Trade in Tasks and the Organization of Firms[*]

Dalia Marin[a]

Jan Schymik[b]

Alexander Tarasov[c]

University of Munich

University of Munich

University of Munich

May 2015

Abstract

We incorporate trade in tasks into Marin and Verdier (2012) to examine how offshoring affects the way firms organize. Offshoring of production tasks and of managerial tasks leads to more decentralized management and to larger CEO wages in open economies. We test the predictions of the model with original firm level data. We find that offshoring firms are 33.4% more decentralized than non-offshoring firms. Offshoring of managers reduces the level of decentralized management by 3.1%, but increases the level of decentralized management by 4% in industries with a level of openness above the 25th percentile of the openness distribution.

Keywords: international trade with endogenous organizations, the rise of human capital, theory of the firm, multinational firms, CEO pay

JEL classification: F12, F14, L22, D23

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 of the firm. It is often characterized by a 'war for talent' rather than a 'war for market shares'. Firms engaged in international activities 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. In this paper, 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 geographically separate 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 intrafirm imports account between 22 to 69 percent of total imports between western and eastern Europe (see Marin (2006)).[2]

Data on the changing nature of the corporation have become available only recently. Rajan and Wulf (2006) and Marin and Verdier (2014) document that firms in the US, Germany, and Austria shifted to a more decentralized organization over time. Marin (2008) and Marin and Verdier (2014) show that firms in the larger economy, Germany, are more decentralized compared to firms in the smaller economy, Austria. Bloom, Sadun and van Reenen (2010) report that firms in the US, UK, and Northern Europe have the most decentralized organization, while firms in Asian countries are most centralized.

The literature on organization and trade has so far examined how international trade in final goods affects the internal organization of firms. Marin and Verdier (2008, 2014) and Caliendo and Rossi-Hansberg (2012) show based, respectively, on a Krugman (1980) model, a Melitz and Ottaviano (2008) model, and on a Melitz (2003) model of international trade, that North-North trade induces firms to reorganize their production and to decentralize decision making power to lower levels of management. Marin and Verdier (2012) examine the organizational implications

---

[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 of labour in Europe, see Marin (2006). For a recent estimate on global value added chains, see Johnson and Noguera (2012).

of trade integration within a framework of a Helpman and Krugman (1985) model of North-South trade in which countries differ in factor endowments. 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 papers 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 intrafirm trade have increased much stronger than final goods trade in the last two 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.[3]

In this paper, we incorporate trade in tasks à la Grossman and Rossi-Hansberg (2008) (hereinafter referred to as GRH) into a small open economy version of the theory of firm organization of Marin and Verdier (2012) (hereinafter referred to as MV) to explore how offshoring of production tasks and managerial tasks affects the internal organization of Northern firms in a small open economy. Specifically, we consider a small open economy 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 à la Helpman and Krugman (1985). In the X-sector firms producing a variety of the differentiated good 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 with the agent. There is free entry into the industry. Workers (low-skilled labour) are used in production of both products, while managers (high-skilled labour) are only used for entry into the industry. In other words, firms need to hire a manager to run a firm.

Our paper contributes in several ways to the recent literature on globalization and the organization of firms. First, we show that the offshoring of production tasks by Northern firms to the South unambiguously increases firms' profits and, thereby, induces firms to reorganize to decentralized management, in which power is allocated to the skilled manager in Northern firms.[4] The offshoring of production workers has two opposing effects on profits. On the one

---

[3]For a review of the impact of international trade on the internal organization of firms, see Marin (2015).

[4]In GRH this effect is absent, as 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. Marin (2011) 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. Amiti and Konings

hand, it lowers the marginal costs of production. On the other, it induces firm entry, increasing competition, which then lowers the firms' revenues and profits. We show that in an open economy, the positive productivity effect is always stronger than the negative competition effect and, as a result, profits unambiguously increase. When profits rise in the North, principals in firms start to monitor more inside the firm potentially destroying the initiative of skilled managers. When the increase in offshoring is sufficiently large, profits rise and the trade-off between control and initiative in the firm moves in favor of keeping the initiative of the skilled manager alive. As a result, principals delegate decision power to the skilled manager.

Second, we find that Northern firms gain market shares from 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 Northern firms. Improved competitiveness as a result of offshoring has so far 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.[5]

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 offshoring of skilled managers to the South has an ambiguous effect on relative CEO pay and the organization of firms in the North. On the one hand, offshoring of managerial tasks lowers the demand for managers in the North which relaxes the resource constraint on managers, lowering their relative wages (the labour market effect). On the other hand, the lower start-up costs of a firm (recall that each firm has to hire a manager to start a firm) induce firm entry into the market, which increases competition and raises the demand for managers, resulting in a rise in the relative wage of managers (the 'war for talent' effect). We show that when the economy is sufficiently open to international trade the 'war for talent' effect dominates the labour market effect, making it more likely that Northern firms decentralize management and pay their CEOs higher wages. The offshoring of managerial tasks to Eastern Europe may explain why the rise

(2007) and Halpern, Koren and Szeidl (2011) quantify the productivity effect from offshoring for Indonesia and Hungary, respectively.

[5]For the labour market effects of offshoring, see Brainard and Riker (1997), Becker and Muendler (2010), Marin (2011). For the increase in export market shares as a result of offshoring, see Marin, Schymik and Tscheke (2015).

4

in CEO compensation in Germany has been less pronounced than in the US.[6] In the empirical part of this paper, we show that offshoring of managerial tasks to Eastern Europe has occurred frequently and has been substantial (in 57% of German and Austrian foreign direct investments with on average 2.63 managers offshored per investment project). This has contributed to lowering CEO wages relative to workers by between 13% and 18%.

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. We find that offshoring firms are 33.4% more decentralized than non-offshoring firms (when we instrument trade in tasks by a 'standardized foreign input' and the headquarter intensity of the parent firms[7]). We find further that an increase in the fraction of managers offshored by the sample mean reduces the level of decentralized management by 3.1%, but increases decentralized management by 4.0% in sectors with a level of openness above the 25th percentile of the openness distribution. Lastly, we find that one additional offshored manager on average lowers the relative wages of executives by 4.9% with the labour market effect reducing CEO relative wages by 6.9% and the 'war for talent' effect increasing CEO relative wages by 2%.

The paper is related to the recent literature on offshoring in a global economy. Antràs and Helpman (2004, 2008) and Antràs, Garicano and Rossi-Hansberg (2006) examine the organization of offshoring in a global economy. Antràs and Helpman (2004, 2008) consider the conditions under which the activity is offshored inside the firm rather than delegated to an independ foreign input supplier. Antràs, Garicano and Rossi-Hansberg (2006) determine the formation of international teams in multinational firms. In this paper we abstract from the organizational issues of offshoring. We examine instead how offshoring - whatever organizational form it may take - affects the organization of firms in the North, whether they decentralize or centralize decision making power between the headquarters and the divisional managers in Northern firms.[8]

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

---

[6]For the stylized features of the rise in CEO pay in Germany, see Fabbri and Marin (2015).

[7]This instrument is inspired by Antràs and Helpman (2008), who argue that offshoring within the firm will be more prevalent, when the foreign input supplier delivers a standardized input with little hold-up problems and headquarters provides R&D input.

[8]For a survey on the organization of offshoring, see Antràs and Rossi-Hansberg (2009).

2 The Model

We consider a small open economy with two goods and two factors of production: skilled and unskilled labour. 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 labour. 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 in an international market, we follow 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 (e.g. perks or career concerns). Thus, there is a potential conflict of interest between the principal and the manager. We denote by αB ($\alpha \in [0, 1)$) the principal's benefit when the best project for the manager is implemented. To simplify the analysis, we assume that the manager's benefit when the best project for the principal is implemented is zero. Here, α captures the degree of conflict between the principal and the manager. B and b are supposed to be known ex ante, but the parties do not know ex ante which project yields which payoff.

To gather information on the payoffs of the projects, the principal uses a low skilled labour monitoring technology. Specifically, by investing some amount of unskilled labour L, the prin-

cipal learns all the payoffs with probability $E = \min(1, \sqrt{L})$ and remains uninformed with probability $1 - E$. Similarly, by exerting some effort ke ($k < b$), the agent learns the payoffs 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 the 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 control over the decision to the informed party that, in this case, has 'real power' rather than 'formal power' in the firm.

In the X-sector, the principals in firms choose between three modes of organization, to maximize utility: P-organization, A-organization, and O-organization. In P-organization, the principal has formal power. In A-organization, the principal delegates formal power to the manager. Finally, in 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 O-organization as P-organization with zero effort put in by the manager).

2.1.1 P-organization

Under P-organization, the principal has formal power. In this case if the principal is fully informed about the payoffs, then the best project for the principal is implemented and the principal's monetary payoff is B, while the manager receives zero. 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 the private benefit b. If both the parties remain uninformed, there is no production.

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

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

Here, w is the wage rate of unskilled labour (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 highlight the

7

trade-off between control and initiative in the firm. They are

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

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

The principal invests in more monitoring the higher the monetary payoff B, 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 her benefit b from the project and the lower the principal's interference (lower E). Thus, the principal's control over the firm comes at the cost of less initiative on the part of the agent.

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

$$E_P^* = \frac{B(1 - \alpha\bar{e})}{2w}, \; e_P^* = \bar{e} \quad \text{if } B/w \leq \tilde{B}_P \tag{2}$$

$$E_P^* = \frac{B}{2w}, \; e_P^* = 0 \quad\quad\quad \text{if } B/w > \tilde{B}_P,$$

with the cutoff level of profits at which the initiative of the agent is killed being

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

Note that the case with zero effort put in by the manager corresponds to O-organization.[9] Thus, it is straightforward to show that the expected utility of the principal under P-organization is

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

2.1.2 A-organization

Under A-organization, the principal delegates formal power to the manager. If both parties are informed, then the best project for the manager is implemented. When the principal is informed and the agent is uninformed, the principal suggests her preferred project and, thereby, has real

---

[9]O-organization can be thought of a firm with P-organization (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 contractable.

power. The expected payoffs of the principal and the agent are

$$v_P = e\alpha B + (1 - e)EB - wE^2,$$
$$v_A = eb - ke.$$

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

$$\text{Principal:} \quad B(1 - e) = 2wE,$$
$$\text{Agent:} \quad e = \bar{e},$$

as b is assumed to be greater than k.

The advantage of delegating formal power to the manager is that the manager has more incentives to become informed. Specifically, under A-organization, the manager always puts in the maximum effort $\bar{e}$. In contrast, the principal has fewer incentives for investing in monitoring the projects and, as a result, the principal loses not only formal power, but also real power. The equilibrium values of E and e are

$$E_A^* = \frac{B(1 - \bar{e})}{2w}, \ e_A^* = \bar{e}.$$

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

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

2.1.3 The Choice of Decentralized Management

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*

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

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

Proof. For convenience, we reproduce the proof of the proposition in the Appendix. ∎

Intuitively, a trade-off between control and initiative arises only at intermediate levels of profits: the trade-off disappears at low and high levels of profits. At $\tilde{B}_P \leq B/w < \bar{B}$, the principal delegates formal power to the manager to maintain the initiative. As a result, A-organization is optimal. At high levels of profits ($B/w \geq \bar{B}$), the principal's stakes are so high that the principal puts a lot effort into monitoring the projects, which in turn leads to zero effort put in by the manager under any type of firm organization. As a result, O-organization is optimal. At low levels of profits ($B/w < \tilde{B}_P$), the principal's stakes are small and, therefore, the principal does little monitoring or intervening, and does not depress the initiative of the manager although keeping control. The manager puts in the maximum effort, and P-organization is optimal.

2.2 Product Markets and the Trade Environment

In the previous section, the profits of firms were exogenous. We now endogenize profits by introducing product market competition and trade into the model. In particular, we consider a small open economy where the number and the prices of foreign varieties are taken as given.[10] In addition, we assume that there is some exogenous foreign demand for domestic varieties, given by $A_m/p(i)^\sigma$ (where A_m is a parameter).

