International Trade and the Organization of Firms:

Governance, Incentives, and Competitiveness

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Contents

List of Tables

List of Figures

CHAPTER I

Preface

Globalization and technological change have been substantially changing the nature of firms. As the global economy became more integrated, we have experienced striking increases in the international activities of corporations. More firms sell on world markets and source their inputs globally. Furthermore, the emergence of information and communication technologies has altered skill demand. These developments have toughened the competition between firms and intensified the role of human capital as an important stakeholder in firms.

This dissertation studies the responses of firms and workers to globalization and technological change. It combines three independent contributions to the fields of international trade and organizational economics. Each contribution corresponds to an individual chapter and can be read independently.

Chapter II studies how international trade and technological change influence the quality of corporate governance standards within firms. In the theoretical part of the chapter, I use an open economy model with heterogeneous firms and human capital and introduce a simple moral hazard problem as in Acharya et al. (2013). Firm heterogeneity arises from the matching of managers to production technologies which determines managerial compensation in equilibrium. Firm owners can incentivize their managers with performance payments or they can monitor them through investments into corporate governance. I use this model to demonstrate that increases in trade openness and skill-biased technological change increase the demand for human capital which raises the reservation wages of the highest skilled managers in the economy. This reduces the incentives of firm owners to invest in corporate governance as the labor market forces them to incentivize managers with performance payments instead of strict monitoring.

In the empirical part of the chapter, I use data on managerial entrenchment opportunities and equity compensation in a sample of public U.S. corporations between 1990 and 2006 to test the predictions of the model. The entrenchment index by Bebchuk et al. (2009) which contains information on the governance quality of large U.S. public companies is an ideal source of data to test the relationship between corporate governance and the industry environment of firms. Furthermore, I obtain information on CEO equity compensation in the U.S. between 1998 and 2006 from the BoardEx database. The data suggest that increases in sectoral openness and the contribution of information and communication technologies reduce the quality of corporate governance and increase the equity compensation of CEOs.

Chapter III is joint work with Dalia Marin and Jan Tscheke. In the chapter we use representative survey data on 15,000 European manufacturing plants to investigate how global sourcing and decentralized management affect the export competitiveness of firms. In order to guide our empirical analysis, we develop a simple theoretical framework where firms adjust their organization in order to meet competitive pressures on foreign markets. First, firms can reorganize production internationally and offshore part of the production to other countries. This allows exporting firms to reduce their costs and to compete on prices. Second, firms can reorganize towards a more decentralized hierarchy which empowers knowledge workers in the firm. This incentivizes workers to suggest new ideas and in consequence allows firms to compete on product quality.

We evaluate the empirical relevance of the model predictions for the European manufacturing industry. Our data contain rich information on the organization and international activities of manufacturing firms across seven European countries. We construct the world export market share of each firm for its respective set of industries and show that firms that source a larger fraction of their inputs from abroad obtain larger market shares on global export markets. We also find that firms with a decentralized management are more likely to offer products with higher quality compared to firms with a more centralized management, particularly when firms are not family managed. We identify the competitiveness effects of offshoring at the firm level with a set of instruments that capture differences in comparative advantages of input industries. Furthermore, we exploit regional variation in different measures of religious beliefs and trust to instrument for the effect of a decentralized organization.

Chapter IV analyzes how executive remuneration in industrialized countries is shaped by the international division of labor. Using unique linked manager-firm data from BoardEx and Worldscope that contain detailed information on the compensation of top executives in public European and U.S. firms, I study how compensation contracts adopt to changes in intermediate imports at the industry level. Globalization has been mentioned as one of the main causes for the rise in executive compensation. In this chapter, I empirically study how the increase in intermediate goods trade has influenced monetary incentives for top managers during the last 15 years.

I find that increases in the exposure to trade in tasks made executive compensation more elastic to changes in firm performance: executive compensation becomes more elastic to changes in firm earnings and stock market performance when industries import a larger fraction of their intermediates. Furthermore, the estimates suggest that the positive effect of trade in tasks on the monetary incentives in executive compensation have increased the earnings inequality between managers and workers within firms.

CHAPTER II

Trade, Technologies, and the Evolution of Corporate Governance

II.1 Introduction

Public companies in the U.S. typically incentivize managers with performance related payments instead of tight monitoring: between 1992 and 2008, the median share of performance payments in U.S. S&P 500 firms increased from 58 to 83 percent[1] while improvements in corporate governance to monitor managerial behavior have been rather absent.[2] This chapter proposes an explanation of this development, by showing that trade and technological change lead to more competition for the most productive managers which can interact with the way how firms provide incentives. Labor economists frequently argue that globalization and skill-biased technological change have been major triggers of increases in the level and the slope of compensation at the very top of the income distribution.[3] Furthermore, skill intensity and open-

[1]See Frydman and Jenter (2010) who document the historical development of U.S. executive compensation.

[2]The two most prominent U.S. corporate governance indices from Bebchuk et al. (2009) and Gompers et al. (2003) indicate that the average corporate governance quality became inferior during the last two decades while there is large variation in the quality of corporate governance between firms.

[3]See for instance Baldwin and Cain (2000) who study the roles of trade and technology for shifts in relative U.S. wages, Bell and Van Reenen (2013) who study the role of globalization on extreme wage inequality in top management or Cuñat and Guadalupe (2005, 2009) who

ness to international trade also seem to matter for managerial compensation across industries: managers in skill intensive and open industries obtain a wage premium.[4] However, the understanding how real economic developments affect corporate governance outcomes is rather scant. Inspired by the impact of trade and technological change on incentives and the managerial skill premium, this chapter investigates how trade openness and skill-biased technological change affect the quality of corporate governance as an alternative incentive device. If trade and technological advancements raise the role of incentives inside firms, it is a priori surprising that firms do not try to invest more in the quality of corporate governance over time to incentivize their management with better control mechanisms.

In order to explain why firms do not incentivize with strict corporate governance, I propose an open economy model with heterogeneous firms. The model considers an economy that is endowed with a measure of heterogeneous production technologies and a measure of agents with heterogeneous skill levels. Firms emerge after matching production technologies with agents which are employed as managers and agents employed as production workers. The quality of the production technology and the level of employed managerial skill jointly determine the productivity of firms. Technologies and managerial skills are both complements such that a positive assortative assignment arises in equilibrium. I borrow here from Monte (2011) when I model preferences, the endowments of the economy and the assignment of workers to production technologies.

I subsequently introduce a stylized theory of the firm with simple incentive contracts to establish a role for corporate governance. Principals offer incentive payments and make an upfront investment into the quality of the monitoring technology for the control of managers reflecting the strength of corporate governance in a firm. In particular, I follow Acharya et al. (2013) in modeling the contracting of performance pay and corporate governance. The objective of a contract between a manager and the firm owner is twofold. First, performance pay and governance should incentivize managers to take

study the effects of globalization on incentive provisions.

[4]Figure A.1 in the appendix plots average CEO compensation for 4-digit SIC industries and illustrates that average compensation is larger in more skill-intensive and more open sectors

the desired action from the owner's perspective. Second, the expected performance pay should make the participation in the firm sufficiently attractive for a manager given his endogenously formed reservation wage.

To determine the distribution of managerial wages in equilibrium, I borrow from the literature on the assignment of managers to firms[5] and make use of the positive assortative matching of managerial skills to production technologies. An assignment implies that the marginal cost of a slightly higher skilled manager is equal to the marginal benefit of this manager in a competitive labor market equilibrium. Therefore, managerial wages depend on the productivity of managers and thus on the individual skill level, the production technology of the firm and industry characteristics.

The chapter proceeds with two comparative static exercises. First, I consider the effects of skill-biased technological change on corporate governance investments and performance payments. More specifically, I model skill-biased technological change as an increase in the effectiveness of production technologies benefiting higher skilled managers relatively more. Second, I extend the model to an open economy version with two symmetric countries and intra-industry trade. The open economy version of the model allows to consider how trade integrations, modeled as a reduction of trade costs, affect corporate governance and performance pay.

In the model, trade and skill-biased technological change raise competition on managerial labor markets and thereby increase reservation wages of the most productive managers in the economy. This increase in reservation wages forces companies to compensate their managers with larger sums. Firms respond to this effect with more performance payments and lower investments into their corporate governance.

The analysis of the impact of real economic outcomes on both, executive compensation and corporate governance structures, joins two prominent and competing explanations for the rise of CEO compensation during the previous decades: managerial power versus market competition. Some economists argue that the rise of executive compensation is due to more powerful managers that can influence their compensation contracts and extract rents from the firm more easily (see Bebchuk and Fried (2003)). Another strand of litera-

[5]See for instance Gabaix and Landier (2008) or Terviö (2008).

ture claims that competition for managerial talent, raised by increases in market capitalization, can account for the rise in executive payments to a large extent (see Gabaix and Landier (2008) and Terviö (2008)). The model combines those two strands by arguing that changes in the real economic environment have triggered a shift in the demand for managerial talent. Thereby, firms endogenously reduce investments in corporate governance which leads to powerful managers and a rise of performance payments at the top.

Using data on managerial entrenchment opportunities and equity compensation in a panel of large U.S. stock companies between 1990 and 2006 combined with information on trade openness and the importance of ICT at the industry level, I can test the comparative statics predictions of the model. The empirical results suggest that companies react to increases in trade openness at the sectoral level, measured as the share of exports relative to the effective market size of the industry, with weaker corporate governance and more equity compensation. Furthermore, the results suggest that the application of information and communication technologies, measured as the contribution of ICT services to the industry growth, led to similar albeit smaller effects: companies adopted weaker corporate governance and paid more equity compensation. I address potential sources of endogeneity by employing an instrumental variable strategy, where trade openness is instrumented with the real effective exchange rate of the industry-weighted most important trading partner countries.

The chapter covers a question at the intersection of organizational and international economics and thus relates to various strands of the literature on the effects of trade and technological change on firm organization and corporate finance.

It contributes to the literature that considers incentive compensation in general equilibrium trade models. Wu (2011) and Chen (2012) focus on the managerial incentive provision in firms with moral hazard in general equilibrium models of intra-industry trade and firm heterogeneity à la Melitz (2003). Gersbach and Schmutzler (2014) show how the global integration of product and labor markets increases the heterogeneity of CEO remuneration in a model with Cournot competition. The focus of these models is the effect of trade integrations on the dispersion of incentive contracts and compensation levels.

