, MAC	0.13	0	1	0.34
affiliate country category gus	1591	Dummy for subsidiaries in the Commonwealth of Independent States	0.12	0	1	0.33
		Measures of Trade and Competition				
foreign competition	1491	Dummy that measures the degree of competition that the firm faces on the global market; takes 0 if the question is answered with either "no" or "few competition" and 1 if "many" or "intense competition"	0.82	0	1	0.39
domestic competition	1529	Dummy that measures the degree of competition that the firm faces on the domestic market; takes 0 if the question is answered with either "no" or "few competition" and 1 if "many" or "intense competition"	0.57	0	1	0.49