The domestic demand for the 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,

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

---

[10]Modeling a large open economy adds unnecessary complexity to the analysis. Moreover, under certain assumptions, we do not expect that the implications will be qualitatively different from those derived in the present framework.

where n^* is the number of foreign varieties in the market (which is exogenous). To simplify the notation, we denote the level of import penetration, $n^* (p_m)^{1-\sigma}$, by IM.

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 homogenous good is produced with a linear one-to-one technology (requiring only unskilled labour). Hence, the wage rate of unskilled labour 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 project for the principal is implemented, then $c(i) = c_B$, otherwise, $c(i) = c_b$ with $c_b > c_B$. The idea here is that when the agent has 'real power' in the firm, the agent does not necessarily pick the cost-minimizing project, but rather that which increases the agent's perks. This is how the conflict of interest between the principal and the agent translates to the production side of the firm. The variable Z_X, in turn, describes the 'productivity' gains from offshoring some production tasks. 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 $C = \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma} \right)^{\sigma-1}$.

2.3 Trade in Tasks

To model the offshoring of labour tasks, we adopt the framework of 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 labour.

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 labour 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[11]

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

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

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

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 are the firms. If there is no offshoring ($I_X = 0$), then Z_X is equal to one and the marginal cost is $wc(i)$.

---

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

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

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

In the same spirit, we consider the offshoring of managerial tasks as a continuum of tasks (of measure one) performed by a manager which may be offshored abroad. Performing each task requires one unit of managerial labour. Tasks that are not offshored are performed by a domestic manager who is paid according to the number of performed tasks. Note that the domestic manager searches for projects for the firm, as the domestic manager receives a non-pecuniary benefit from an implemented project. We assume that the 'foreign' manager does not receive any benefits from implemented projects and, therefore, does not have any incentive to search for projects. That is, the foreign manager only performs some offshored tasks that are necessary to start a firm.

We assume that the fraction of tasks that can be offshored is exogenously given by I_S.[12] Offshoring managerial tasks is profitable only if the cost of foreign managers is less than the cost of a domestic manager: i.e., $q > q^*$ (where q and q^* are the costs of skilled labour at home and abroad, respectively). 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. In this case, the cost of entry into the market is given by $q(1 - I_S) + q^* I_S$.

2.4 The Equilibrium

Recall that the profits of a firm producing variety i are

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

When the principal picks the project and has real power in the firm, the marginal cost of production is c_B and the principal's benefit is

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

with

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

Depending on the parameters in the model, there are three types of equilibria (under P-organization, A-organization, and O-organization). Each equilibrium is characterized by the free entry condition and the factor market clearing conditions. The free entry condition means that the expected principal's profits are equal to the cost of starting a firm. Remember that

---

[12]Endogenizing I_S does not substantially change the qualitative results, but makes the analysis more cumbersome.

the expected principal's profits are given by $w(E_k^*)^2 + e_k^* \alpha B$ where k represents the type of the organizational equilibrium: $k \in \{P, A, O\}$. Thus, the free entry condition can be written as follows:

$$w(E_k^*)^2 + e_k^* \alpha B = q(1 - I_S) + q^* I_S. \tag{8}$$

Let us denote by n the number of firms in the market. Then, under k-organization, $E_k^* n$ firms implement projects that are best for their principals, $(1 - E_k^*) e_k^* n$ firms implement projects that are best for their 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 (specifically, only $1 - I_X$ tasks are performed domestically), the demand for unskilled labour in the differentiated sector at k-equilibrium is

$$L_X^k = n(1 - I_X) * \begin{cases} [E_k^* c_B x_B + (1 - E_k^*) e_k^* c_b x_b] & \text{if } k = P, O \\ [E_k^* (1 - e_k^*) c_B x_B + e_k^* c_b x_b] & \text{if } k = A \end{cases},$$

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

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

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

Finally, the demand for skilled labour is equal to the number of firms entering the market multiplied by the number of managerial tasks performed at home. Thus, the market clearing condition for skilled labour is

$$H = n(1 - I_S), \tag{10}$$

where H is the endowment of skilled labour in the economy. Hence, the number of domestic firms in the economy is exactly determined by the endowment of skilled labour and the number of managerial tasks offshored.

Note that if I_S is close to unity, the number of firms, n, is close to infinity. This, in turn, means that firms' expected profits can be sufficiently low. At the same time, however, firms' expected profits are pinned down by the cost of managerial labour abroad, q^*, and are therefore not necessarily as low as required to clear the skilled labour market. As a result, it is possible that for sufficiently high values of I_S, no equilibrium in the model exists (this happens when the demand for skilled labour is lower than the supply). To avoid problems with the existence of an

14

equilibrium, we impose an upper bound on I_S. Specifically, we assume that

$$I_S \leq \frac{wL}{wL + q^* H}.$$

In the Appendix, we show that this condition is sufficient to guarantee the existence of an equilibrium in the model. Notice that if q^* tends to zero, the upper bound tends to one.

As the wage rate of unskilled labour 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.

To be consistent with the k-organization equilibrium, the equilibrium values of B/w must belong to the proper interval. Specifically, in order for P-organization to take place, the parameters in the model must be such that the solution of the equilibrium system of equations (for $k = P$) results in an equilibrium value of B/w less than $\tilde{B}_P$ (see Proposition 1). Similarly, in order for A-organization to take place, the solution of the equilibrium equations (for $k = A$) needs to result in a B/w between $\tilde{B}_P$ and $\bar{B}$. Finally, for the occurrence of O-organization, the equilibrium value of B/w implied by the equilibrium equations for $k = O$ needs to be higher than $\bar{B}$.

Note that in the present paper we do not explore under which conditions a certain type of equilibrium takes place in the model. For instance, it can be the case that for some parameters there are multiple equilibria under P- or A-organization (see Marin and Verdier (2012) for details). What we do in this paper is to analyse how the offshoring of different types of tasks affects the equilibrium outcomes, assuming that the economy is either in a P-, A-, or O-equilibrium.

3   Decentralized Management and Offshoring

We now explore how the offshoring of production and managerial tasks affects the type of firm organization chosen by the principals. In particular, we examine how changes in I_X and I_S affect real profits B/w. The idea behind this exercise is the relation between the type of firm organization and real profits as stated in Proposition 1. In particular, 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 real profits. Thus, understanding the relation between offshoring and real profits sheds light on the connection between offshoring and firm organization.

Since the results we formulate below hold in any type of equilibrium (see Section 3.3 for details), without loss of generality, we consider the equilibrium under P-organization. The free entry condition at P-equilibrium is given by

$$w\left(E_P^*\right)^2 + e_P^* \alpha B = q(1 - I_S) + q^* I_S.$$

Taking into account the expressions for E_P^* and e_P^* (see (2)), the free entry condition can be rewritten:

$$\frac{(1 - \bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2 + \bar{e}\alpha\frac{B}{w} = \frac{q(1 - I_S) + q^* I_S}{w}. \tag{11}$$

Recall from (7) that the principal's benefit from picking the project is

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

where R is the total expenditure of the economy given by $wL + qH$. Thus, we have

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

The price index in the economy is given by

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

As at P-equilibrium, $E_P^* n$ domestic firms implement projects with cost c_B and $(1 - E_P^*)e_P^* n$ firms implement projects with cost c_b, the price index can be written

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

where $\rho = (\sigma - 1)/\sigma$. Moreover, using the expressions for E_P^* and e_P^* in (2), it is straightforward to show that
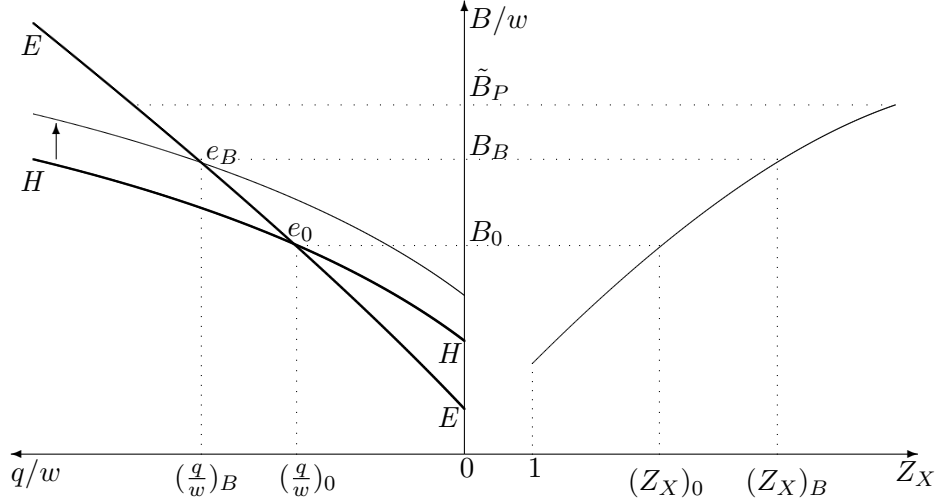
$$E_P^* + (1 - E_P^*)e_P^*\alpha = \bar{e}\alpha + \frac{(1 - \bar{e}\alpha)^2}{2}\frac{B}{w}$$

and the price index is equal to

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

Taking into account that the supply of skilled labour is equal to H (implying that $n =$

Figure 1: Equilibrium and Offshoring of Production Tasks

$H/(1 - I_S)$), the skilled labour market clearing condition can be written as

$$B/w = C \left(\frac{w}{Z_X} c_B \right)^{1-\sigma} \left(\frac{a \left(L + \frac{q}{w} H \right)}{\frac{H}{1-I_S} \left(\frac{1}{\rho} \frac{w}{Z_X} c_B \right)^{1-\sigma} \left(\bar{e}\alpha + \frac{(1-\bar{e}\alpha)^2}{2} \frac{B}{w} \right) + IM} + \frac{A_m}{w} \right). \qquad (12)$$

Thus, we have two conditions that determine the equilibrium values of B/w and q/w: the free entry condition (11) and the skilled labour market clearing condition (12), from which we solve for B/w and q/w. In the Appendix, we show that a solution of (11) and (12) exists and is unique. Hence, a P-organizational equilibrium exists if and only if the B/w that solves (11) and (12) is less than $\tilde{B}_P$.

Figure 1 (left quadrant) illustrates the equilibrium. The HH curve depicts the market clearing condition for skilled labour from (12), which equates the number of firms n requiring a manager to the supply of skilled managers $H/(1 - I_S)$. The HH curve is upward sloping because larger q/w requires larger B/w to satisfy (12). When q/w is large, too many firms are looking for a manager. In order for (12) to hold, the number of firms n has to decline and thus B/w increases. The EE curve shows the free entry condition from (11). It equates expected profits to the fixed costs of market entry. It is upward sloping as well, because as B/w rises, firms want to enter the market. Firms can enter the market only by hiring a skilled manager. Since the number of firms is fixed by the resource constraint on skilled managers, q/w rises: entering firms try to lure away managers from incumbent firms, thus pushing up q/w. For this reason, the EE curve may be called the 'war for talent' curve.