The chapter is also related to a literature that links the decision to delegate authority inside firms to globalization and the technological frontier. Marin and Verdier (2008b, 2012a,b) show that globalization affects the delegation of formal and real authority in organizations. They embed the allocation of formal decision authority à la Aghion and Tirole (1997) into models of international trade and explain how economic integration leads to the delegation of power inside firms. Since agents are infinitely risk-averse with respect to income, performance payments cannot be used to incentivize agents. Consequently, their models do not allow to draw inferences on the choice between managerial power and performance pay. Additionally, the quality of managerial talent is homogenous such that variation in managerial power across firms within industries is absent. Marin et al. (2015) investigate how the allocation of power inside firms is affected by offshoring managers or production tasks in a small open economy model. Caliendo and Rossi-Hansberg (2012) show that exporting firms increase the control span of managers and the number of management layers within their hierarchies after trade liberalizations. Acemoglu et al. (2007) analyze how technology diffusion affects firm decentralization. They argue that decision rights are more decentralized when private information of agents is crucial. Consequently, the delegation of authority is more likely when firms are relatively close to the technological frontier such that technologies are not public knowledge. Compared to their model, technologies play a different role in this chapter. While the quality of ideas and managerial skills are modeled as complementary inputs in my model, the complexity of technologies and the quality of the managerial talent is exogenous in their paper.

I add an integrated view to this literature that considers both, the choice of corporate governance and performance payment which are subject to labor market outcomes. This allows to draw novel conclusions about the effects of trade and technological change on the substitution patterns between both, payment and governance, to provide incentives.

The effects of product markets on either managerial power or incentive compensation have also been analyzed in several empirical papers. Here, the literature has primarily focused on the delegation of decision authority as a particular dimension of managerial power. Bloom et al. (2010a) and Guadalupe and Wulf (2010) use data on the organization of firms to show

how more import penetration leads to flatter firm hierarchies and more decentralized decision making. Marin and Verdier (2012a) show that German and Austrian multinationals have a more decentralized organization when they are faced by a stronger trade exposure. Cuñat and Guadalupe (2005) consider the appreciation of the British Pound as a quasi-natural experiment to quantify the effect of product market competition on executive performance pay within a panel of British manufacturing firms. They find that the implied import competition shock led to a higher pay to performance sensitivity for managers in more open sectors.

The chapter is also related to recent research on assignment models that consider corporate finance decisions of the firm. Eisfeldt and Kuhnen (2013) present a model where CEOs and firms form matches based on multiple characteristics to explain low turnover rates in an industry equilibrium. Bénabou and Tirole (2013) analyze the impact of labor market competition and skill-biased technological change on the structure of compensation in a Hotelling framework. They demonstrate that competition for talent shifts effort from less easily contractible tasks, like long-term investments, towards more easily contractible tasks. In addition Baranchuk et al. (2011), Edmans et al. (2009) and Falato and Kadyrzhanova (2012) develop industry equilibrium models with moral hazard problems to show how CEO compensation interacts with the industry environment of firms. Dicks (2012) establishes a role for corporate governance regulation in an industry equilibrium model with moral hazard and assignment of CEOs to firms. Acemoglu and Newman (2002) consider the impact of labor supply and demand on the corporate structure of firms and show how the outside option of production workers affects production worker monitoring.

The remainder of the chapter is organized as follows. Section II.2 develops the model in the closed economy and characterizes the equilibrium solution. Section II.2.5 addresses the effects of skill-biased technological change in a closed economy setting. Section II.2.6 deals with the open economy case and considers the effects of globalization through a decline in trade costs. Section II.3 describes the data, empirical modeling strategy and presents the evidence. Section II.4 concludes.

II.2 The Model

In this section I present the model in a closed economy setting. I follow Acharya et al. (2013) in modeling the organization of firms subject to moral hazard. This partial equilibrium model of the firm is subsequently introduced into an industry environment with heterogeneous skills and technologies. Complementarities in the effectiveness of managerial skills and production technologies lead to a positive assortative matching of managers to production technologies in equilibrium. The structure of the general equilibrium model borrows from Monte (2011).

The outline of the timing structure is as follows:

$t = 0$: All firms that want to enter the market make an upfront investment into the level of corporate governance $g \in [0, 1]$ that they want to establish at their firm. Better corporate governance leads to more efficient control of their managers and thus to a closer alignment of the manager's incentives to the owner's interests.

$t = 1$: All firms that want to enter the market need to hire a manager. Owners make a "take it or leave it" contract offer to a manager, taking into account the value of the manager's outside option. The prospective manager receives the offer which specifies a performance payment and the level of corporate governance investment chosen in $t = 0$. This level of corporate governance allows a prospective manager to infer how likely it is to pursue personal goals without being caught. Managers in more weakly governed firms have a higher chance to remain uncaught when shirking such that their incentives are less closely aligned with the owners' interests. Managers may decide to accept or decline the offer depending on their respective outside option. Labor market clearing requires that the remaining agents that do not get an offer for a CEO position become production workers.

$t = 2$: After a manager accepts the offer, he chooses to either behave (exert effort) or misbehave (shirk). Whenever the manager chooses to shirk, the output production will fail and whenever the manager chooses to expand effort, there is a positive chance that the firm produces output.

The quality of corporate governance is introduced as a probability g with that firm owners receive a signal on the expected production outcome. If the signal indicates a failure of output production, firm owners can displace a manager in order to obtain some liquidation value.

$t = 3$: After the production occurred, all agents are compensated and profits are realized.

II.2.1 Preferences, Skills and Technologies

I continue with a description of the consumer preferences and the endowment of the economy. Preferences can be described by a standard CES utility function over a set of differentiated varieties J

$$U = \left[\int_{j \in J} y_j^{(\sigma-1)/\sigma} dj \right]^{\sigma/(\sigma-1)}, \tag{II.1}$$

where y_j is the amount that is consumed of variety j and $\sigma > 1$ is the constant elasticity of substitution. This implies that consumers spend $x_j = X \left(\frac{p_j}{P} \right)^{1-\sigma}$ on each variety that is produced, where $P \equiv \left[\int_{j \in J} p_j^{(1-\sigma)} dj \right]^{1/(1-\sigma)}$ is the price index in the economy and X the aggregate consumption expenditure. A firm needs three inputs in order to exist: a production technology, a manager and production labor in proportion to the firm's output. All firms are single product firms.

The economy is populated by a mass of agents L which can be employed either as production workers or as managers. Agents differ in their managerial skill but they are equal in the skills that they provide as production workers. The distribution of managerial skills is described by $L(s) = L/s$, where $s \in [1, \infty)$ is an agent's skill level and $L(s)$ is the measure of agents with managerial skills that are at least as good as the skill level s. Agents that fill an occupation as production worker provide one efficiency unit of production labor, independently of their managerial skills. The occupational choice between production work and managerial work will be endogenized later in the model. Note that, unlike in Melitz (2003), where the production labor supply is fixed and similar to Wu (2011), the allocation of agents into production worker jobs and managerial jobs endogenously determines the supply of production labor.

Besides the skill level of the employed manager, firm productivity is influenced by the quality of the production technology. All production technologies are owned by a mutual fund (the principal) maximizing the individual profits of firms and redistributing them equally across the population.[6] The quality distribution of technologies is given by $G(z) = T/z$, where $z \in (0, \infty)$ is the quality of a technology and $G(z)$ is the measure of technologies that are at least as good as a technology with quality z. This implies that the number of available (however, bad) technologies is sufficient to accommodate any number of managers in equilibrium.

The production costs of a firm depend on the skill of the manager and the production technology: managerial talents and technologies complement each other regarding the production of output. This complementary relationship is implied by the firm's unit cost of production. In particular, if production with a technology of efficiency z is run by a manager with skill s, unit costs are $\varphi(z,s) = \underline{w}/(z^{\kappa}s^{\mu})$, where $\underline{w}$ is the production labor wage. The parameter $\mu > 0$ measures the influence of the manager's skill and the parameter $\kappa > 0$ the impact of the production technology on firm productivity.

Let $x\left(p_j\right) - \frac{x(p_j)}{\varphi(z,s)p_j}$ be the surplus (revenues net of production costs) of a firm that chooses the price level p_j for its variety. Standard optimization yields that the firm charges a constant markup over production costs: $p_j = p\left(z,s\right) = \frac{\sigma}{\sigma-1}\frac{\underline{w}}{z^{\kappa}s^{\mu}}$. The revenue function x_j and the optimal price $p\left(z,s\right)$ can now be used to state the surplus that a firm can obtain if it produces successfully, denoted by $Y\left(z,s\right)$, as

$$Y\left(z,s\right) \quad = \quad M\left(\frac{z^{\kappa}s^{\mu}}{\underline{w}}\right)^{\sigma-1}. \qquad \text{(II.2)}$$

The term $M \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}XP^{\sigma-1}$ captures the size of the market from the perspective of an individual firm. Markets are large if the elasticity of substitution between varieties is low and the aggregate expenditure level X or the price index P are large.

[6]This is a standard assumption in the literature on heterogeneous firms to abstract from any wealth effects among economic agents.

Note that a marginal increase in the managerial skill s increases the surplus (II.2) for all firms but due to complementarities between skills and technologies the increase of surplus is larger, the better the quality of technology z: $\partial^2 Y(z,s) / (\partial s \partial z) > 0$. This property will be important when the assignment of managers to production technologies is discussed at a later stage of the chapter.

II.2.2 Moral Hazard and Firm Governance

In this section, I explain the contracting between the firm owner and a prospective manager in a partial equilibrium setting, where I treat the outside option of the manager and the potential surplus of the firm as exogenous. I show that the optimal level of corporate governance depends on the expected value of the manager's outside option. Specifically, I borrow from Acharya et al. (2013) in modeling contracting with corporate governance investments under moral hazard.

As discussed previously, firm owners make an upfront investment into the level of corporate governance in $t = 0$ and hire a manager in $t = 1$ to become active on the market. A contract between both parties consists of a performance payment $w \geq 0$ and the strength of corporate governance $g \in [0, 1]$ that the owner has implemented in $t = 0$. Investments in corporate governance generate linear personal costs $C\underline{w}g$.[7] These costs reflect the owner's ex-ante effort cost to set up a system in order to monitor the manager ex-post. The benefit of stricter corporate governance is that it increases the chance of learning the productivity of the manager such that the manager may be displaced more easily whenever he is unproductive.

The manager chooses an unobservable and hence incontractible action $Z \in \{manage, shirk\}$ after a contract is signed. The action $Z = \{shirk\}$ generates a private non-pecuniary benefit B for the manager and no production output for the firm. The action $Z = \{manage\}$ instead generates no private benefits for the manager but positive surplus $Y > 0$ for the firm with likelihood ε and zero

[7] I choose to express the owner's costs and benefits of corporate governance in terms of the production labor wage rate $\underline{w}$ in order to simplify the notation when I derive the equilibrium solution in II.2.4. This simplifies the characterization of an equilibrium in the open economy case and leaves the qualitative results of the comparative static analyses in II.2.5 and II.2.6 unaffected.

production output $Y = 0$, otherwise. Whenever the positive surplus $Y > 0$ is realized, the manager is compensated with his bonus w.