Figure 2: An Increase in the Level of Openness
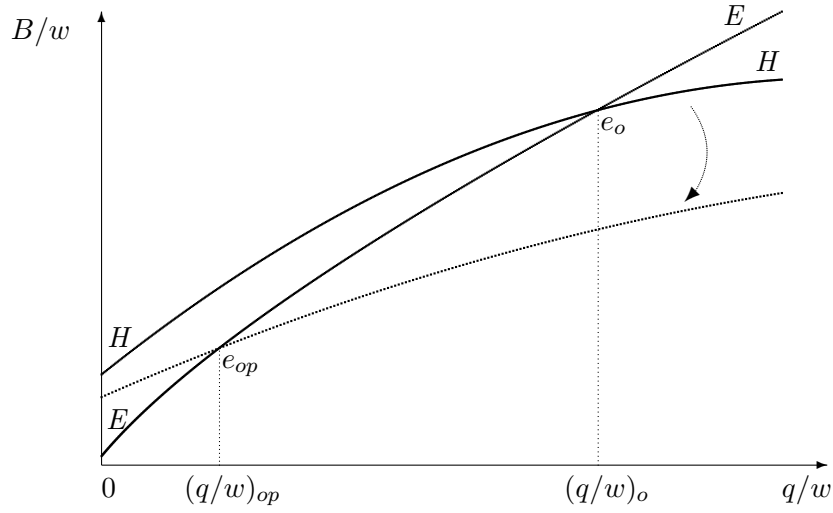
3.0.1 A Change in the Level of Openness

Next, we want to explore how a change in openness IM affects the labour market conditions for managers as given by (12). We illustrate an increase in the level of openness with the help of Figure 2. A rise in IM has two effects on the HH curve. First, it shifts the HH curve downwards as tougher foreign competition reduces firms' profits for any q/w. Second, with a rise in IM, the slope of the HH curve becomes flatter. To illustrate this, we take the derivative of B/w with respect to q/w. Taking into account (12), this derivative is given by

$$\frac{dB/w}{dq/w} = \frac{C\rho^{1-\sigma}aH}{\frac{H}{1-I_S}\left(\bar{e}\alpha + (1-\bar{e}\alpha)^2 \frac{B}{w} - \frac{(1-\bar{e}\alpha)^2}{2}\frac{A_m}{w}C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\right) + IM\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{\sigma-1}}.$$

As can be seen, a rise in IM decreases the value of the derivative for any B/w and q/w. In an economy with more foreign firms, there are relatively fewer domestic firms active in the market as there is less of an incentive for domestic firms to enter (the downward shift of the HH curve). An increase in q/w requires the number of firms to decline (in order for the labour market condition for managers (12) to hold), which increases B/w by less when the economy is more open to trade, as only domestic firms' profits increase. Consequently, the HH curve flattens when the economy becomes more open. Figure 2 shows that an increase in the level of openness reduces the relative wage for managers as there are more foreign firms in the market who do not require a domestic manager. Foreign firms employ foreign managers when they deliver goods to the domestic market. Therefore, an increase in openness eases the demand for local managers.

18

3.1 Offshoring of Production Tasks

We now explore how changes in the scale of offshoring of production tasks, I_X, 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 pinned down by the world price of the homogenous good, the only effect of I_X on B/w is through changes in Z_X. In particular, a larger I_X results in higher productivity gains Z_X. Thus, we need to explore how a rise in Z_X affects real profits. The following proposition holds.

Proposition 2 *In P-organizational equilibrium, a rise in Z_X leads to a higher value of real profits B/w and to a rise in q/w in equilibrium.*

Proof. The proof follows directly from (11) and (12). ∎

We illustrate the intuition with the help of Figure 1. A rise in Z_X shifts the HH curve upwards, while the free entry curve EE does not change (left quadrant). As a result, the equilibrium values of B/w and q/w rise. There are two opposing effects of a rise in Z_X on real profits: it lowers marginal costs $wc(i)/Z_X$ and increases firms' real profits for any q/w (the productivity effect); at the same time, all other domestic firms become more productive as well, lowering firms' revenues and profits through a decrease in $RP^{\sigma-1}$ (the revenue effect). Note that the number of firms entering the market does not change as it is given by the resource constraint on managers $n = H/(1 - I_S)$. As can be seen from Proposition 2 and Figure 1, the positive productivity effect dominates the negative revenue effect and, as a result, real profits B/w unambiguously rise with the offshoring of production tasks Z_X (right quadrant). This is because we consider an open economy. When the domestic market is open to foreign competition (as captured by IM), a rise in Z_X affects only the productivity of domestic firms but leaves those of their foreign rivals unchanged. The improved competitiveness of domestic firms weakens the negative revenue effect. Moreover, the presence of export markets (given by A_m) enhances the effect of lower marginal costs on profits.[13]

---

[13]Actually, in the small open economy (SOE) we consider here, the foreign market share IM is exogenous and does not change when domestic firms become more competitive due to an offshoring of production tasks. As a result, the foreign market share IM prevents revenues $RP^{\sigma-1}$ from falling proportionally to the rise in Z_X (as prices for foreign varieties do not fall when domestic firms become more productive). In a fully developed general equilibrium North–South model of offshoring, IM falls in response to a rise in Z_X, as domestic firms take some of the domestic market from foreign rivals. For the gain in market shares due to offshoring, see Marin, Schymik, and Tscheke (2015).

In a closed economy (when $A_m = 0$ and $IM = 0$), the system of equations (11) and (12) changes to

$$
\begin{cases}
\dfrac{q(1-I_S)+q^*I_S}{w} = \dfrac{(1-\bar{e}\alpha)^2}{4}\left(\dfrac{B}{w}\right)^2 + \bar{e}\alpha\dfrac{B}{w}, \\[4mm]
B/w = \dfrac{Ca\rho^{1-\sigma}\left(\frac{L}{H}+\frac{q}{w}\right)(1-I_S)}{\bar{e}\alpha+\frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}}.
\end{cases}
\tag{13}
$$

and the two opposing effects on real profits exactly cancel out. Thus, in a closed economy, a rise in B/w (due to lower marginal costs) is exactly compensated by the decline in B/w (due to the smaller revenue when all other domestic firms serving the market become more productive as well) and the offshoring of production tasks does not change real profits and the way firms organize.

When the increase in Z_X is sufficiently large, B/w rises and exceeds the cutoff $\tilde{B}_P$ (see Proposition 1). As a result, firms switch from P-organization to A-organization and decentralize formal power to the skilled manager to foster that manager's initiative.

3.2 Offshoring of Managerial Tasks

In this section, we consider the offshoring of managerial tasks. In particular, we examine how the offshoring of managerial labour affects firm's real profits, their level of decentralization, and the relative wages for managers. As in the previous section, we analyse the P-equilibrium in the model. Recall that offshoring managerial tasks takes place only if the cost of a foreign manager is lower than the cost of a domestic manager, i.e., $q > q^*$. In the model, q is endogenously determined and affected by offshoring. To guarantee $q > q^*$ for any value of I_S, we assume that q^* satisfies

$$
C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w} > 2\frac{\sqrt{(\bar{e}\alpha)^2 + \frac{q^*}{w}(1-\bar{e}\alpha)^2} - \bar{e}\alpha}{(1-\bar{e}\alpha)^2}.
\tag{14}
$$

Note that the latter inequality holds when q^* is sufficiently small. In this case, the equilibrium value of q is strictly greater than q^* for any size of the domestic market (for details, see the Appendix).

Proposition 3 examines how changes in the number of managerial tasks offshored affect real profits and the relative wages for managers.

Proposition 3 *At P-equilibrium, there exists a cutoff level of openness of the economy, denoted by IM_P, such that for $IM > IM_P$: B/w and q/w are increasing in I_S; and for $IM \leq IM_P$: B/w is declining in I_S, while the impact of I_S on q/w is ambiguous.*

20

Proof. See the Appendix. ∎

We explain the intuition behind Proposition 3 with the help of Figures 3 and 4. The left quadrant of Figures 3 and 4 gives the free entry curve EE and the market clearing curve HH, while the right quadrant shows the real profits B/w as a function of the offshoring of managerial tasks I_S. The offshoring of managerial tasks has three distinct effects on the equilibrium outcome. First, a rise in I_S lowers the cost of market entry and shifts down the free entry curve EE, increasing B/w and q/w (the war for talent effect: a move from e_0 to e_T). The lower costs of entry make it attractive for firms to enter the market. However, firms can enter only if they hire a manager. As the number of firms is fixed by the resource constraint for managers, firms compete with the incumbent firms for the available pool of managers in the economy, pushing up the relative costs of managerial labour q/w and the level of profits firms require to enter the market B/w.

Second, a rise in I_S lowers the demand for skilled managers in the North and shifts the HH curve down, decreasing the skill premium for managers q/w and real profits B/w (the labour market effect: a move from e_T to e_L). This relaxes the resource constraint on skilled managers in the North, allowing more domestic firms to find a manager. As the number of domestic firms rises, competition in the domestic market intensifies and firms' real profits B/w decrease (the competition effect).

The overall effect on B/w and q/w depends on the relative sizes of these effects (the war for talent effect, the labour market effect, and the competition effect). This depends on the exposure to international trade IM. When openness to trade is sufficiently high ($IM > IM_P$), the positive war for talent effect prevails over the negative competition effect and, as a result, real profits unambiguously rise with an increase in I_S (see Figure 3). To understand why, recall from the previous section that the derivative $\frac{dB/w}{dq/w}$ becomes smaller with larger IM. When the trade exposure is large, the number of foreign firms is large in the domestic economy and, thus, fewer domestic firms have an incentive to enter, reducing real profits only a little. As a result, a rise in I_S shifts the HH curve down only a little. Otherwise, when the level of import competition is sufficiently small ($IM \leq IM_P$), the competition effect dominates the war for talent effect and profits decline in response to a rise in I_S. As a result, an increase in I_S results in a large downward shift of the HH curve (see Figure 4).

The impact of a rise in I_S on q/w remains ambiguous, as the war for talent effect pushing up q/w and the labour demand effect lowering q/w cannot be ranked in magnitude. For $IM > IM_P$, a rise in I_S leads to an unambiguous rise in q/w as the war for talent effect prevails over the labour market effect. In an economy with many foreign firms, fewer domestic firms

Figure 3: Offshoring of Managerial Tasks: $IM>IM_P$
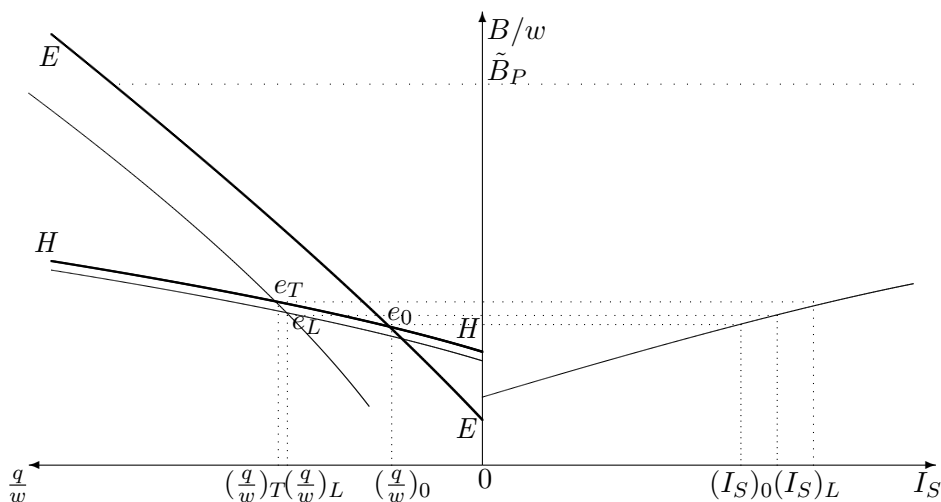
demand a manager, as fewer firms find it profitable to enter the market (see Figure 2 for an increase in openness IM). As the number of entrants is smaller in an open economy, changes in their demand for managers affect the relative wage for managers only a little. As a result, the labour market effect is small for $IM > IM_P$ (see Figure 3).

For $IM < IM_P$, the direction of the change in q/w cannot be signed. On the one hand, a lower IM makes the downward shift of the HH curve larger, with a stronger negative impact on q/w via the labour demand effect. On the other hand, a lower IM makes the slope of the HH curve steeper (for $IM < IM_P$, changes in the demand for managers have a large effect on the relative wages of managers), which in turn makes the positive effect on q/w stronger through the war for talent effect (as a rise in the number of entrants pushes up the relative cost of skilled managers). Hence, for sufficiently low IM, we cannot determine the overall impact on q/w.

Proposition 3 suggests that the impact of the offshoring of managerial labour on firm organization depends on the level of openness to foreign competition. If the economy is sufficiently open, an offshoring of managerial labour results in firm decentralization (the P-equilibrium becomes 'closer' to the A-equilibrium). Otherwise, an offshoring of managerial labour leads firms to recentralize power with their top management.

3.3 Offshoring under A- or O-organization

In this section, we argue that Propositions 2 and 3 hold for A- and O-equilibria as well. Remember that the O-equilibrium is a special case of the P-equilibrium with $\bar{e}$ being equal to zero.

Figure 4: Offshoring of Managerial Tasks: $IM < IM_P$
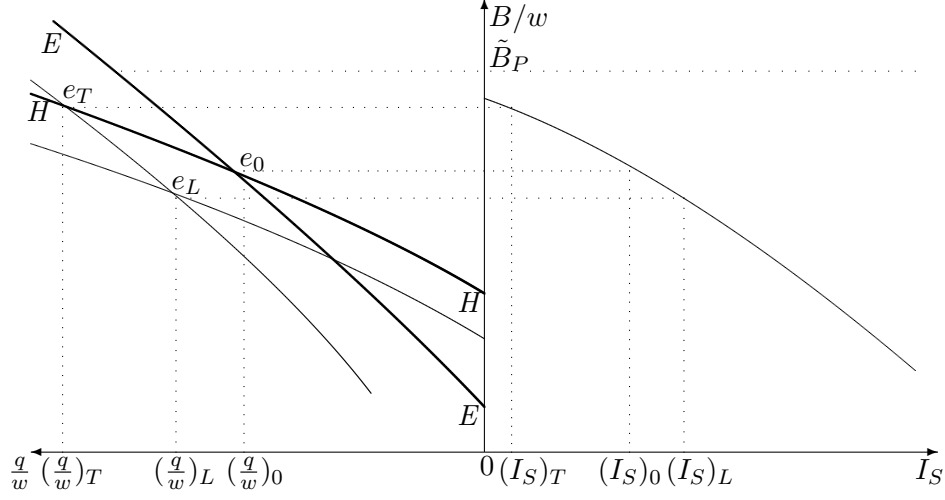
In particular, the O-equilibrium is described by

$$
\begin{cases}
\frac{q(1-I_S)+q^*I_S}{w} = \frac{1}{4}\left(\frac{B}{w}\right)^2, \\[4mm]
B/w = C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{a\left(L+\frac{q}{w}H\right)(1-I_S)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{1}{2}\frac{B}{w}\right)+(1-I_S)IM} + \frac{A_m}{w}\right).
\end{cases} \tag{15}
$$

An O-equilibrium exists if the value of B/w determined by the above system of equations is greater than $\bar{B}$. As the proofs of Propositions 2 and 3 hold for any non-negative value of $\bar{e}$ including the zero value, they obviously hold in case of an O-equilibrium as well. The only difference from a P-equilibrium is the threshold value of the level of foreign competition in Proposition 3, IM_P. In O-equilibrium, it is different (as $\bar{e} = 0$). We denote it by IM_O.

The equations for an A-equilibrium are

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

As can be seen, the equilibrium equations describing an A-equilibrium correspond to the equations describing an P-equilibrium with α being equal to one. Since the proofs of Propositions 2 and 3 hold for any positive value of α including one, the propositions hold for an A-equilibrium as well. Again, at an A-equilibrium, the threshold value of the level of foreign competition in

Proposition 3 is different from those at P- and O- equilibria. We denote this value by IM_A.

Notice that to guarantee that the cost of foreign skilled labour is lower than the cost of domestic skilled labour in an equilibrium of any type (see (14)), we need to assume that

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

4   Empirical Analysis

In this section, we test the predictions of the model using a unique survey of firm level data of Austrian and German multinational firms with subsidiaries in Eastern Europe. We start with a description of the data.

4.1   The Data

We conducted a survey of 660 multinational corporations in Austria and Germany with 2200 affiliate firms in Eastern Europe, Russia, the Ukraine, and other former Soviet Republics. The sample is an unbalanced panel of 1200 German and 1000 Austrian foreign direct investments and it covers 80% of total German investment and 100% of total Austrian investment to Eastern Europe in 1990–2001 (the actual numbers are from the 1997–2000 in Germany and 1999–2000 in Austria). In 1998–1999, about 90% of the total outgoing foreign direct investment of Austria was reoriented to Eastern Europe, while in Germany, Eastern Europe accounted for only about 4%–5% of total outgoing foreign direct investment. This explains why the sample consists of relatively more Austrian multinational investments in spite of Austria being much smaller than Germany (with 8 million people, Austria's population is 10% of Germany's). Since foreign direct investment activity in Eastern Europe began with the fall of communism in 1990, having been prohibited during the period of central planning, we were able to obtain a representative sample of foreign direct investment in spite of collecting detailed information on the internal organization of these firms.

4.1.1 Decentralized Management

As a measure of *the level of decentralization of authority* in an offshoring firm, we employ the allocation of decision authority within the parental multinational firm.[14] This measure is obtained from the question: 'Who decides the following issues concerning your corporation, top CEO/owner or the divisional manager, please rank between 1 (centralized decision taken at the top CEO/owner level) and 5 (decentralized decision taken at the divisional level)?' The survey lists 13 corporate decisions for Austrian parent firms and 16 corporate decisions for German parent firms. The categories of corporate decisions include decisions over acquisitions, finance, the budget, new strategies, transfer pricing, new products, R&D expenditures, firing and hiring of personnel, changes of suppliers, product pricing, and wage increases. We then calculate a simple average of the available scores of these corporate decisions. The average level of decentralization in the sample is 2.83. In addition, we normalize the index to a *z*-score with a mean of zero and a standard deviation of one in order to facilitate the interpretation of the estimated effects. Values of the normalized index indicate the difference from the mean of the original decentralization index (2.83) in numbers of standard deviations (0.87).

4.1.2 Offshoring of Production Tasks

To proxy the level of offshoring of production tasks, we use information in the survey on intrafirm trade flows between affiliate firms and the parent firm. The idea here is that the multinational firm is an offshoring firm if it imports some intermediate inputs from its affiliates in Eastern Europe. In particular, as a proxy for the number of production tasks offshored by a firm, we consider the variable *intrafirm imports in percent of parent firm's sales*, which is defined as the sum over all intrafirm imports of intermediate inputs of one particular multinational firm from all its affiliates in Eastern Europe relative to the domestic sales of this multinational firm. As an alternative, we use the dummy variable *intrafirm imports* to capture whether or not the multinational firm is offshoring production labour at all.

As an instrument for the offshoring of production tasks, we use the dummy variable *standardized input*, which indicates whether the affiliate firm delivers an input good that is standardized in both quality and design. Table 5 in the Data Appendix shows that in 61% of the investments to Eastern Europe, affiliate firms supplied a standardized input to the parent firm. We discuss the instrumental variable in greater detail when we describe the empirical results in the next

---

[14]Note that, in accordance to our theory, we examine variation in the level of decentralization within parental firms but not between parent firms and their subsidiaries.

section.

4.1.3 Offshoring of Managerial Tasks

To proxy the level of offshoring of managerial tasks, we use information derived from the survey question: 'How many managers of your parent company have been sent to the affiliate firm?' Specifically, we assume that if the affiliate firm hires the manager from the local host country market (that is, the manager is not sent by the parent company), then some managerial tasks are considered to be offshored by the parental firm to the local host country. Based on this logic we construct the following proxy for the offshoring of managerial tasks. We sum over all managers in the multinational firm's affiliates in Eastern Europe that have not been sent by the parent company, and express this as a fraction of the sum of these affiliates' employment. We also express this sum of offshored managers as a fraction of parental employment with an academic degree. As an alternative proxy, we use the dummy variable *offshored manager dummy*, which captures whether or not the multinational firm is offshoring one or more managers to its subsidiary in Eastern Europe. This dummy is equal to one if the multinational firm does not send managers to its affiliate, and to zero if it sends one or more managers.

As can be seen from Table 5 in the Data Appendix, in 57% of the investment to Eastern Europe, multinational firms from Austria or Germany have not sent managers to the affiliate firm in Eastern Europe. On average, the multinational firms have offshored 2.63 managers per investment project with a maximum of 39 managers.

4.1.4 Competition and Trade Openness

We use several proxies for the level of competition and trade openness. The variables *domestic competition* and *foreign competition* are dummy variables that are subjective firm level measures of domestic and foreign competition as perceived by the firm. They are constructed using information from the survey question: 'How many competitors do you face in your local (Austrian or German) market and worldwide, respectively?' The dummy variables take the value 1 if the parent firm states that it faces *many or very many* competitors for their product in their local markets or worldwide, rather than *no or few* competitors. These dummies represent the firm level measures of domestic competition and openness.

We calculate sectoral measures of domestic competition and openness by taking the sample means of the firm level measures of domestic, respectively foreign competition at the ISIC 3 digit level. These measures stand for the level of domestic competition or openness of the industry to

which the firm belongs. We then use this measure of the industry openness to construct a dummy variable *highly open* and *less open*, respectively. The variable highly open is a dummy for when the sector's openness is above the 25th percentile of the openness distribution, and less open indicates when the sector's openness is below the 40th percentile or below the 10th percentile of the same distribution. In addition, as a sectoral measure of domestic competition, we use the change in the number of establishments between 1997 and 1998 in Germany and Austria at the 4 digit ISIC level taken from the United Nations Industrial Development Organization INDSTAT database.

4.1.5   Human Resources

Our survey also includes information on the human resource policies of the multinational firms in the sample. Information on the compensation of executives in our multinational firms is based on two sources. First, we obtained executive payment data from Kienbaum Management Consulting. Kienbaum is a management consultancy specializing in remuneration policies, which collects annual information on the executive compensation at large German firms. The Kienbaum data allow us to calculate the average compensation per executive, since the data contain information on the total compensation of the executive board and the number of executive board members. Since Kienbaum provides information only for the largest German firms, we additionally hand-collected this information from the annual reports of the remaining firms whenever available. Likewise, we divided the aggregate earnings of executives by the number of executives working for the firm to obtain the average compensation of board members. All average executive payments are expressed relative to the average wage of the firm in logarithms. The latter information comes from our firm survey.

4.2   Empirical Results

We start with a cross-industry analysis. Our theory predicts a relationship between the average level of firm decentralization and the level of offshoring at the sectoral level.

4.2.1   Cross-Industry Results

To examine the cross-industry variation in the data, we aggregate information on decentralized management and offshoring at the country-industry cell level, where the country is the location of the multinational parent (i.e. Austria or Germany) and industries are broad ISIC industries at the 2-digit level. Since our data virtually cover the full population of foreign direct investment

projects made by German and Austrian multinationals with Eastern Europe, we consider our aggregations at the country-industry level as a fairly accurate representation of the variation at the industry level.[15] Overall, we end up with information on 40 country-industry cells (26 for managerial offshoring) that aggregate information on 29.6 multinational investment projects on average.

According to Proposition 2 and Figure 1, an increase in the offshoring of production tasks leads to an increase in profits. According to Proposition 1, the increase in profits ultimately induces firms to switch from a centralized P-organization to a decentralized A-organization. Thus, we can formulate

Prediction 1a: *In a cross-section of industries in an economy open to trade, industries will have more decentralized management on average when there is more offshoring of production tasks to low wage countries.*

In order to test Prediction 1a, we consider the following empirical model for decentralized management:

$$dec_{cs} = \partial_0 + \partial_1 \, offsh_{cs} + \partial_2 X_{cs} + \varepsilon_{cs}, \tag{17}$$

where dec_{cs} denotes the average level of decentralization in country c and sector s, $offsh_{cs}$ is the average level of offshoring of production tasks (see Section 4.1.2), X_{cs} is a set of controls, and ε_{cs} is the error term. According to Prediction 1a, we expect $\partial_1 > 0$.