Before the surplus is realized, owners observe a signal $\widetilde{x} \in \{Y, 0\}$ on the expected firm surplus with probability g. After observing this signal, owners can choose to displace the manager and liquidate the firm to obtain some liquidation value $R\underline{w}$. This liquidation value induces firm owners to displace managers whenever the signal on output production turns out to be negative.[8] In order to make the analysis interesting, I make the following assumptions:

Assumption.
(1) $C\underline{w} \in ((1-\varepsilon) R\underline{w}, (1-\varepsilon) R\underline{w} + B)$*: the choice of* g *is non-trivial. If corporate governance investments were cheaper, the firm would always invest. If instead corporate governance investments were more expensive, investments would never be profitable.*
(2) $\varepsilon Y > B$*: incentivizing managers to exert effort is socially efficient.*
(3) $\varepsilon Y > R\underline{w}$*: owners have no incentive to displace the manager and obtain the liquidation value* $R\underline{w}$ *when they do not observe the signal* $\widetilde{x}$*.*

A contract between both parties needs to be incentive compatible and to satisfy the manager's participation constraint. To sum up, the owner's problem is given by

$$\max_{w,g} \varepsilon (Y - w) + (1-\varepsilon) gR\underline{w} - C\underline{w}g \tag{II.3}$$

$$s.t.$$

$$\varepsilon w \geq (1-g) B \tag{II.4}$$

$$\varepsilon w \geq \overline{W}. \tag{II.5}$$

Firm owners choose the performance payment w and the level of corporate governance g to maximize their expected profits (II.3) subject to the manager's incentive compatibility constraint (II.4) and the participation constraint (II.5). If the manager chooses the action $Z = \{shirk\}$, firm output is always 0 and the manager receives his private benefit B whenever he is not displaced which occurs with probability $1 - g$. If the manager chooses the action $Z = \{manage\}$, he is compensated with performance payment w when-

[8] An empirical counterpart of this liquidation value could be the owner's benefits of a merger or the acquisition by another firm.

ever the firm produces output $Y > 0$ which happens with probability ε. The incentive compatibility constraint (II.4) ensures that the manager's expected payoff from $Z = \{manage\}$ is weakly larger than his expected payoff from $Z = \{shirk\}$. The participation constraint (II.5) additionally requires that the manager's expected payoff from $Z = \{manage\}$ is weakly larger than his market wage $\overline{W}$.

Note that ex ante, corporate governance and performance pay are substitutes with respect to the provision of incentives. From the perspective of the manager, a stricter level of corporate governance reduces his power to obtain private benefits such that incentive compatibility is achievable with lower levels of performance pay. Vice versa, more performance pay makes effort provision more attractive such that less control is required. This substitutive relationship is impaired by the participation constraint that imposes a minimum payment requirement $\overline{W}$.

The optimal choice of corporate governance and performance payment is given in the following proposition.

Proposition 1. *The optimal contract for a manager is:*

$$\begin{aligned} w &= \frac{\overline{W}}{\varepsilon} \\ g &= \begin{cases} 1 - \frac{\overline{W}}{B} & \text{if } \overline{W} \leq B \\ 0 & \text{if } \overline{W} > B. \end{cases} \end{aligned}$$

Proof. See Appendix. □

Intuitively, the optimal incentive contract depends on the value of the manager's outside option. If the manager has a valuable outside option $\overline{W} > B$, the incentive compatibility constraint becomes redundant since incentive pay is already sufficiently large to incentivize the manager to choose $Z = \{manage\}$ such that investments in corporate governance are inefficient. If the manager has a less valuable outside option $\overline{W} \leq B$, owners optimally choose the cheapest contract that keeps both constraints binding in equilibrium.

II.2.3 Assignment and Managerial Compensation

Proposition 1 describes the choice of performance pay and the upfront investment in corporate governance for an exogenous outside option $\overline{W}$. Next, I endogenize the managerial wage function in order to describe how firms choose their governance in equilibrium. I proceed in two steps. First, I describe the positive assortative matching of production technologies and agents to form firms. Then, I borrow from the assignment literature and obtain equilibrium managerial payments. A satisfied participation constraint then prevents all managers from switching firms.

Complementarities between the effectiveness of production technologies and managerial skills and a competitive labor market lead to a positive assortative matching of managerial skill levels and production technologies, as it is standard in the assignment literature.[9] The positive assortative matching of managerial skills to production technologies implies that the measure of the upper tail of the managerial skill distribution and the measure of the upper tail of the technology distribution need to be of equal size for each matched firm pair (s, z) such that

$$L/s = T/z \quad \Leftrightarrow \quad z = ts,$$

where $t \equiv T/L$ is a relative measure of the technology size in the economy. The equilibrium surplus (II.2) can be restated as a function of the managerial skill s and industry-specific parameters:

$$Y(s) = M\left(\frac{t^{\kappa}s^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1}. \tag{II.6}$$

In order to pin down the equilibrium function of managerial payments $\overline{W}(s)$, I make use of a standard assignment equation as in Gabaix and Landier

[9]See for example Gabaix and Landier (2008) or Terviö (2008). Furthermore, consider the following intuitive argument: Suppose there were two technology-skill matches (z_1, s_2) and (z_2, s_1) that form firms in equilibrium with $z_1 < z_2$ and $s_1 < s_2$. The aggregate surplus could be increased by making the CEO with skill s_1 the head of the firm with production technology z_1 and the other CEO with skill s_2 the head of the firm with z_2 instead. Since any competitive equilibrium is efficient, this is a contradiction.

(2008) or Monte (2011):

$$\frac{\partial \varepsilon Y(z,s)}{\partial s}_{|z=z(s)} = \overline{W}'(s). \tag{II.7}$$

Equation (II.7) implies that the marginal cost of a slightly better manager equals the marginal benefit of a slightly better manager from the perspective of the firm.[10] Differentiating the surplus (II.2) with respect to s and plugging $z(s) = ts$ in, then gives

$$\varepsilon M \left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1} \mu(\sigma-1) s^{(\kappa+\mu)(\sigma-1)-1} = \overline{W}'(s). \tag{II.8}$$

I integrate the left hand side of equation (II.8) over s and make use of the fact that the marginal manager with skill s_c is indifferent between an occupation as production worker or as manager such that $\overline{W}(s_c) = \underline{w}$. This gives the equilibrium function of managerial payments:

$$\begin{aligned}\overline{W}(s) &= \int_{s_c}^{s} \frac{\partial \varepsilon Y(z,\iota)}{\partial \iota}_{|z=z(\iota)} d\iota + \underline{w} \\ &= \varepsilon M \left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \left(s^{(\kappa+\mu)(\sigma-1)} - s_c^{(\kappa+\mu)(\sigma-1)}\right) + \underline{w}. \end{aligned} \tag{II.9}$$

Intuitively, the compensation of a manager increases with the skill difference between this manager and the marginal manager with skill s_c, the market size M, the relative technology size t and the contribution of managerial talent to firm productivity μ.

II.2.4 Equilibrium

In this section, I establish the conditions that determine the equilibrium and characterize the choice of corporate governance and performance pay that firms offer in the economy. The following three conditions need to be satisfied in equilibrium. First, all firm owners offer the optimal mix between performance pay and corporate governance according to Proposition 1 after

[10]Note, that the marginal cost of the CEO do not include any marginal corporate governance costs since corporate governance investments have been made in $t = 0$ and are therefore sunk in the hiring stage $t = 1$. See the Appendix for a discussion of the credibility of reservation wages.

taking the managerial payments (II.9) into account. Second, only firms with non-negative expected profits are active on the market and hire a manager (the zero cutoff earnings condition). Third, the labor market clears (the labor market clearing condition).

Due to the positive assortative assignment, the marginal firm employs the least-skilled manager with managerial skills s_c. This manager must be indifferent between an occupation as production worker or an occupation as manager such that his outside option is $\overline{W}(s_c) = \underline{w}$. I make the following assumption in order to focus on the more interesting equilibria where at least some firms invest in corporate governance to monitor their managers:

Assumption. $\underline{w} < B$*: there are some firms in the economy that choose to invest in corporate governance such that there is variation in the quality of corporate governance across firms.*

According to Proposition 1, the contract offered by the marginal firm is characterized by a performance payment $w(s_c) = \underline{w}/\varepsilon$ and the highest level of governance in the economy $g(s_c) = 1 - \frac{\underline{w}}{B}$. The following zero cutoff earnings condition ensures that the marginal firm is indifferent between entering or leaving the market

$$\varepsilon \left[M \left(\frac{t^{\kappa} s_c^{\kappa+\mu}}{w} \right)^{\sigma-1} - \frac{\underline{w}}{\varepsilon} \right] - \left(1 - \frac{\underline{w}}{B} \right) \left(C - (1-\varepsilon) R \right) \underline{w} = 0. \tag{II.10}$$

Since the market size M depends on the price index which again depends on the cutoff skill level s_c, I restate M in terms of the aggregate expenditure X and the cutoff skill level s_c. The CES price index can be written as function of fundamentals and the managerial ability cutoff s_c itself, using $z_c = ts_c$ for the marginal firm[11]:

$$P = \frac{\sigma}{\sigma-1} t^{-\kappa} \underline{w} \left(\frac{\psi}{\varepsilon L} \right)^{1/(\sigma-1)} s_c^{\psi/(\sigma-1)}, \quad \psi \equiv 1 - (\sigma-1)(\kappa+\mu). \tag{II.11}$$

Here, I make the following assumption.

Assumption. $(\sigma-1)(\kappa+\mu) < 1$*: the improper integral for the price index exists.*

[11]See the Appendix for a more detailed derivation of the price index in the closed economy.

Intuitively, this assumption implies that there is no single firm that is sufficiently productive to push the price index towards zero.[12] Plugging the price index (II.11) and the expenditure level X into the zero cutoff earnings condition (II.10) and rearranging terms, yields the following function $X(s_c)$:

$$X = \frac{\sigma L \underline{w} \lambda}{\psi} s_c^{-1}, \tag{II.12}$$

where $\lambda \equiv \left(\left(1 - \frac{w}{B}\right)\left(C - (1-\varepsilon) R\right) + 1\right)$ is the net cost of corporate governance for the marginal firm.

The zero cutoff earnings curve is downward sloping since an increase in the cutoff managerial skill s_c increases the productivity of the marginal firm. Therefore, the aggregate expenditures X must decrease in order to restore zero earnings of this firm.