Furthermore, according to Proposition 3 and Figures 3 and 4, an increase in the offshoring of managerial tasks leads to an increase in profits when the effect of the lower costs of market entry on profits (the 'war for talent' effect) outweighs the effect of the increase in the number of firms on profits (the competition effect, which lowers profits). This is the case when the economy is sufficiently open to foreign competition. This increase in profits, in turn, induces firms to switch from P-organization to A-organization, as stated in Proposition 1. Thus, we can formulate

Prediction 2a: *In a cross section of industries in an economy open to trade, industries which offshore more managerial tasks to low wage countries and are sufficiently open to trade will have more decentralized management on average.*

We specify the following model for decentralized management to test Prediction 2a:

---

[15]A comparison between our data and the OECD FDI data yields a correlation coefficient of 0.82 when comparing average FDI stocks in Eastern European countries from Austria or Germany between 1997-2000. Our levels of FDI stocks are on average larger compared to the OECD data because we also included investment projects with an ownership share between 10 and 20%.

$$dec_{cs} = \partial_0 + \partial_1 offm_{cs} + \partial_2 offm_{cs} \times foreign_{cs} + \partial_3 foreign_{cs} + \partial_4 X_{cs} + \varepsilon_{cs}, \qquad (18)$$

where $offm_{cs}$ is the average level of offshoring of managerial tasks at the 2-digit ISIC industry level in country c (see Section 4.1.3), $foreign_{cs}$ is a proxy for the openness of the sector, X_{cs} is a set of controls, and ε_{cs} is an error term. The explanatory variable $offm_{cs}$ captures the lower demand for managers as a result of managerial offshoring (the labour market effect), lowering the level of profits that firms require to enter the market. These lower profits, in turn, induce firms to switch back to P-organization, resulting in more centralized management. Thus, we expect $\partial_1 < 0$. The interaction term $offm_{cs} \times foreign_{cs}$ is supposed to account for the prediction of the theory that profits and the level of decentralization will increase in response to managerial offshoring only when firms are sufficiently exposed to foreign competition. Hence, we expect $\partial_2 > 0$.

Table 1 about here

Our main findings are summarized in Table 1. In column 1, we regress the average level of decentralization across multinational parent firms within a country-industry cell on the average intrafirm imports relative to domestic parental firms' sales within the same country-industry, controlling for average parental sales and affiliate sales, the average level of foreign competition and a dummy for industries in Germany. Consistent with Prediction 1a, we find a positive association between intrafirm imports and decentralized decision making which is significant at the 5% level. In column 2, we consider an alternative measure of offshoring of production tasks, which is the share of parental firms with positive intrafirm imports. This share is, however, not significant.

In column 3, we include the average number of offshored managers relative to the parental firms' employees with an university degree to proxy for managerial offshoring at the country-industry level. Our proxy for managerial offshoring turns out to be insignificant. In column 4, we proceed to include the interaction term $offm_{cs} \times foreign_{cs}$. $foreign_{cs}$ is the fraction of firms within a country-industry cell that faces (very) many foreign competitors. As predicted by our theory, the coefficient on the interaction term $offm_{cs} \times foreign_{cs}$ is now positive and significant at the 10% level. The coefficient on $offm_{cs}$ is negative and significant at the 5% level.

4.2.2 Cross-Firm Results

Offshoring of Production Tasks and Decentralized Management

In the cross-industry analysis of the previous subsection we assumed away heterogeneity in offshoring across firms as is predicted in the theory. However, taking into account that our data set is firm-level, we examine now in more detail the data pattern for the cross-firm variation. We expect that firms which offshore more tasks will face a larger increase in profits and thus, they are more likely to decentralize decision making power. Therefore, we modify Prediction 1a in the following way:

Prediction 1b: *In a cross-section of firms in an economy open to trade, multinational firms will have more decentralized management when they are offshoring more production tasks to low wage countries.*

In order to test Prediction 1b, we consider the following modification of (17):

$$dec_i = \partial_0 + \partial_1 \, offsh_i + \partial_2 X_i + \varepsilon_i, \tag{19}$$

where dec_i denotes the level of decentralization within a parental firm i, $offsh_i$ is a proxy for the level of offshoring of production tasks of parental firm i (see Section 4.1.2), X_i is a set of controls, and ε_i is the error term. According to Prediction 1b, we expect $\partial_1 > 0$. We also, when possible, include a set of industry dummies and home and host country fixed effects. Note, that the unit of observation in all following regressions is an investment project i, comprising a parent firm together with one of its affiliate firms. Therefore, multinational firms with more affiliates get a larger weight in the regression and have a stronger influence on the parameter estimates. Thus, standard errors are likely to be correlated between foreign direct investments of identical parental firms. To take this into account, we use cluster-robust standard errors with clustering at the parental firm level when we calculate the significance of the estimated parameters.

Our main findings are given in columns 1–5 of Table 2, which presents ordinary least squares estimates of Equation (19). In columns 1–4, we use *intrafirm imports in percent of parental sales* as the proxy for the number of production tasks offshored. As predicted by the theory, the estimated coefficients are positive and significant at the 1%–5% level. The estimated coefficient of 0.003 in the second column means that an increase in the share of intrafirm imports in parental sales by 8.4% (which is the mean of the sample) increases the level of decentralized management by 0.63%.[16]

---

[16]We obtain this number by multiplying 0.003 by the mean of intrafirm imports in parental sales of 8.4 *(0.003 × 8.4 = 0.0252)*. *0.0252* corresponds to an increase in the decentralization index of 0.63%.

In column 3, we rerun the regression of column 1 with a firm level measure of foreign competition with similar results. In column 4, log affiliate sales are introduced to additionally control for the size of affiliate firms. This additional size control has little effect on the estimates. In column 5, we replace the measure of offshoring by the dummy variable *intrafirm imports* to see if it makes a difference whether the firm offshores at all or how many tasks it offshores. The results are, however, similar. In column 6, we replace the dependent variable with a normalized decentralization index with mean 0 and standard deviation of one to facilitate the economic interpretation. An increase in the share of intrafirm imports in parental sales by one percentage point increases the level of decentralization by 0.003. In other words, this means that an increase in the share of intrafirm imports by one standard deviation (34.72) raises the level of decentralization by about 0.1 standard deviations ($34.72 \times 0.003 = 0.106$).

In columns 7–8, we deal with potential endogeneity. Reversed causality might be present in our regressions if firms that are more decentralized choose to offshore more. In order to address this potential endogeneity problem, we re-estimate Equation (19) by two stage least squares and instrument for intrafirm imports. As instruments, we use the dummy variable *standardized input* and the interaction *standardized input* with the headquarter intensity of the parental firms. The idea here is that when the affiliate firm delivers a standardized input to the parental firm and the parental firm is sufficiently headquarter intensive, the offshoring of production tasks will rather be organized inside the firm in the form of a foreign direct investment than at arm's length to an independent foreign input supplier. It is more important to give the parental firm stronger incentives to provide headquarter services rather than to the foreign input supplier. Thus, we expect more intrafirm imports when the parental firm is more R&D intensive and the input is standardized.

In column 7, we use the dummy *standardized input* and its interaction with *R&D intensity* as instrumental variables. Since *R&D intensity* possibly affects the decentralization decision itself, we include *R&D intensity* as a control in our specification. The Angrist-Pischke *F*-statistic of 3.65 shows that the instruments are relevant. Furthermore, the Hansen *J*-statistic to test the null hypothesis of an overidentified model is not rejected (*p*-value 0.884). However, the interaction term of standardized input and *R&D intensity* is not significant. We proceed to increase the *R&D intensity* of the parental firms since - according to Antràs and Helpman (2008) - headquarter services have to be sufficiently large for the input supplier's hold-up problem to have any effect on intrafirm imports.

In column 8, we interact the dummy *standardized input* with a dummy that captures the top quartile of the distribution of R&D intensity of all parental firms and use this as an instrument.

Now, the coefficient of *standardized input × top 25 %ile R&D* is positive and significant at the 10% level. Moreover, the F-statistic testing for the relevance of the instrument has improved. The estimated coefficient of 1.330 in column 8 suggests that offshoring firms are 33.4% (1.330/4 = 0.334) more decentralized than non-offshoring firms.

<div align="center">**Table 2 about here**</div>

Offshoring of Managerial Tasks and Decentralized Management

Next, we study the relation between the offshoring of managerial tasks and the level of decentralized management in the parental firms of multinational corporations. Specifically, we formulate the analogue of Prediction 2a:

Prediction 2b: *In a cross section of firms in sectors sufficiently open to trade, multinational firms will have more decentralized management when they offshore more managerial tasks to low wage countries.*

We specify the following model for decentralized management to test for Prediction 2b

$$dec_i = \partial_0 + \partial_1 offm_i + \partial_2 offm_i \times openl + \partial_3 openl + \partial_4 X_i + \varepsilon_i, \tag{20}$$

where $offm_i$ is a proxy for the level of offshoring of managerial tasks (see Section 4.1.3), $openl$ is the dummy variable *highly open* used as a proxy for the openness of the sector to which the firm belongs (recall that this dummy is equal to one if the sector's openness is above the 25th percentile), X_i is a set of controls, and ε_i is an error term. As in our specification to test for Prediction 2a, we expect $\partial_1 < 0$ and $\partial_2 > 0$.

Table 3 presents the ordinary least squares estimates of Equation (20). Note that the sample size has dropped substantially from that of Table 2, as we have fewer observations of managerial offshoring than of production offshoring. In column 1, we employ the dummy variable *offshored manager* as a proxy for the offshoring of managerial tasks. The coefficient on the offshored manager dummy is negative, but not significant. In column 2, we add the interaction term *highly open × offshored manager dummy* as a measure of $offm_i \times openl$. Now the coefficient on $offm_i$ is negative and significant at the 5% level. Moreover, as predicted by the theory, the interaction term $offm_i \times openl$ is positive and significant at the 10% level.

In columns 3–6, we consider alternative proxies for the offshoring of managerial tasks, as we expect the number of offshored tasks to matter for the results. In columns 3 and 4, we replace the *offshored manager dummy* by the variable Σ *# offshored managers / Σ affiliate employment*, which is now significant as well as the corresponding interaction term $offm_i \times openl$.

<div align="center">32</div>

Alternatively, in columns 5 and 6 we use $\Sigma \ \# \ offshored \ managers \ / \ parent \ skilled \ employment$ as a proxy for the number of offshored managerial tasks. Managerial offshoring as well as the interaction term have the expected signs and are both highly significant, at the 1% level.

Also note that the explanatory power (measured by R^2) substantially rises from 0.181 to 0.265 with the inclusion of the interaction term. As predicted by the theory, the interplay of offshoring managerial tasks with sectoral openness plays an important role in explaining the variation in the level of decentralization across multinational firms. From column 6, an increase of the fraction of managers offshored by the sample mean of 1.48 (expressed in terms of the number of academics employed by the parent firm) reduces the level of decentralization by 3.1% ((-0.084×1.48)/4 = -0.031), but increases the level of decentralization by 4.0% ((-0.084+0.193)×1.48/4 = 0.040) if foreign competition is above the 25th percentile of the openness distribution.

In column 7, we use the normalized index of the level of decentralization as the dependent variable and rerun specification (6) to interpret the results. Column 7 shows that an increase of the fraction of managers offshored by the sample mean of 1.48 reduces the level of decentralization by 0.148 standard deviations, but increases the level of decentralization by 0.192 standard deviations if foreign competition is above the 25th percentile of the openness distribution.

Table 3 about here

Offshoring of Managerial Tasks and CEO Wages

Finally, we examine the relation between the offshoring of managerial tasks and the relative wages of managers. According to Proposition 3 and Figures 3 and 4, an increase in the offshoring of managerial tasks reduces the demand for managers, lowering CEO wages (the labour market effect), and leads to firm entry, pushing up CEO wages (the 'war for talent' effect). The relative sizes of these effects depends on the openness of the economy. When the economy is sufficiently closed to international trade, the 'war for talent' effect as well as the labour market effect are large. From this, we have

Prediction 3: *In a cross section of firms, multinational firms will pay their CEOs lower wages when they are offshoring managerial tasks to low wage countries and they will pay their CEOs higher wages when the number of firms in the domestic market increases. Both effects are magnified in less open sectors.*

We specify the following model for CEO wages to test for Prediction 3.

$$wage_i = \partial_0 + \partial_1 offm_i + \partial_2 \Delta firms + \partial_3 offm_i \times opens + \partial_4 opens + \partial_5 X_i + \varepsilon_i, \qquad (21)$$

where $wage_i$ is the natural logarithm of the average executive wage in the parental firm i relative to its average firm wage. The variable $\Delta firms$ is the change in the number of firms in the sector, $opens$ is a dummy for when the openness of the sector is below the 40th percentile of the openness distribution (or below the 10th percentile), X_i is a set of controls, and ε_i is an error term. Here, $offm_i$ captures the reduced demand for managers as a result of managerial offshoring's lowering relative CEO wages (the labour market effect). Thus, we expect $\partial_1 < 0$. The variable $\Delta firms$ measures the increase in the number of firms in the sector of the firm, resulting in a larger demand for managers pushing up CEO wages (the 'war for talent' effect). Thus, we expect $\partial_2 > 0$. The interaction term $offm_i \times opens$ is supposed to take into account the prediction that the negative effect of a lower demand for managers on relative CEO wages is magnified in less open sectors. Hence, we expect $\partial_3 < 0$.

Table 4 presents the ordinary least squares estimates of Equation (21) to test for the labour market effect and the 'war for talent' effect of managerial offshoring. Note that our sample size is substantially smaller in the regressions of Equation (21). This is due to the lack of data on executive remuneration in the limited liability corporations in our sample. These firms are not subject to the same disclosure requirements of preparing annual reports with information on executive remunerations. Nevertheless, we consider our estimates to be informative since our data are the first that allow assessing the effect of offshoring managerial tasks on executive wages in stock companies.

In column 1, we include the *offshored manager dummy* and the variable $\Delta firms$. The *offshored manager dummy* is not significant, suggesting that the status of a firm as an offshorer itself does not affect the relative wage it pays its CEOs. As can be seen in column 2, the number of managers offshored is what matters for the labour market outcome of executive pay. In column 2 we replace the dummy variable by the number of managers offshored (*# offshored managers*). As predicted by the theory, the higher is the number of managerial tasks offshored by the parental firm, the lower is the relative wage of its CEOs (controlling for the 'war for talent' effect). More specifically, an additional manager offshored lowers the relative CEO compensation by 6.9%. To give this finding more economic meaning, we multiply the estimated coefficients of $offm_i$ in columns 2 and 3 of Table 4 by the average number of managers offshored per subsidiary of 2.63, implying that relative CEO wages were lower by between 13.1 (-0.0499×2.63)% and 18 (-0.069×2.63)% due to managerial offshoring. Note that by replacing the dummy variable with *#offshored managers*, the explanatory power of the regression increases from 0.457 to 0.626.

We include the *change in the number of establishments '97–'98* in columns 1 and 2 to test whether an increase in the competition for managers pushes up CEO wages. This is indeed the

case. An increase by one competitor increases relative CEO compensation of parental firms by 2%. The effect is highly significant at the 1% level. To quantify the total effect of an additional offshored manager on relative CEO wages, we subtract from the estimated labour market effect of -6.9% the estimated 'war for talent' effect of 2.0 and, as a result, obtain -4.9% (see column 2 of the table).[17] Notice that in all regressions we include *intrafirm imports / parental sales* to control for offshoring of production tasks. As expected from the theory (see Proposition 2), a rise in the share of intrafirm imports has a positive impact on relative CEO wages. Specifically, an increase in the share of intrafirm imports by 1 percentage point leads to an increase in CEO wages relative to workers of 1.2%.

In columns 3 to 5 we examine the effect of openness. We expect the labour market and the 'war for talent' effect to be larger when the economy is not too open to foreign competition. Due to the limitations of the data, we can test for the role of openness in determining the labour market effect only. From Figure 2, we expect that a decline in openness (lower IM) increases relative CEO wages. In column 3, we include the dummy *less open <40th percentile,* which appears to be not significant. In column 4, we add the interaction term *less open <40th pctl. × # offshored managers,* which appears to be not significant as well. In column 5, we lower the degree of openness by using the dummy less open <10th percentile to examine whether the labour market effect becomes stronger for less open firms. As can be seen from the table, this is not the case. Although both being less open itself as well as the interaction term *less open <10 × # offshored managers* are now highly significant at conventional levels, the sign of the coefficients is not as expected.

The sign of *less open <10th percentile* is negative, suggesting that foreign firms put additional pressure on the domestic labour market for managers. This can be explained by the fact that foreign firms may need domestic managers to operate in the market. As a result, there being fewer foreign firms eases the foreign demand for domestic managers and, thereby, lowers relative CEO wages. In our model, however, being less open means that fewer foreign firms sell output on the domestic market, which is produced with the use of foreign managers only, thereby putting less pressure on the domestic labour market for managers.[18] Note that the R^2 substantially rises from 0.200 to 0.248 with the less open measure (see columns 5 and 6).

---

[17]This calculation assumes that one additional offshored manager allows one additional competitor to enter the market. This assumption is motivated by our model, in which the equilibrium condition for the managerial labour market is given by $n(1 - Is) = H$. The latter can be rewritten as $n - n \times Is = H$. If we interpret $n \times Is$ as the number of managers offshored, then one additional manager offshored means that $n \times Is$ goes up by one. This, in turn, implies that in order for the equilibrium condition to hold, n must go up by one unit as well.

[18]The empirical findings here are consistent with Marin and Verdier (2012), who suggest that international trade (rather than trade in tasks) triggers a competition for managers, which in turn pushes up CEO wages. Empirically, this is supported by Cunat and Guadalupe (2009).

Table 4 about here

5   Conclusion

In this paper we incorporate a stylized model of trade in tasks into a small open economy version of the theory of firm organization of Marin and Verdier (2012). We test the predictions of the model with data of 660 offshoring firms in Austria and Germany. We find that offshoring of production and managerial tasks leads to more decentralized management. For managerial tasks this holds, however, only for sufficiently open economies. We find further that managerial offshoring leads to lower CEO wages relative to workers. We obtain large effects on relative CEO wages from managerial offshoring, which suggests that CEOs operate in a tight labour market giving them large rents.

References

Aghion, P. and Tirole, J. (1997), 'Formal and Real Authority in Organizations,' Journal of Political Economy, 105(1), 1–29.

Antràs, P., Garicano, L. and Rossi-Hansberg, E. (2006), 'Offshoring in a Knowledge Economy,' Quarterly Journal of Economics, 121(1), 31–77.

Antràs, P., Garicano, L. and Rossi-Hansberg, E. (2008), 'Organizing Offshoring: Middle Managers and Communication Costs', in Helpman, E., Marin, D., Verdier, T., eds, *The Organization of Firms in a Global Economy*, Cambridge, MA: Harvard University Press.

Antràs, P. and Helpman, E. (2004), 'Global Sourcing,' Journal of Political Economy, 112(3), 552–580.

Antràs, P. and Helpman, E. (2008), 'Contractual Frictions and Global Sourcing,' in Helpman, E., Marin, D., Verdier, T., eds, *The Organization of Firms in a Global Economy*, Harvard University Press, Cambridge, MA.

Antràs, P. and Rossi-Hansberg, E. (2009), 'Organizations and Trade,' Annual Review of Economics, 1, 43–64.

Amiti, M. and Konings, J. (2007), 'Trade Liberalization, Intermediate Inputs, and Productivity,' American Economic Review, 97(5), 1611–1638.

Becker, S. and Muendler, M. (2010), 'Margins of Multinational Labor Substitution,' American Economic Review, 100(5), 1999–2030.

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

Brainard, S. L. and Riker, D. (1997), 'Are U.S. Multinationals Exporting U.S. Jobs?,' NBER Working Paper no. 5958.

Caliendo, L. and Rossi-Hansberg, E. (2012), 'The Impact of Trade on Organization and Productivity,' Quarterly Journal of Economics, 127(3), 1393–1467.

Cunat, V. and Guadalupe, M. (2009), 'Globalization and the Provision of Incentives inside the Firm: The Effect of Foreign Competition,' Journal of Labor Economics, 27(2), 179–212.

Demidova, S. and Rodríguez-Clare, A. (2009), 'Trade Policy under Firm-Level Heterogeneity in a Small Economy,' Journal of International Economics, 78(1), 100–112.

The Economist (2006), 'The New Organisation,' January 19th.

Fabbri, F. and Marin, D. (2015), 'What Explains the Rise in CEO Pay in Germany? A Panel Data Analysis for 1977–2009,' Scandinavian Journal of Economics, forthcoming.

Feenstra, R. (1998), 'Integration of Trade and Disintegration of Production in the Global Economy,' Journal of Economic Perspectives, 12(4), 31–50.

Grossman, G. M. and Rossi-Hansberg, E. (2008), 'Trading Tasks: A Simple Theory of Offshoring,' American Economic Review, 98(5), 1978–1997.

Halpern, L., Koren, M. and Szeidl, A. (2011), 'Imported Inputs and Productivity,' CeFiG Working Paper no. 8.

Helpman, E. and Krugman, P. (1985), 'Market Structure and Foreign Trade,' MIT Press, Cambridge, MA.

Hummels, D., Ishii, J. and Yi, K.-M. (2001), 'The Nature and Growth of Vertical Specialization in World Trade,' Journal of International Economics, 54(1), 75–96.

Johnson, R. and Noguera, G. (2012), 'Fragmentation and Trade in Value Added over Four Decades,' NBER Working Paper No. 18186.

Krugman P. (1980), 'Scale Economies, Product Differentiation, and the Pattern of Trade,' American Economic Review, 70(5), 950–959.

Marin, D. (2006), 'A New International Division of Labor in Europe: Outsourcing and Offshoring to Eastern Europe,' Journal of the European Economic Association, 4(2–3), 612–622.

Marin, D. (2008), 'The New Corporation in Europe,' Bruegel Policy Brief 2008/07.

Marin, D. (2011), 'The Opening Up of Eastern Europe at 20: Jobs, Skills, and "Reverse Maquiladoras" in Austria and Germany,' in: Jovanovic, M., ed., *International Handbook on the Economics of Integration*, Vol. 2.

Marin, D. (2015), 'The Theory of the Firm goes Global,' in: Aghion, P., Dewatripont, M., Legros, P., and Zingales L., eds, *The Impact of Incomplete Contracts on Economics*, Oxford University Press.

Marin, D., Schymik, J. and Tscheke, J. (2015), 'Organizations as Competitive Advantage,' University of Munich, mimeo.

Marin, D. and Verdier, T. (2008), 'Competing in Organizations: Firm Heterogeneity and International Trade,' in Helpman, E., Marin, D., and Verdier, T., eds, *The Organization of Firms in a Global Economy*, Harvard University Press, Cambridge, MA.

Marin, D. and Verdier, T. (2012), 'Globalization and the Empowerment of Talent,' Journal of International Economics, 86(2), 209–223.

Marin, D. and Verdier, T. (2014), 'Corporate Hierarchies and International Trade: Theory and Evidence,' Journal of International Economics, 94(2), 295–310.

Melitz, M. (2003), 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,' Econometrica, 71(6), 1695–1725.

Melitz, M. and Ottaviano, G. (2008), 'Market Size, Trade, and Productivity,' Review of Economic Studies, 75(1), 295–316.

Nunn, N. and Trefler, D. (2008), 'The Boundaries of the Multinational Firm: An Empirical Analysis,' in Helpman, E., Marin, D., and Verdier, T., eds, *The Organization of Firms in a Global Economy*, Harvard University Press, Cambridge, MA.