Next, I consider the labor market clearing condition. In contrast to the classical Melitz (2003) model with heterogeneous firms, the labor supply is not fix in my model since the mass of production workers depends on the number of managers and the number of firms in the economy, respectively. The labor market clears when the aggregate expenditure on production workers that is required to produce the aggregate output of all active firms equals the aggregate earnings of those production workers:

$$\int_{s_c}^{\infty} \varepsilon \left(x\left(i\right) - Y\left(i\right)\right) L i^{-2} di = L\underline{w}(1 - s_c^{-1}). \tag{II.13}$$

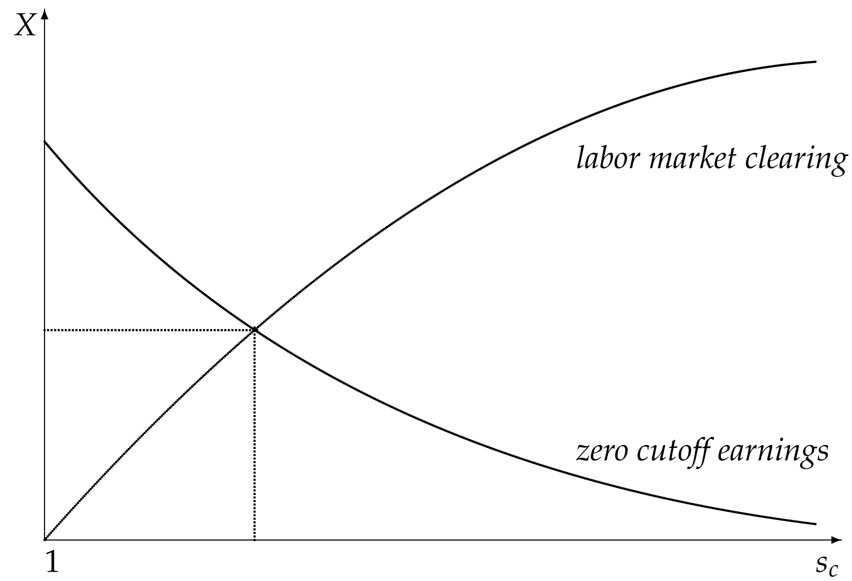
The left hand side of equation (II.13) integrates the difference between expected revenues and the expected surplus over all firms and thus corresponds to the aggregate expenditure on production labor in the economy. The right hand side of (II.13) corresponds to the aggregate earnings of production workers. Solving the integral on the left hand side gives rise to a simple term for the aggregate expenditure on production labor: $\varepsilon \frac{\sigma-1}{\sigma} X$.[13] This simplifies the labor market clearing condition to the following function $X\left(s_c\right)$:

$$X = \frac{L\underline{w}}{\varepsilon} \frac{\sigma}{\sigma - 1} \left(1 - s_c^{-1}\right). \tag{II.14}$$

[12] Also see Monte (2011) for a more detailed discussion.

[13] See the Appendix for a detailed derivation of the aggregate expenditure on production labor.

Figure II.1: Determination of the Closed Economy Equilibrium in the (X, s_c) Locus.



The labor market clearing curve (II.14) is upward sloping in s_c. Intuitively, a rise in s_c increases the supply of production labor. Therefore, the production labor demand has to rise as well and thus the aggregate expenditure level X needs to increase to keep the labor market in equilibrium.

Figure II.1 illustrates the zero cutoff earnings and the labor market clearing curve graphically. Since both curve intersect once, there exists a unique equilibrium solution for X and s_c. The subsequent proposition summarizes the closed form solutions of X and s_c in the closed economy version of the model.

Proposition 2. *The zero cutoff earnings condition and the labor market clearing condition uniquely determine the equilibrium solution of the cutoff skill s_c and the aggregate expenditure X in the closed economy:*

$$\begin{aligned} X &= \frac{\sigma L \lambda \underline{w}}{\varepsilon(\sigma-1)\lambda+\psi} \\ s_c &= 1+\frac{\varepsilon(\sigma-1)\lambda}{\psi}. \end{aligned}$$

Proof. See Appendix. □

Given the solution for X and s_c, it will turn out to be convenient to state the managerial payment function as follows:

$$\overline{W}(s) = \lambda \underline{w} \frac{\mu}{\kappa + \mu} \left(\left(\frac{s}{s_c} \right)^{(\kappa+\mu)(\sigma-1)} - 1 \right) + \underline{w}. \tag{II.15}$$

In the next subsection, I make use of the managerial payment function to characterize the distribution of corporate governance across firms in the economy.

II.2.4.1 The Distribution of Corporate Governance across Firms

Since the managerial wage function is increasing with managerial skills, firms are heterogeneous in their upfront investments in corporate governance. Firms that employ the managers with relatively little managerial skills choose to invest into corporate governance since the equilibrium payments are insufficient to incentivize their managers. On the contrary, firms that employ the managers with relatively high managerial skills also have to pay them more. These firms use the payments to incentivize their managers which makes investments into better corporate governance inefficient for them.

The following function summarizes the strength of governance g as a function of the managerial skill s, taking into account Propositions 1 and 2 and the payment function (II.15):

$$g = \begin{cases} 1 - \frac{\lambda \underline{w} \frac{\mu}{\kappa+\mu} \left(\left(\frac{s}{s_c} \right)^{(\kappa+\mu)(\sigma-1)} - 1 \right) + \underline{w}}{B} & \text{if } s \leq \widetilde{s} \\ 0 & \text{if } s > \widetilde{s}. \end{cases} \tag{II.16}$$

Firms that employ a manager with skills above $\widetilde{s}$ leave all the power to their manager and choose not to invest in corporate governance. Firms that employ managers with skill levels below $\widetilde{s}$ choose to provide incentives with both instruments, stricter monitoring and performance payments. Consequently, the managers in smaller firms have less power to obtain their benefits from shirking. According to Proposition 1, the critical skill level $\widetilde{s}$ is defined as

$$\varepsilon M \left(\frac{t^{\kappa}}{\underline{w}} \right)^{\sigma-1} \frac{\mu}{\kappa + \mu} \left(\widetilde{s}^{(\kappa+\mu)(\sigma-1)} - s_c^{(\kappa+\mu)(\sigma-1)} \right) + \underline{w} = B. \tag{II.17}$$

Using the equilibrium values of X and s_c from Proposition 2 leads to

$$\widetilde{s} = \left(1 + \frac{(\kappa + \mu)(B - \underline{w})}{\lambda \mu \underline{w}}\right)^{\frac{1}{1-\psi}} s_c. \tag{II.18}$$

Note that $\widetilde{s}$ increases proportionally with s_c. Thus, an increase of the cutoff managerial skill puts pressure on managerial payments which leads to more corporate governance investments in the economy since more managers need to be further incentivized

For the subsequent comparative static exercises, I analyze the effects on the share of firms in the economy that do not invest in corporate governance ($g = 0$) in equilibrium. This share is characterized by the following Proposition.

Proposition 3. *The share of firms θ that do not invest in corporate governance is equal to*

$$\theta \equiv \frac{L\widetilde{s}^{-1}}{Ls_c^{-1}} = \left(1 + \frac{(\kappa + \mu)(B - \underline{w})}{\lambda \mu \underline{w}}\right)^{\frac{1}{\psi-1}}. \tag{II.19}$$

θ is large if the costs of corporate governance λ are relatively high or the shirking benefits of managers B are relatively small.

The following two sections of the chapter present comparative statics results of either skill-biased technological change or economic integration in an open economy version of the model on the share of weak governance firms θ.

II.2.5 Skill-Biased Technological Change

This section provides comparative static results to illustrate the effects of skill-biased technological change on managerial payments and firm investments in corporate governance. There has been a debate in the economics literature that technological change is to a large extent skill-biased in the sense that it increases the effectiveness of technologies that disproportionally benefit the productivity of firms that employ relatively high-skilled agents. For instance, the availability of computers and related information technologies is particularly relevant for workers that frequently use these technologies.[14] This skill-bias in technological change can be modeled as an exogenous increase in the

[14] See Autor et al. (1998) for empirical evidence.

parameter κ which measures the influence of the production technology on the overall firm productivity.[15] A higher value for κ immediately translates into a more dispersed productivity distribution since the productivity of firms with higher skilled agents improves disproportionally.[16] First, I consider the effects of skill-biased technological change on the zero cutoff earnings condition. Then, I analyze how the effects on X and s_c affect corporate governance choices of firms and how the share of weak governance organizations θ in the economy changes.

An increase in κ leaves the labor market equilibrium clearing condition (II.14) unaffected since changes in the effectiveness of technologies neither affect the aggregate production labor expenditure nor the earnings on production labor. However, a larger κ affects the zero cutoff earnings condition (II.12). A skill-biased increase in the effectiveness of technologies has two opposing effects on the surplus of the marginal firm. First, there is a positive productivity effect since the marginal costs $\frac{t^{\kappa}s_c^{\kappa+\mu}}{\underline{w}}$ decrease. Second, there is a negative market size effect that is due to a lower price index because all other firms also become more productive. Since an increase in κ disproportionally benefits firms that employ relatively high skilled agents, the negative effect on the price index dominates the positive productivity effect for the marginal firm. To restore zero earnings for a given cutoff skill s_c, the marginal firm now requires a larger expenditure level X to cover the corporate governance costs to enter the market. This mechanism turns the zero cutoff earnings curve outward which unambiguously increases X and the cutoff skill s_c in the new equilibrium.

Consider next the effects of skill-biased technological change on the critical skill level $\widetilde{s}$ from equation (II.18). Skill-biased technological change has three effects on managerial wages and the choice of governance within firms and the skill level $\widetilde{s}$.

First, an increase of κ strengthens the contribution of the production technology to firm productivity and therefore weakens the bargaining position of the manager and decreases managerial wages (the bargaining effect). The decrease of managerial wages translates to a lower share of weak governance

[15] see Monte (2011)

[16] The elasticity of the firm productivity with respect to changes in κ is increasing in the employed skill level s since $e(\kappa) = \kappa \ln(ts)$.

firms in the economy since lower bonus payments require additional incentives from stricter monitoring.

Second, an increase of κ increases the marginal productivity of managers and thus has a positive effect on managerial wages which reduces the critical skill $\widetilde{s}$ and increases the share of weak governance firms θ (the productivity effect).

Third, skill-biased technological change leads to a tougher selection (s_c rises) such that managerial wages fall and $\widetilde{s}$ increases (the selection effect).

Note, that the selection effect only affects the cutoff skill level $\widetilde{s}$ but leaves the share of organizations with zero corporate governance θ unaffected since $\widetilde{s}$ rises proportionally with s_c. Consequently, tougher selection from technological change affects the number of firms but leaves the share of firms with weak governance unaffected. Nevertheless, the bargaining effect and the productivity effect have an influence on θ. I restate equation (II.19) as follows:

$$\theta = \left(\frac{\lambda \mu \underline{w}}{\lambda \mu \underline{w} + (\kappa + \mu)\,(B - \underline{w})} \right)^{\frac{1}{(\kappa+\mu)(\sigma-1)}} .$$

The bargaining effect is captured by an increase of the denominator $\lambda \mu \underline{w} + (\kappa + \mu)\,(B - \underline{w})$ such that θ decreases. The positive productivity effect is captured by a decrease of the exponent $\frac{1}{(\kappa+\mu)(\sigma-1)}$ such that θ rises. I show in the appendix that the productivity effect outweighs the bargaining effect such that $\frac{\partial \theta}{\partial \kappa} > 0$. Proposition 4 states how skill-biased technological change affects the share of firms that do not invest into corporate governance.

Proposition 4. *Skill-biased technological change ($\kappa \uparrow$) increases competition for the most productive managers and thereby raises the share of firms that do not invest in corporate governance ($\theta \uparrow$).*

Proof. See Appendix. □

II.2.6 The Open Economy

The current section establishes an open economy version of the model. I consider two identical countries that participate in intra-industry trade. Economic activities on the domestic market are denoted with a subscript d and exporting activities with a subscript x. An exporting firm needs to produce $\tau > 1$

units of a good for 1 unit to reach the foreign destination. Additionally, a firm needs a fixed amount of production labor f to sell to the export market. Formally, a firm that employs a manager with skill s in the open economy faces the following objective function:

$$\max \varepsilon \left(Y_d(s) + I_x Y_x(s) - w(s)\right) - I_x f \underline{w} - \left(1 - g\left(s\right)\right)\left(C - \left(1 - \varepsilon\right) R\right) \underline{w}, \quad \text{(II.20)}$$

where I_x is an endogenous export participation indicator. Again, firms choose the bonus payment $w\left(s\right)$ and level of corporate governance $g\left(s\right)$ according to Proposition 1. Since exporting firms face identical demand elasticities on both markets, the exporting price is a constant multiplier of the domestic price adjusted by the variable trade cost: $p_x(s) = \tau p_d(s)$. Therefore, the operating profits from exporting are

$$Y_x\left(s\right) = \tau^{1-\sigma} Y_d\left(s\right) = \tau^{1-\sigma} M \left(\frac{t^{\kappa} s^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1}.$$

Denote s_d the managerial skill of the marginal local firm and s_x the managerial skill of the marginal exporting firm. Firms will choose to export whenever their productivity is large enough to cover the fix costs of exporting. Thus, the marginal exporter obtains operating profits from exporting $Y_x(s_x)$ that are just sufficiently large to cover the fixed costs of entering the export markets such that $\varepsilon M \left(\frac{t^{\kappa} s_x^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1} = \tau^{\sigma-1} f \underline{w}$. The managerial skill level of the marginal exporter s_x can be written as a function of the marginal skill level of a domestic firm manager s_d

$$s_x = \left(\frac{\tau^{\sigma-1} f}{\lambda}\right)^{\frac{1}{1-\psi}} s_d, \quad \text{(II.21)}$$

where I assume that $\left[\tau^{\sigma-1} f\right]^{\frac{1}{1-\psi}} > \lambda$ in order to assure a meaningful exporting behavior of firms with $s_x > s_d$. The open economy price index can now be written as

$$P = \frac{\sigma}{\sigma-1} \underline{w} t^{-\kappa} \left(\frac{\psi}{\varepsilon L}\right)^{\frac{1}{\sigma-1}} s_d^{\frac{\psi}{\sigma-1}} \left[1 + \lambda^{\frac{\psi}{1-\psi}} \Delta^{-1}\right]^{1/(1-\sigma)}, \quad \text{(II.22)}$$

where $\Delta \equiv \tau^{\frac{1}{\kappa+\mu}} f^{\frac{\psi}{1-\psi}}$ is an index that captures the distance between both countries. The additional term $\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]^{1/(1-\sigma)}$ captures the effect of foreign competition on the price index. If the economic distance between the two countries is small (low values for Δ occur whenever f and τ are small), competition from foreign exporters lowers the domestic price index. In the limit, when both economies are very remote and Δ approaches infinity, the price index converges to its closed economy version (II.11).

An equilibrium in the open economy again requires that labor markets clear. The aggregate expenditure on production labor now consists of three components: expenditure on labor to produce for the domestic market, expenditure on labor to produce for the export market and additionally, the expenditure on production labor that is required to cover the fixed investments f. The aggregate expenditure on production labor can again be found by integrating the labor demand of an individual firm over all active firms and now includes the additional labor expenditure to cover the fix costs of exporting f:

$$\int_{s_d}^{\infty} \frac{\varepsilon q_d(s)}{t^{\kappa} s^{\kappa+\mu}} L s^{-2} ds + \int_{s_x}^{\infty} \frac{\varepsilon q_x(s)}{t^{\kappa} s^{\kappa+\mu}} L s^{-2} ds + f \underline{w} L s_x^{-1} = L\underline{w}(1 - s_d^{-1}).$$

Similar to the closed economy case, expenditure on production labor can be simplified to $\varepsilon X(\sigma-1)\sigma^{-1} + f\underline{w}Ls_x^{-1}$ such that labor markets clear in the open economy if

$$\varepsilon \frac{\sigma-1}{\sigma} X + f\underline{w}Ls_x^{-1} = L\underline{w}\left(1 - s_d^{-1}\right).$$

Replacing s_x with (II.21) leads to

$$X = \frac{\sigma}{\sigma-1}\frac{L}{\varepsilon}\left[1 - \left(1+\lambda^{\frac{1}{1-\psi}}\Delta^{-1}\right)s_d^{-1}\right]. \tag{II.23}$$

Equation (II.23) is the open economy version of the labor market clearing condition in the closed economy (II.14). Here, the additional factor Δ^{-1} captures the labor demand for exporting activities.

Consider the zero cutoff earnings condition in the open economy. The zero cutoff earnings firm is only active on the domestic market and faces competition from foreign exporters through a smaller price index (II.22). Plugging

(II.22) into (II.10) yields the open economy version of the zero cutoff earnings condition:

$$X = \frac{\sigma L \lambda \underline{w}}{\psi} \left[1 + \lambda^{\frac{\psi}{1-\psi}} \Delta^{-1} \right] s_d^{-1}. \tag{II.24}$$

Equations (II.23) and (II.24) determine the equilibrium solution for X and s_d in the open economy which is summarized in Proposition 5.

Proposition 5. *The zero cutoff condition and the labor market clearing condition uniquely determine the equilibrium solution of the domestic cutoff skill s_d and the aggregate expenditure X in the open economy:*

$$\begin{aligned} X &= \frac{\sigma L \lambda \underline{w} \left(1 + \lambda^{\frac{\psi}{1-\psi}} \Delta^{-1} \right)}{\psi + \varepsilon\lambda (\sigma - 1) + (\psi + \varepsilon (\sigma - 1)) \lambda^{\frac{1}{1-\psi}} \Delta^{-1}} \\ s_d &= 1 + \frac{\varepsilon\lambda (\sigma - 1)}{\psi} + \left(1 + \frac{\varepsilon (\sigma - 1)}{\psi} \right) \lambda^{\frac{1}{1-\psi}} \Delta^{-1}. \end{aligned}$$

Proof. See Appendix. □

Plugging the equilibrium values for X and s_d into the term for the market size M leads to

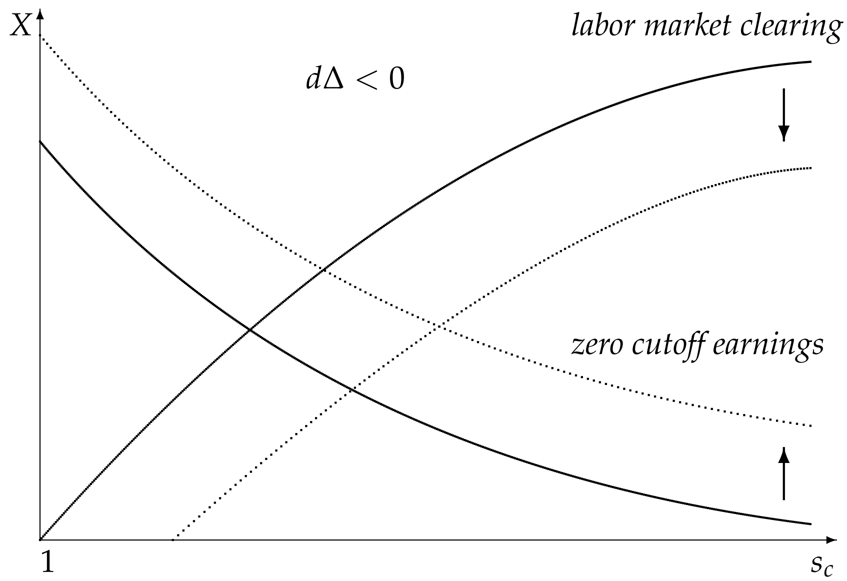
$$M = \frac{\lambda}{\varepsilon} \underline{w}^{\sigma} t^{-\kappa(\sigma-1)} s_d^{\psi-1}. \tag{II.25}$$

The equilibrium function of managerial payments in the open economy now requires a case distinction. Managers that are employed by exporting firms obtain an additional wage premium $\varepsilon M \left(\frac{t^\kappa}{\underline{w}} \right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \tau^{1-\sigma} \left(s^{1-\psi} - s_x^{1-\psi} \right)$ that arises from serving a larger market. Since globalization allows them to additionally serve the foreign market, these CEOs have a higher marginal productivity and thus obtain a higher income:

$$\overline{W}(s) = \begin{cases} \varepsilon M \left(\frac{t^\kappa}{\underline{w}} \right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \left(s^{1-\psi} - s_d^{1-\psi} \right) + \underline{w} & \text{if } s \in [s_d, s_x) \\ \varepsilon M \left(\frac{t^\kappa}{\underline{w}} \right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \left(\left(s^{1-\psi} - s_d^{1-\psi} \right) \right. & \\ \left. + \tau^{1-\sigma} \left(s^{1-\psi} - s_x^{1-\psi} \right) \right) + \underline{w} & \text{if } s \geq s_x. \end{cases} \tag{II.26}$$

With the open economy equilibrium from Proposition 5 and the open economy managerial payment function (II.26) it is straightforward to analyze the

Figure II.2: The Effects of a Trade Integration ($d\tau < 0$ and/or $df < 0$) on the Managerial Cutoff Skill Level s_d.



effects of globalization on θ.