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

Table 1: Offshoring and Decentralized Management Across Industries

dependent variable:	(1)	(2)	(3)	(4)
	level of decentralization of authority	level of decentralization of authority	level of decentralization of authority	level of decentralization of authority
	OLS	OLS	OLS	OLS
intrafirm imports / parental sales	0.00894**		0.0130**	0.0140**
	(0.0177)		(0.0307)	(0.0195)
share of parental firms with intrafirm imports		0.458		
		(0.139)		
# offshored managers / parent skilled employment			0.0634	-2.470*
			(0.593)	(0.0604)
foreign comp. × (# offshored managers / parent skilled empl.)				2.607*
				(0.0554)
ln parental sales	0.133	0.0966	0.193	0.182
	(0.116)	(0.210)	(0.178)	(0.178)
ln affiliate sales	-0.0486	-0.0183	-0.0318	-0.127
	(0.657)	(0.855)	(0.830)	(0.412)
foreign competition	0.361	0.434	0.238	-0.901
	(0.269)	(0.168)	(0.630)	(0.188)
Germany dummy	0.104	0.170	-0.213	-0.404
	(0.501)	(0.306)	(0.463)	(0.168)
observations	40	40	26	26
R-squared	0.315	0.271	0.340	0.443

Notes: Standard errors are robust and p-values are in parentheses. All variables are aggregated to the country-industry level, where industries are categorized according to broad ISIC 2-digit industries. The dependent variable *level of decentralization of authority* is an index that measures the average degree of decentralization in decision making at the country-industry level, with values between 1 (decisions are taken by the CEO) and 5 (decisions are taken at the divisional level). *foreign competition* is the fraction of firms in a country-industry cell that face many or very many foreign competitors. *** denotes $p<0.01$, ** denotes $p<0.05$, * denotes $p<0.1$.

Table 2: Offshoring of Production Tasks and Decentralized Management

dependent variable:	(1) level of decentralization of authority	(2) level of decentralization of authority	(3) level of decentralization of authority	(4) level of decentralization of authority	(5) level of decentralization of authority	(6) normalized level of decentralization of authority	(7) level of decentralization of authority	(8) level of decentralization of authority
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV
sum of intrafirm imports / parental sales	0.00251** (0.0466)	0.00265** (0.0484)	0.00404*** (0.000949)	0.00345** (0.0116)		0.00304** (0.0484)		
intrafirm imports dummy					0.322** (0.0245)		1.116** (0.0451)	1.330*** (0.00876)
ln parental sales	0.140*** (0.00520)	0.142*** (0.00445)	0.145*** (0.00263)	0.126** (0.0231)	0.118*** (0.00457)	0.163*** (0.00445)	0.144*** (9.12e-05)	0.141*** (0.000487)
ln affiliate sales				0.0983*** (0.007)				
R&D intensity							0.124 (0.940)	-0.187 (0.908)
skill intensity								
foreign competition (sample)	1.439*** (0.000348)	1.342*** (0.00166)			1.409*** (0.000110)	1.542*** (0.00166)	1.769*** (1.25e-08)	1.739*** (6.30e-08)
domestic competition (sample)		0.192 (0.593)			0.199 (0.556)	0.220 (0.593)		
foreign competition (firm)			0.499** (0.0405)	0.462* (0.0709)				
Germany dummy	-0.224 (0.136)	-0.254 (0.103)	-0.167 (0.325)	-0.145 (0.380)	-0.206 (0.155)	-0.292 (0.103)	-0.199 (0.276)	-0.214 (0.311)
industry dummies	no	no	yes	yes	no	no	no	no
host country region dummies	yes	yes	yes	yes	yes	yes	yes	yes
first stage: standardized input							-0.399*** (0.009)	-0.408*** (0.002)
standardized input × R&D intensity							3.565 (0.194)	
standardized input × top 25%ile R&D								0.285* (0.059)
Angrist-Pischke F-statistic							3.65	5.10
Hansen overidentification test p-value							0.884	0.615
Observations	640	640	615	540	640	640	531	531
R-squared	0.233	0.236	0.195	0.232	0.256	0.236	-	-

Notes: Standard errors are clustered at the parental firm level and *p*-values are in parentheses. The dependent variable *decentralization of decision authority* is an index that measures the degree of decentralization in decision making, with values between 1 (decisions are taken by the CEO) and 5 (decisions are taken at the divisional level). The normalized decentralization of decision authority is a standardized version of this index, with mean = 0 and standard deviation = 1. *Foreign competition (firm)* is a dummy that takes the value 1 if the firm faces many or very many foreign competitors and 0 otherwise. The instrumental variable *standardized input* is a dummy that indicates whether the input supplied by the affiliate firm is standardized in quality and design. *** denotes $p<0.01$, ** denotes $p<0.05$, * denotes $p<0.1$.

Table 3: Offshoring of Managerial Tasks and Decentralized Management

dependent variable:	(1) level of decentralization of authority	(2) level of decentralization of authority	(3) level of decentralization of authority	(4) level of decentralization of authority	(5) level of decentralization of authority	(6) level of decentralization of authority	(7) normalized level of decentralization of authority
	OLS	OLS	OLS	OLS	OLS	OLS	OLS
offshored manager dummy	-0.129 (0.514)	-0.636** (0.033)					
Σ # offshored managers / Σ affiliate employment			-5.699*** (0.001)	-10.32*** (0.001)			
Σ # offshored managers / parent skilled employment					0.0102 (0.872)	-0.0843*** (0.000)	-0.0969*** (0.000)
interaction terms:							
highly open × offshored manager dummy		0.681* (0.063)					
highly open × (Σ # offshored managers / Σ affiliate employment)				6.066* (0.091)			
highly open × (Σ # offshored managers / parent skilled employment)						0.193*** (0.002)	0.222*** (0.002)
highly open	0.432* (0.071)	-0.0400 (0.880)	0.280 (0.130)	0.00710 (0.976)	0.359 (0.134)	0.00907 (0.970)	-0.0104 (0.970)
ln parental sales	0.178*** (0.329)	0.183*** (0.340)	0.138** (0.255)	0.132** (0.245)	0.226*** (0.402)	0.248*** (0.442)	0.285*** (0.442)
Germany dummy	-0.0581 (0.827)	-0.0653 (0.807)	0.189 (0.425)	0.0618 (0.802)	-0.266 (0.420)	-0.261 (0.405)	-0.299 (0.405)
industry dummies	no	no	no	no	no	no	no
host country region dummies	yes	yes	yes	yes	yes	yes	yes
observations	474	474	454	454	410	410	410
R-squared	0.174	0.196	0.230	0.246	0.181	0.265	0.265

Notes: Standard errors are clustered at the parental firm level and *p*-values are in parentheses. The dependent variable *decentralization of decision authority* is an index that measures the degree of decentralization in decision making, with values between 1 (decisions are taken by the CEO) and 5 (decisions are taken at the divisional level). The normalized decentralization of decision authority is a standardized version of this index, with mean = 0 and standard deviation = 1. The variable *highly open* is a dummy which takes the value 1 if the parent firm operates in an ISIC 3-digit industry that is above the 25th percentile of *foreign competition (sample)*. Managerial offshoring: *Offshored manager dummy* is a dummy variable that indicates whether the firm offshored managers to the affiliate. Σ # *offshored managers* / Σ *affiliate employment* is the total number of offshored managers relative to the total employment over all affiliates; Σ # *offshored managers* / *parent skilled employment* is the total number of offshored managers relative to the number of university graduates employed in the parental firm. *** denotes $p<0.01$, ** denotes $p<0.05$, * denotes $p<0.1$.

Table 4: Trade in Tasks and Executive Compensation Relative to Workers

dependent variable:	(1)	(2)	(3)	(4)	(5)
	ln (CEO compensation / average firm wage)				
			openn. <40*th pctl.*	*openn.* <40*th pctl.*	*openn.* <10*th pctl.*
sum of intrafirm imports / parental sales	0.00867	0.0122***	0.0100***	0.0125***	0.00919***
	(0.247)	(0.002)	(0.002)	(0.001)	(0.006)
offshored manager dummy	-0.305				
	(0.257)				
# offshored managers		-0.0690*	-0.0499*	-0.0987**	-0.0717**
		(0.055)	(0.070)	(0.021)	(0.025)
Δ establishments '97–'98	0.0220***	0.0229***			
	(0.008)	(0.002)			
less open			-0.139	-0.368	-0.836**
			(0.636)	(0.331)	(0.029)
less open x # offshored managers				0.0765	0.121***
				(0.138)	(0.001)
ln parental sales	-0.0310	-0.0479	0.0597	0.0506	0.130
	(0.870)	(0.807)	(0.525)	(0.580)	(0.255)
Germany dummy	1.137	0.809	0.220	0.222	0.00898
	(0.181)	(0.203)	(0.556)	(0.542)	(0.982)
industry dummies	no	no	no	no	no
host country region dummies	no	no	no	no	no
observations	61	56	120	120	120
R-squared	0.457	0.626	0.170	0.200	0.248

Notes: Standard errors are clustered at the parental firm level and p-values are in parentheses. The dependent variable *ln (average executive wage relative to average firm wage)* is the natural logarithm of the average executive wage relative to the average wage paid in the multinational parent. The variable *less open* is a dummy which takes the value 1 if the firm is within the 40th or 10th percentile, respectively, of the openness distribution. *Offshored manager dummy* is a dummy variable that indicates whether the firm offshored managers to the affiliate. *# offshored managers* is the number of managers offshored to the affiliate firm. *** denotes $p<0.01$, ** denotes $p<0.05$, * denotes $p<0.1$.

Table 5: Descriptive Statistics

variable:	obs.	mean	min	max	std. dev.	obs. with dummy =1/=0
Decentralized Management:						
level of decentralization of authority	1161	2.83	1	5	0.87	-
normalized level of decentralization of authority	1161	0.00	-2.10	2.50	1	-
Offshoring of Production Tasks:						
intrafirm imports in percent of parent firm's sales	1957	8.37	0	560.00	34.72	-
intrafirm imports	1995	0.39	0	1	0.49	776 / 1219
IV: standardized input	2073	0.61	0	1	0.49	1273 / 800
IV: top 25%ile R&D	2123	0.17	0	1	0.38	1758 / 365
Offshoring of Managerial Tasks:						
manager sent	809	0.43	0	1	0.49	345 / 464
offshored manager dummy = 1 - manager sent	809	0.57	0	1	0.49	464 / 345
Σ # offshored managers / Σ affiliate employment	797	0.047	0	0.479	0.066	-
Σ # offshored managers / parent skilled employment	685	1.48	0	13.6	2.49	-
# offshored managers	731	2.63	0	39	3.73	-
Competition and Trade Openness:						
foreign competition (firm)	2010	0.82	0	1	0.38	1657 / 353
foreign competition (sample)	2122	0.82	0	1	0.21	-
domestic competition (sample)	2120	0.57	0	1	0.28	-
highly open	2122	0.74	0	1	0.44	1566 / 556
less open (below 10th percentile)	2122	0.074	0	1	0.263	158 / 1964
less open (below 40th percentile)	2122	0.46	0	1	0.50	972 / 1150
Δ establishments '97–'98	1021	-91.76	-1357	313	155.78	-
Human Resources:						
CEO compensation in EUR	767	869,756	17,767	5,066,667	906,156	-
firm wages in EUR	1586	57,659	1816	566,867	45,813	-
CEO compensation / average firm wage	561	15.00	0.29	143.12	21.02	-
ln (CEO compensation / average firm wage)	561	2.22	-1.23	4.96	0.94	-
Control Variables:						
ln parental sales	1733	18.80	13.24	24.78	2.09	-
ln affiliate sales	1722	15.46	7.44	21.86	1.80	-
R&D intensity	1458	0.031	0	2.21	0.090	-
Germany dummy	2123	0.56	0	1	0.50	1186 / 937