II.2.6.1 Trade Integration

Figure II.2 illustrates the effects of a trade integration on the domestic managerial cutoff skill level s_d. A reduction of economic distance Δ between both countries, either stemming from a decrease of the variable or the fix trade costs $d\tau < 0$ or $df < 0$, has an effect on both, the labor market clearing and the zero cutoff earnings condition.

If the two economies become more integrated, the labor market curve shifts downwards. Intuitively, better exporting opportunities allow the labor market to clear at a lower expenditure level. Simultaneously, more integration shifts the zero cutoff earning curve upwards. A trade integration fosters import competition such that the marginal domestic producer requires a larger expenditure level to break even. These two effects lead to an unambiguous increase of the domestic managerial cutoff skill s_d. Furthermore, the cutoff skill of the marginal exporting firm s_x falls since a lower productivity level is sufficient to cover the fix trade costs and a larger share of firms become exporters since $\partial \left[s_d / s_x \right] / \partial \Delta < 0$.

In the interest of a statement on the comparative statics of firm governance in an open economy, I distinguish two cases: first the case with low trade openness (large Δ), then the case with high trade openness (small Δ). The effect of a trade liberalization on managerial payments are substantially different in these two cases which has different effects on the choice of corporate governance in equilibrium.

Low Trade Openness

Suppose that both countries are very remote such that the selection of firms into exporting is only efficient for a small share of firms. In this scenario, the export cutoff managerial skill level s_x is very high such that the sorting of skill levels is as follows:

$$s_d < \widetilde{s} < s_x.$$

Since only very few firms export, most managers cannot benefit from trade liberalization since these managers do not obtain an exporter wage premium. If the organizational cutoff skill level $\widetilde{s}$ is smaller than the export cutoff managerial skill level s_x, all exporters (and additionally some non-exporters) are weak governance firms. The organizational cutoff $\widetilde{s}$ can again be evaluated as the skill level of the manager that has an outside option with value B such that this manager is the least productive manager that is hired by a firm that chooses not to invest in corporate governance:

$$\varepsilon M \left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \left(\widetilde{s}^{(\kappa+\mu)(\sigma-1)} - s_d^{(\kappa+\mu)(\sigma-1)}\right) + \underline{w} \quad = \quad B. \qquad \text{(II.27)}$$

This leads to an equilibrium share of firms with weak corporate governance of

$$\theta \equiv \frac{L\widetilde{s}^{-1}}{Ls_d^{-1}} = \left(1 + \frac{(\kappa+\mu)\,(B-\underline{w})}{\lambda\mu\underline{w}}\right)^{\frac{1}{\psi-1}} \qquad \text{(II.28)}$$

which is identical as in closed economy version of the model. Obviously, θ is not affected by changes in the openness of the economies.

In this scenario, economic integration only increases the market wages of the managers that manage the most productive exporting firms. Only these managers obtain an exporter wage premium that allows them to compensate the downward pressure on managerial wages arising from tougher import competition. The remaining managers suffer from tougher selection via an increase in s_d and since $\tilde{s}$ increases proportionally, the share of weak governance firms remains constant.

High Trade Openness

Next, suppose that both countries are relatively integrated such that many firms serve the export market. In this scenario, the export cutoff skill level is very low such that the sorting of skill levels is

$$s_d < s_x < \tilde{s}.$$

This sorting implies that the firm that employs the manager with the organizational cutoff skill $\tilde{s}$ is an exporting firm. Consequently, the organizational cutoff $\tilde{s}$ is defined as

$$\varepsilon M \left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1} \frac{\mu}{\kappa+\mu} \left(\left(\tilde{s}^{1-\psi} - s_d^{1-\psi}\right) + \tau^{1-\sigma}\left(\tilde{s}^{1-\psi} - s_x^{1-\psi}\right)\right) + \underline{w} \quad = \quad B$$

which leads to the following term for the share of organizations with weak corporate governance θ:

$$\theta \quad = \quad \left(\left(\frac{(\kappa+\mu)(B-\underline{w}) + \lambda\mu\underline{w}}{\lambda\mu\underline{w}} - \frac{\lambda}{\tau^{2(\sigma-1)} f}\right)\left(\frac{1}{1+\tau^{1-\sigma}}\right)\right)^{-\frac{1}{1-\psi}} \quad \text{(II.29)}$$

Now, the share of firms that do not invest in corporate governance depends on the trade costs. A reduction in either the variable trade costs τ or the fix trade costs f unambiguously increase θ. Intuitively, a reduction of trade costs increases the market wages for a large share of the managers in the economy since these become more productive and firms that compete for managerial talent are willing to pay them more. This rise in wages is then used to incentivize their manager. Consequently, firms substitute away from incentive provision via better corporate governance towards performance payments.

The following Proposition summarizes the previous discussion and explains how trade integrations affect the share of weak governance firms θ.

Proposition 6. *A reduction of fix and/or variable trade costs unambiguously increases the domestic cutoff skill level s_d since the selection into market entry becomes*

tougher.
Relatively large firms in the market reduce their quality of corporate governance and incentivize managers with pay-for-performance to compete for managerial skills.
The effect of a trade integration on the share of firms that do not invest in corporate governance at all (θ) depends on the level of sectoral openness:
(i) If there is low trade openness such that $s_d < \widetilde{s} < s_x$, the share of organizations with weak governance θ remains unaffected by a reduction of the trade costs.
(ii) If there is high trade openness such that $s_d < s_x < \widetilde{s}$, the share of organizations with weak governance θ increases when trade costs are reduced.

Proof. See Appendix. □

II.3 Empirical Analysis

In this section, I test the comparative static predictions of the model using data on entrenchment opportunities and equity compensation in large U.S. stock companies. The empirical section continues with a brief description of the data sources and the variable construction, followed by a description of the estimation strategy and concludes with the discussion of the evidence. I leave a more detailed discussion about the construction of the dataset for the Data Appendix A.2.

II.3.1 Data Sources

In order to test how changes in trade openness and skill-biased technological change over time affect the quality of corporate governance within firms, I make use of firm level data and match it with information at the industry level.

II.3.1.1 Firm Level Data

At the firm level, I make use of three different data sources. In order to measure the quality of corporate governance, I use of the entrenchment index (E-index) from Bebchuk et al. (2009) which measures the quality of corporate governance at the firm level across time. The index combines information on six governance provisions that capture managerial entrenchment opportunities: staggered boards, limits to shareholder bylaw amendments, poison pills, golden parachutes, and supermajority requirements for mergers as well as for charter amendments. Bebchuk et al. (2009) argue that these six provisions are the most relevant ones since they play a key role in the relation between corporate governance and firm value. These provisions are also a subset of the provisions used in the GIM-index by Gompers et al. (2003). Four of the six provisions limit the voting power of shareholders (staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, supermajority requirements for charter amendments), while the two remaining provisions (poison pills, golden parachutes) are salient measures taken in preparation for hostile offers. The E-index is a score between 0 to 6, based on the number of these provisions that a firm provides in a given year. The captured entrenchment opportunities from weak corporate governance are associated with adverse effects on the behavior of managers and managerial incentives. Information on the six different governance attributes is provided by the Investor Responsibility Research Center (IRRC) and includes S&P 500 firms and a set of additional firms. Observations span the time period between 1990 and 2006, with information on the E-index for the years 1990, 1993, 1995, 1998, 2000, 2002, 2004 and 2006.[17]

As a second data source, I use information about CEO equity compensation in quoted U.S. corporations that is provided by BoardEx. BoardEx is a business intelligence service provider that collects remuneration details on business leaders across the world. I consider the equity-linked compensation of CEOs in U.S. firms. The BoardEx panel spans the period between 1998 and 2006.[18]

I match the entrenchment and the equity compensation panels with the Thomson Worldscope database, the third data source at the firm level. Thomson Worldscope provides balance sheet information and the main 4-digit SIC industry of the companies in the two samples. In particular, Worldscope con-

[17]The E-index panel data are publicly available on Lucian Bebchuk's website `http://www.law.harvard.edu/faculty/bebchuk/data.shtml`.

[18]Since BoardEx data are mostly formatted for business client applications, a preparation of the data for academic purposes was needed before the data could be used for empirical work. Please see the Data Appendix A.2 for more details on the necessary preparation steps and underlying assumptions.

tains annual information on employment, assets, and total investment returns.

II.3.1.2 Industry Level Data

The sectoral information that is used in the empirical analysis is obtained from three different sources. I use the NBER CES manufacturing industry database to obtain information on total factor productivity, value added and the consumption of intermediate inputs at the 4-digit SIC industry level.

Additionally, I use the UN Comtrade database to obtain U.S. exports and imports at the 4-digit SIC level. My sectoral measures of trade openness build on those two data sources. The main measure *ln(openness)* is the natural logarithm of the sectoral exports in % of the "effective market size" at the 4-digit SIC level, where "effective market size" is the gross industry output less imports. Since the measure of trade openness is only relevant and available for firms in the manufacturing sector, the estimation sample in the trade related regressions is reduced to all manufacturing firms.

In order to capture skill-biased technological change, I use information on the contribution of information and communication technology (ICT) to the growth of industry value added that is available from the EUKLEMS database. The variable "contribution of ICT" has also been used by Michaels et al. (2014) to estimate whether ICT has polarized the skill demand of labor. This variable is based on a growth accounting exercise and is provided for 36 industries at the 2-digit ISIC Rev. 3 level.

Table A.1 provides summary statistics of all variables in the corporate governance and the equity compensation sample.

II.3.2 Estimation Strategy

The theoretical model predicts that large firms respond to increases in trade openness and skill-biased technological change with weaker corporate governance. In order to test if the strength of corporate governance becomes weaker when firms face a larger degree of sectoral openness or technological change, the econometric model takes the following form:

$$e_{fjt} = \beta s_{jt} + x'_{fjt}\delta + u_{fjt}. \tag{II.30}$$

The outcome of interest e_{fjt} is firm f's entrenchment index in industry j at year t. Larger values for e_{fjt} translate to more provisions for executives, i.e. more entrenchment opportunities (worse corporate governance). s_{jt} measures trade openness and the usage of skill-biased technologies at the sectoral level. According to the theory, entrenchment should be a function of the sectoral trade openness o_{jt} and skill-bias in technologies t_{jt}. I measure o_{jt} as the natural logarithm of industry j's exports in percent of (gross output - imports) of industry j: $o_{jt} = \ln\left(\frac{EX_{jt}}{GO_{jt}-IM_{jt}} \cdot 100\%\right)$. In order to proxy for technological change that is skill-biased, I directly obtain t_{jt} from EUKLEMS as the contribution of ICT to value added growth in % at the sectoral level.[19]

One potential concern with openness and the contribution of ICT is that they could be correlated such that the individual impact of each variable cannot be estimated consistently when the other variable is excluded. Moreover, including both variables can lead to bad control problems if one variable explains the other: for instance, ICT investments make industries more productive which can lead to changes in comparative advantages. I address these concerns by showing specifications, where I include either both variables, o_{jt} and t_{jt} or only one of them. Furthermore, I instrument sectoral openness with a basket of weighted real effective exchange rates, where the weights are industry-specific. Note that the theoretical model considered intra-industry trade while the instrument is based on a comparative advantage argument. However, as Bernard et al. (2007) have shown, heterogeneous firm models with intra-industry trade can be extended to models with both, comparative advantages and intra-industry trade, where trade flows are determined by factor endowments and preferences for variety. The idea of the instrumental variable is to use the weighted real effective exchange rates of Canada, Mexico, the UK, China and Japan vis-à-vis the rest of the world, where the country weights are the industry specific shares of exports that go to each of these countries (their average for the years 1991-1995).[20] This instrument is relevant for sectoral trade openness since it measures the international competitiveness of each U.S. industry vis-à-vis its main trade partners. Furthermore, the

[19] See for instance Autor et al. (1998) and Michaels et al. (2014) on the skill-bias of computerization.

[20] See the subsection A.1 in the Data Appendix for more details on the construction of the instrument.

instrument satisfies the exclusion restriction to the extent that exchange rates are formed at financial markets. In light of Propositions 6 and 4, I expect negative effects of openness and ICT on corporate governance quality, thus $\beta > 0$.[21] The vector x_{fjt} contains control variables and u_{fjt} is the error term.

In all variants of the model (II.30), the vector x_{fjt} includes firm and year fix effects. Thus, although a large share of the variation in the entrenchment index is across firms, the model links variation of entrenchment *within* firms as a response to changes in the industry environment over time. This allows to directly test the implications of Propositions 4 and 6: large firms respond to trade liberalizations and technological change with more opportunities for managerial entrenchment. Additionally, the firm fix effect model controls for endogeneity arising from unobservable time-invariant firm and industry characteristics that are correlated with the observables. The inclusion of year fix effects controls for another potential source of endogeneity: unobservable economy-wide corporate governance shocks that are correlated with the development of trade openness and ICT.

To provide further evidence that sector variables are relevant for the managerial labor market and drive managerial incentive compensation, I then estimate the same specifications in light of the model (II.30) with CEO equity compensation w_{fjt} as the dependent variable. Equity compensation w_{fjt} is the natural logarithm of equity-linked compensation in 1000 USD.

II.3.3 Results

Trade Openness, ICT, and Corporate Governance

Table II.1 reports estimates of model (II.30): within firm level adjustments of corporate governance as a response to within industry changes in trade openness and technological change. All standard errors are corrected for heteroscedasticity robustness.

Columns (1) to (4) in Table II.1 show the instrumental variable estimation results that consider the effect of trade openness and ICT contribution on corporate governance according to specification (II.30). The regressors of interest are *ln(openness)* which is instrumented by the *REER basket* and the *ICT con-*

[21] Remember that larger values of e_{fjt} correspond to weaker corporate governance.

tribution in %. Not surprisingly, the real effective exchange rate variable is positive and significant in the first stage estimations: larger exchange rates of the trading partners are associated with larger comparative disadvantages and consequently more imports from the U.S. The first stage Kleibergen-Paap F-statistics are above 12.00 in all specifications which means that weak instrumentation is not a large concern. Column (1) includes openness as the main explanatory variable. Additional controls are the total factor productivity at the sector level (4-digit SIC) and firm employment. The inclusion of the total factor productivity variable controls for omitted variable biases since openness and ICT could be correlated with factor productivity which itself might drive firm governance. Employment is included as a measure of firm size since the theoretical model suggests that larger firms are governed more weakly.[22] The openness regressor is positive and significant at the 5% level. Column (2) additionally includes the ICT contribution as an explanatory variable. The ICT contribution regressor enters the model with a positive sign at the 10% significance level. Column (3) then again excludes ICT but uses total assets and the total investment return as additional controls for firm size and performance. The reason to include investment returns as additional control variable is twofold: first, it controls for managerial or total firm performance and second, the corporate governance literature argues that there is a correlation between corporate governance and stock returns. However, the coefficient of investment returns remains insignificant in all specifications. Taking into account the evidence on this correlation and the time period this result is not surprising: while Gompers et al. (2003) find that an investment strategy that was based on buying firms with strong shareholder rights and selling firms with weak shareholder rights earned abnormal returns during 1991 and 1999, Bebchuk et al. (2013) find that this correlation did not persist for the subsequent period. They explain their findings with the gradual learning of investors. The preferred model specification is then presented in column (4): openness and ICT enter the model with significantly positive signs after instrumenting openness and controlling for firm size in terms of employment and assets, investment returns and industry factor productivity. Note that the

[22] I include employment to control for changes in firm size over time, although the negative correlation between firm size and corporate governance quality in the theoretical model is *across* firms.

size and significance of the coefficients for openness and ICT remain at a similar level throughout all IV specifications (1) to (4): the coefficient for openness varies between 1.022 and 1.185 and is significant at the 10% level; the coefficient for the contribution of ICT is 0.123 and significant at the 5% level in column (2), respectively 0.112 and significant at the 10% level in column (4). The estimated coefficients for openness suggest that an increase of the sectoral openness from its mean (2.47) by the within firms standard deviation (0.38) increases the entrenchment index in a firm within this sector by between 0.15 and 0.17 points which is about one third of the within firms standard deviation of the entrenchment index (0.50). The coefficients for the contribution of ICT suggest that an increase of the ICT variable by one within firm standard deviation (0.69) from its sample mean (0.98) increases the entrenchment index by between 0.06 and 0.07 points.

Columns (5) to (8) present the evidence based on ordinary least squares estimations of the specifications from columns (1) to (4). Trade openness enters all specifications with a significantly positive sign at the 10% significance level although the size of the coefficients are much smaller (between 0.0967 and 0.0976). One reason for the smaller ordinary least squares coefficients might be due to measurement errors in fix effects models. If the openness variable is a combination of the true signal which is highly correlated over time and an error component that is serially uncorrelated, the inclusion of firm fix effects increases the variance of the error component while it decreases the variance of the signal.[23] Also the coefficients of the ICT contribution are much smaller and remain insignificant in the least squares estimates.

Trade Openness, ICT, and Equity Compensation

Table II.2 provides additional evidence on the effects of trade openness and ICT on the managerial labor market. The table reports estimates of within firm level adjustments of CEO equity compensation as a response to within industry changes in trade openness and technological change. All standard errors are again corrected for heteroscedasticity robustness. The specifications are identical to those presented in Table II.1 but now the dependent variable is

[23] See Angrist and Pischke (2009) for a more detailed discussion on measurement errors and fix effects.

Table II.1: Corporate Governance, Trade Openness, and ICT

dependent variable:				***entrenchment index***				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	IV	*IV*	*IV*	*IV*	*OLS*	*OLS*	*OLS*	*OLS*
ln openness	1.185**	1.101**	1.090**	1.022**	0.0970**		0.0976**	0.0967**
	(0.476)	(0.428)	(0.439)	(0.401)	(0.0390)		(0.0389)	(0.0390)
ICT contribution %		0.123**		0.112*		0.00699	0.00648	0.00695
		(0.0616)		(0.0581)		(0.0373)	(0.0373)	(0.0373)
tfp index	0.0163***	0.0171***	0.0162***	0.0168***	0.00802*	0.00490	0.00809**	0.00809*
	(0.00478)	(0.00491)	(0.00477)	(0.00488)	(0.00413)	(0.00447)	(0.00410)	(0.00413)
ln employment	0.0922***	0.0883**	0.167***	0.156***	0.0794**	0.107***	0.0792**	0.0963*
	(0.0356)	(0.0348)	(0.0636)	(0.0600)	(0.0402)	(0.0388)	(0.0402)	(0.0547)
ln assets			-0.0918	-0.0838				-0.0177
			(0.0663)	(0.0629)				(0.0525)
total investment return			-1.77e-05	-9.13e-05				-0.000110
			(0.000277)	(0.000268)				(0.000227)
firm f.e.	yes	yes	yes	yes	yes	yes	yes	yes
year f.e.	yes	yes	yes	yes	yes	yes	yes	yes
R^2 *(within)*	-	-	-	-	0.095	0.096	0.095	0.095
first stage Kleibergen-Paap F-statistic	13.24	15.50	14.69	16.90				
REER basket (first stage)	0.0073***	0.0079***	0.0077***	0.0082***				
	(0.0020)	(0.0020)	(0.0020)	(0.0020)				
observations	3,839	3,839	3,807	3,807	3,839	4,811	3,839	3,807
number of firms	994	994	989	989	994	1,107	994	989

All columns report results from firm fix effects models. Columns *(1)* - *(4)* report results for IV estimates after instrumenting *ln openness* with the real effective exchange rate of the sector specific main trade partners while columns *(5)* - *(8)* report results for ordinary least squares estimates. The dependent variable is the entrenchment index from Bebchuk et al. (2009) that ranges between 0 (high corporate governance standards) and 6 (low corporate governance standards) and measures the level of managerial entrenchment opportunities within a given firm-year. All specifications additionally include year fix effects. Standard errors are heteroscedasticity robust. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

the natural logarithm of the CEO's equity-linked compensation as a measure of incentive compensation.[24] The coefficient for openness in the IV models (1) to (4) varies between 1.821 and 2.050 and is at the 1% level significantly different from zero. The estimated coefficient of the ICT contribution is equal to 0.481 in column (2) and 0.494 in column (4) and also significant at the 1% level in both specifications. The first stage coefficients of the real effective exchange rate basket are a bit larger in the equity compensation models compared to the corporate governance models (0.0094-0.0098 versus 0.0073-0.0082). The estimated coefficients for openness suggest that an increase of the sectoral openness from its mean (1.55)[25] by the within firms standard deviation (0.28) raises the CEO equity compensation from its mean by between 36 and 41 percent. The estimates for the ICT contribution variable in the IV models suggest that an increase of the ICT contribution by one within firm standard deviation (0.68) from its sample mean (0.75) increases the CEO equity compensation from its mean by between 36 and 37 percent.

The evidence based on ordinary least squares estimations is again presented in columns (5) to (8). In the OLS estimations the coefficients for openness are again much smaller and not significantly different from zero. The coefficients for the ICT contribution are only a bit smaller compared to the IV coefficients (0.237-0.252 versus 0.481-0.494) and significant at the 1% level.