Table 6: Variable Descriptions

variable:	
Decentralized Management:	
level of decentralization of authority	index that measures the degree of decentralization in decision making at the parent firm with values between 1 (decisions are taken at the top by the CEO/owner) and 5 (decisions are taken at the divisional level); the index is the mean value of decentralization of 16 (for German parents) or 13 (for Austrian parents) types of corporate decisions. These include decisions on acquisitions, new strategies, transfer pricing, human resources, R&D expenditure, new products, financing, budget, hiring and firing personnel.
normalized level of decentralization of authority	z-score of the decentralization index: rescales the index to a mean of 0 and a standard deviation of 1; each value of this normalized index indicates its difference from the mean of the original decentralization index in number of standard deviations (of the original index)
Offshoring of Production Tasks:	
intrafirm imports in percent of parent firm's sales	sum of all intrafirm imports that a parent firm sources from its affiliates relative to the size of the parent firm (measured by the parent's domestic sales) multiplied by 100%
intrafirm imports	dummy that takes the value 1 if the parent firm has intrafirm imports from at least one of its affiliates and 0 otherwise
IV: standardized input	dummy that takes the value 1 if the affiliate firm supplies a good that is standardized in both, quality and design and 0 otherwise
IV: top 25%ile R&D	dummy that takes the value 1 if the parental firm's R&D intensity is within the top 25th percentile of the R&D intensity distribution and 0 otherwise
Offshoring of Managerial Tasks:	
offshored manager dummy	dummy that takes the value 1 if the parent firm does not send managers to the affiliate firm and 0 otherwise
Σ # offshored managers / Σ affiliate employment	sum of managers that work in all affiliate firms and are not sent from the parent firm relative to the total employment in all affiliate firms
Σ # offshored managers / parent skilled employment	sum of all managers that work in affiliate firms and are not sent from the parent firm relative to the number of university graduates employed in the parent firm
# offshored managers	number of managers in the affiliate firm that are not sent from the parent (absolute)
Competition and Trade Openness:	
foreign competition (firm)	dummy that takes the value 1 if the parent firm faces many or very many foreign competitors and 0 otherwise
foreign competition (sample)	average of the dummy *foreign competition (firm)* at the ISIC 3 digit level
domestic competition (sample)	average of the dummy *domestic competition (firm)* at the ISIC 3 digit level
highly open	dummy that takes the value 1 if the parent firm operates in an ISIC 3 digit industry that is above the 25th percentile of *foreign competition (sample)*
less open (below 10th percentile)	dummy that takes the value 1 if the parent firm operates in an ISIC 3 digit industry that is below the 10th percentile of *foreign competition (sample)*
less open (below 40th percentile)	dummy that takes the value 1 if the parent firm operates in an ISIC 3 digit industry that is below the 40th percentile of *foreign competition (sample)*
Δ establishments '97–'98	change in the number of establishments between 1997 and 1998 within the sector and home country of the parent firm; 4 digit information is used wherever available if not then 3 or 2 digit information is used; data source: INDSTAT4 2013
Human Resources:	
CEO compensation / average firm wage	average executive compensation of executive board members relative to the average employee wage of the parent firm; data sources: average executive compensation is obtained from Kienbaum and additionally hand-collected from annual reports of the firms; whenever only consolidated reports were available from a superordinated entity, executive payments are obtained from there; average employee wages come from the firm survey
Control Variables:	
ln parental sales	natural logarithm of the parent firm's domestic sales in EUR
ln affiliate sales	natural logarithm of the affiliate firm's total sales in EUR
R&D intensity	expenditures on R&D by the parental firm relative to parental firm sales
Germany dummy	dummy that takes the value 1 if the parent firm is located in Germany and 0 if the parent firm is located in Austria

For Online Publication - Appendix

The Proof of Proposition 1

Case 1. Consider first the case when $B/w < \tilde{B}_P = 2(1 - k/b)/(1 - \alpha\bar{e})$. As $B/w < \tilde{B}_P$, the manager puts in the maximum effort, $\bar{e}$, under both types of the firm organization. Hence, the principal's utility in case of P-organization is

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

Under A-organization, the utility is

$$
\begin{aligned}
v_P^* &= w\,(E_A^*)^2 + e_A^*\alpha B \\
&= w\left(\frac{B(1 - \bar{e})}{2w}\right)^2 + \bar{e}\alpha B.
\end{aligned}
$$

It is straightforward to see that $u_P^* > v_P^*$ (as $\alpha < 1$). As a result, P-organization is optimal.

Case 2. Consider now the case when $\tilde{B}_P \leq B/w < \bar{B}$. In this case, the manager puts in zero effort under P-organization and the maximum effort under A-organization. As a result,

$$
\begin{aligned}
u_P^* &= w\left(\frac{B}{2w}\right)^2, \\
v_P^* &= w\left(\frac{B(1 - \bar{e})}{2w}\right)^2 + \bar{e}\alpha B.
\end{aligned}
$$

It can be shown that

$$
v_P^* > u_P^* \iff B/w < \bar{B},
$$

implying that A-organization is optimal if $\tilde{B}_P \leq B/w < \bar{B}$.

Case 3. Finally, from the previous reasoning, it follows that when $B/w \geq \bar{B}$, P-organization is optimal: $u_P^* > v_P^*$ and the manager puts in zero effort. That is, we have O-organization as the equilibrium outcome.

Existence and Uniqueness of the Equilibrium

In this subsection of the Appendix, we show that there exists a unique solution of (11) and (12) in B/w and q/w. It is straightforward to see from (11) and (12) that B/w solves the following equation (we substitute the free entry condition into the skilled labour market clearing

condition):

$$B/w = C \left(\frac{w}{Z_X}c_B\right)^{1-\sigma} \left(\frac{a\left(L(1-I_S) + \left(\frac{(1-\bar{e}\alpha)^2}{4}\left(\frac{B}{w}\right)^2 + \bar{e}\alpha\frac{B}{w} - \frac{q^*I_S}{w}\right)H\right)}{H\left(\frac{1}{\rho}\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\bar{e}\alpha + \frac{(1-\bar{e}\alpha)^2}{2}\frac{B}{w}\right) + IM(1-I_S)} + \frac{A_m}{w}\right). \quad (22)$$

Let us define $F(B/w)$ as the right-hand side of (22). 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 $Ca\rho^{1-\sigma}/2$. Recall 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 neighbourhood of infinity is $a/2\sigma$, which is strictly less than one (as $a < 1$ and $\sigma > 1$). Thus, for high values of B/w, we have $F(B/w) < B/w$. Moreover, it is straightforward to show that if $I_S \leq wL/(wL + q^*H)$, then $F(0) > 0$. This implies that for low values of B/w, one has $F(B/w) > B/w$. This in turn immediately implies that there is a solution of (22).

Note that Equation (22) can be transformed into a quadratic equation of B/w and, therefore, cannot have more than two solutions. Taking into account the properties of the function $F(B/w)$, one can see that Equation (22) cannot have exactly two solutions as well. As a result, (22) has a unique solution. This in turn implies that (11) and (12) has a unique solution.

When Offshoring is Profitable

Note 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 I_S tasks are offshored. That is, in P-equilibrium,

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

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

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

$$\frac{B}{w} > 2\frac{\sqrt{(\bar{e}\alpha)^2 + \frac{q^*}{w}(1-\bar{e}\alpha)^2} - \bar{e}\alpha}{(1-\bar{e}\alpha)^2}.$$

As can be inferred from the equilibrium condition for B/w (see (22)), 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

The proof below establishes our predictions regarding the effect of managerial offshoring on firm organization as stated in Proposition 3. Specifically, we consider how the equilibrium real profits in Equation (22) are affected by the fraction of offshored managerial tasks. First, we analyse the derivative of the equilibrium real profits from (22) with respect to the measure of managerial offshoring I_S. Then, we provide a necessary and sufficient condition for this derivative to be positive (in this case, a rise in the number of offshored managerial tasks under P-organization leads to an increase in the real profits and thereby prompts a transition to a decentralized A-organization).

Let us denote the right-hand side of (22) by $F(B/w, I_S)$. Then, the equilibrium value of B/w solves

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

where

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

It can be shown that

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

47

where

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

Note that $G(B/w)$ is a quadratic function of B/w. As $G(B/w)$ is U shaped and $G(0)$ is negative, the equation $G(B/w) = 0$ has two solutions: one positive and one negative. Let us write $(B/w)^*$ for the positive solution of

$$G(B/w) = 0.$$

Specifically, $(B/w)^*$ satisfies

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

Taking into account the properties of $G(B/w)$, it is straightforward to see that $G(B/w) > 0$ (for positive values of B/w) 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 marginal 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 this finding is that B/w is increasing in I_S on $[0, wL/(wL + q^*H)]$ if and only if $(B/w)^0 > (B/w)^*$, where $(B/w)^0$ is the solution of
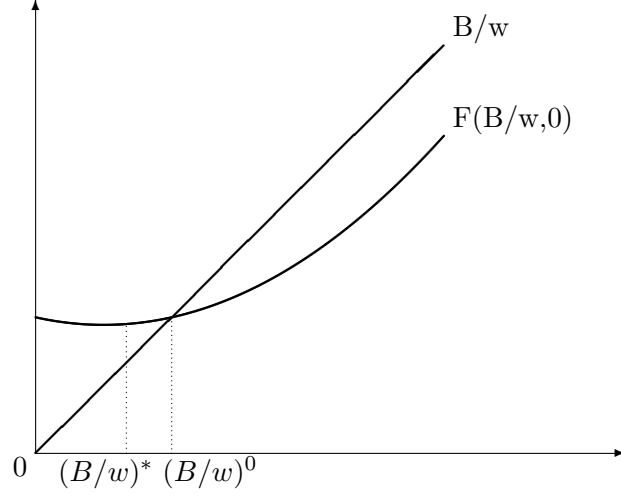
$$B/w = F(B/w, 0).$$

That is, $(B/w)^0$ is the equilibrium value of B/w when $I_S = 0$ (there is no offshoring of managerial labour).

Next, we find the condition when $(B/w)^0 > (B/w)^*$. Since by definition $(B/w)^0$ solves $B/w = F(B/w, 0)$, one can see that $(B/w)^0 > (B/w)^*$ if and only if $F((B/w)^*, 0) > (B/w)^*$ (see Figure 4). We have that

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

Figure 5: The Equilibrium Value of B/w

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

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

Hence, we derive that

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

As a result, B/w is increasing in I_S on $[0, wL/(wL + q^*H)]$ if and only if

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\left(\frac{A_m}{w} + \frac{a\left(L + \frac{q^*}{w}H\right)}{IM}\right) > (B/w)^*. \tag{23}$$

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

$$\begin{aligned}
D_0 &= IM\frac{(1-\bar{e}\alpha)^2}{4} > 0, \\
D_1 &= IM\bar{e}\alpha - \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\frac{(1-\bar{e}\alpha)^2}{2}, \\
D_2 &= \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\bar{e}\alpha + IM\frac{q^*}{w} > 0.
\end{aligned}$$

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, the inequality (23) is equivalent to

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

$$C\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\frac{A_m}{w} > \frac{1}{IM}\left(2\frac{\sqrt{D_1^2 + 4D_0D_2} - D_1}{(1 - \bar{e}\alpha)^2} - Ca\left(L + \frac{q^*}{w}H\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}\right). \quad (24)$$

Let us denote the right-hand side of inequality (24) by $K(z)$, where z is $\frac{1}{IM}$. That is,

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

where

$$K_1 = \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\frac{(1 - \bar{e}\alpha)^2}{2},$$

$$K_2 = \left(L + \frac{q^*}{w}H\right)\left(\frac{wc_B}{Z_X\rho}\right)^{1-\sigma}\bar{e}\alpha,$$

$$K_3 = Ca\left(L + \frac{q^*}{w}H\right)\left(\frac{w}{Z_X}c_B\right)^{1-\sigma}.$$

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

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

Hence,

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

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

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

as $Ca\rho^{1-\sigma} < 1$ (recall that $Ca\rho^{1-\sigma} = a/\sigma < 1$). Thus, $K(z)$ is increasing in a neighbourhood 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 of z. Here we employ the following argument: if $K(z)$ were not increasing, then it would have at least two local extrema (since $K'(0) > 0$ and $K'(\infty) > 0$). In that case, there would exist a constant $\bar{A}$ such that the equation $K(z) = \bar{A}$ would have at least three solutions, which contradicts the properties of $K(z)$.

This in turn means that the right-hand side of (24) is always positive and decreasing in IM with its value at infinity being equal to

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

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 (14)), there exists a value of IM (hereinafter denoted by IM_P) such that (24) holds if and only if $IM > IM_P$.