II.4 Conclusion

This chapter analyzes how corporate governance decisions within firms are affected by real economic outcomes. I integrate a stylized model of performance pay and corporate governance investments into a general equilibrium model with heterogeneous skills and technologies to study the relation between corporate governance, trade and technological change. Since technologies and skills are complementary in terms of productivity, a positive assortative assignment of skills to technologies arises in equilibrium. The most productive

[24] An advantage of equity-linked compensation as measure of performance payments is its direct link to the firm value. However, using equity-linked compensation underestimates pay-for-performance since it excludes direct bonus remuneration.

[25] Since the equity panel includes a similar but yet different set of firms and the years 1998-2006 instead of 1990-2006, the sample means and standard deviations differ compared to the corporate governance panel. See Table A.1 for summary statistics.

Table II.2: Equity Compensation, Trade Openness, and ICT

dependent variable:					***ln CEO equity compensation***			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	IV	*IV*	*IV*	*IV*	*OLS*	*OLS*	*OLS*	*OLS*
ln openness	2.050***	1.886***	1.961***	1.821***	-0.0279		0.000629	0.00810
	(0.620)	(0.573)	(0.625)	(0.583)	(0.0559)		(0.0541)	(0.0541)
ICT contribution %		0.481***		0.494***		0.301***	0.237***	0.252***
		(0.0985)		(0.101)		(0.0661)	(0.0632)	(0.0625)
tfp index	-0.0206*	-0.0189*	-0.0264**	-0.0246**	-0.0516***	-0.0481***	-0.0491***	-0.0524***
	(0.0112)	(0.0111)	(0.0109)	(0.0108)	(0.00847)	(0.00813)	(0.00846)	(0.00878)
ln employment	0.120*	0.0981	0.288***	0.253***	0.132*	0.0890	0.121	0.158
	(0.0710)	(0.0696)	(0.101)	(0.0957)	(0.0759)	(0.0724)	(0.0752)	(0.102)
ln assets			-0.184*	-0.171*				-0.0356
			(0.0957)	(0.0917)				(0.0833)
total investment return			6.36e-05	5.95e-05				4.65e-05
			(5.12e-05)	(5.04e-05)				(5.33e-05)
firm f.e.	yes	yes	yes	yes	yes	yes	yes	yes
year f.e.	yes	yes	yes	yes	yes	yes	yes	yes
R^2 *(within)*	-	-	-	-	0.079	0.082	0.084	0.091
first stage Kleibergen-Paap F-statistic	35.08	38.82	34.28	37.55				
REER basket (first stage)	0.0094***	0.0098***	0.0094***	0.0098***				
	(0.0016)	(0.0016)	(0.0016)	(0.0016)				
observations	4,353	4,353	4,237	4,237	4,353	4,877	4,353	4,237
number of firms	668	668	659	659	668	724	668	659

All columns report results from firm fix effects models. Columns *(1)* - *(4)* report results for IV estimates after instrumenting *ln openness* with the real effective exchange rate of the sector specific main trade partners while columns *(5)* - *(8)* report results for ordinary least squares estimates. The dependent variable is the natural logarithm of CEO equity compensation in 1000 USD within a given firm-year. All specifications additionally include year fix effects. Standard errors are heteroscedasticity robust. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

firms endogenously choose an organization where governance is weak and managers can extract rents because investments into stronger corporate governance become inefficient incentive mechanisms when firm owners are constraint to pay high wages by the managerial labor market.

The model provides an explanation of a puzzle in the development of CEO compensation: while incentive compensation has become more and more prominent over time, incentive provision via better control inside the firm has fallen behind. This pattern can be explained by changes in the macroeconomic environment of firms through globalization or technological change. Trade liberalizations and skill-biased technological change toughen the competition for managerial talent and thereby induce firms to allow for more managerial entrenchment on average.

I test these predictions with data on managerial entrenchment opportunities and equity compensation in a panel of large quoted U.S. companies and find positive effects of sectoral openness and the contribution of ICT to industry growth on managerial entrenchment in firms and equity-linked compensation of managers.

CHAPTER III

Organizations as Competitive Advantage

III.1 Introduction

Little is known about the effect of organizational choices on the international competitiveness of firms within their markets. This chapter links the organization of firms to their export activity using representative firm level data for the European manufacturing sector. Two important margins of organizational adjustment are offshoring and decentralization of decision making. Firms that reorganize production internationally and offshore part of the production to other countries can reduce their costs and compete on prices. Firms with a more decentralized hierarchy can empower their knowledge workers to suggest new ideas and compete on product quality.

During the last decade, much of the literature on international trade has centered around the heterogeneity of firm export activities.[1] More productive firms are more likely to enter export markets, obtain more sales from exports, export more products and sell higher quality goods.[2]

This chapter is joint work with Dalia Marin and Jan Tscheke. We have benefited from the access to the EU-EFIGE/Bruegel-UniCredit database, managed by Bruegel and funded by the EU 7th Framework Programme ([FP7/2007-2013] under grant agreement no. 225551), as well as by UniCredit.

[1]See Bernard et al. (2012) for a literature review.

[2]Melitz (2003); Melitz and Ottaviano (2008) show that firms with lower production costs are more likely to become exporters and sell more on international markets. Bernard et al.

Furthermore, the increasing availability of firm level data during recent years has pushed research in organizational economics to new empirical grounds. This allowed for a linkage between differences in organizational choices and firm productivity.[3]

This chapter aims at the largely untapped overlap between these two strands of the literature, linking the organization of firms to their export activity. This allows us to shift the focus away from exogenously given productivity distributions towards actual firm level decisions that determine the competitive position of firms within international markets. Naturally, it is important for policy makers to understand the specific channels linking firm decisions to international competitiveness.

We provide firm level evidence on the role of firm organization on international competitiveness based on representative data of nearly 15,000 European manufacturing plants with detailed information about their exporting and organizational behavior.[4] We show that both, offshoring and decentralized management, are important determinants of firm competitiveness and thus relevant for European policy makers.

We motivate our empirical analysis with a stylized theoretical framework that links organizational decisions to market shares and the product quality that firms offer. Firm success in foreign markets is based on two determinants: production costs and product quality. We propose two channels of adjustment for these determinants that have been widely discussed in the literature. First, firms in our model can import intermediates inputs which reduces their production costs. Second, firms may switch towards a more decentralized hierarchy where strategic decisions are made at lower levels of the hierarchy. Decentralizing decision rights empowers knowledge workers and raises their creative efforts. Flatter chains of command thus promote creativity and incentivize the creation and implementation of new ideas, which ultimately translates into higher quality competitiveness.

(2011), Eckel and Neary (2010) and Nocke and Yeaple (2008) show that lower production costs increase the scope of exported products. Hottman et al. (2014) provide evidence on the quality channel in export sales.

[3] See Bloom et al. (2010b) for a literature review.

[4] Our data span information from manufacturing plants in 7 European countries (Austria, France, Germany, Hungary, Italy, Spain, UK) and are representative for the manufacturing sectors in each of those countries.

Based on the model, we test the following predictions: First, offshoring and better product quality increase the competitive position of a firm within its specific market. Second, decentralization of decision authority leads to improvements in product quality. And third, the effect of decentralization on quality is particularly strong if the conflict of interest within firms is large.

In order to measure competitiveness, we link our data to balance sheet information and trade flows at the industry level to construct the actual market share of each individual firm in its specific world market. Our data reveal that firms which import a larger share of their intermediates also capture a larger market share on export markets. We exploit variation in wages paid by intermediate good producers in typical sourcing regions and variation in the skill intensity of input production across different output industries in Europe to identify how offshoring affects export competitiveness. After controlling for firm size, labor productivity, product quality, sector and regional fix effects, we find that an exporter importing 30% of its inputs (the average import intensity in our sample) has a market share in global markets about three times as high as an exporter that sources purely domestically.

We then analyze how more decentralized chains of command can help firms to become more competitive. Our results suggest that the probability of outperforming the national competition in terms of quality is on average about 70 percentage points higher for non-family firms with a decentralized organization than for their centralized competitors. Similar results hold for the probability of product innovations. In order to identify the effects of decentralized management on product quality, we exploit regional variation in religious beliefs and trust across Europe.

This chapter relates to several literatures. First, we establish an empirical relationship between the international sourcing of intermediates and the competitive position of European firms in world markets. This relates our work to the literature on offshoring, plant productivity and exporting. The changing nature of world trade flows from trade in final goods towards vertical specialization and trade in intermediate goods has been documented by Hummels et al. (2001) and Hanson et al. (2005).

Previous empirical studies by Halpern et al. (2011) and Amiti and Konings (2007) have identified a link between intermediate imports and firm level productivity. Our theoretical framework borrows from Grossman and Rossi-

Hansberg (2008) who show theoretically that offshoring can increase firm productivity as it gives firms the opportunity to exploit differences in factor costs across borders. Antràs et al. (2006) show theoretically that offshoring increases firm productivity as globalization improves the matching opportunities for knowledge workers in industrialized countries.

Additionally, various theoretical and empirical studies have investigated the link between offshoring and exporting. Kleinert and Zorell (2012) analyze the export-magnification effect of offshoring in an extended Melitz (2003) framework. Empirically, Bas (2012) finds that reductions in input tariffs also increase the probability of exporting for Argentinean firms. Kasahara and Lapham (2013) structurally estimate the relationship between importing and exporting using Chilean plant-level data and find that importing intermediates increases the probability of exporting.

We add to this literature with a link between intermediate imports and an actual measure of firm export competitiveness. Our empirical findings suggest that better importing opportunities lead to reallocations of market shares towards offshoring firms.

Second, we show that decentralized management improves product quality. Thus, we relate to the literature that analyzes the productivity effects of firm organization. Several empirical papers on management practices have established a connection between the quality of management and total factor productivity differences between firms (see e.g. Bloom and Van Reenen (2007); Bloom et al. (2012) and Bloom et al. (2014) for a survey). Furthermore, Marin and Verdier (2008a) show theoretically that heterogeneity in the organization of decision making gives rise to firm heterogeneity. Marin et al. (2015) show that offshoring affects the organization of firms and their productivity. Acemoglu et al. (2007) find that firms who compete in innovations are more likely to decentralize.

Third, we argue that product quality and innovativeness are important determinants for firm competitiveness. Related papers are Hallak and Sivadasan (2013) and Antoniades (2012) who develop models of international trade with firm heterogeneity in product quality and find that exporters sell higher quality products. Hottman et al. (2014) estimate a structural model of heterogeneous multiproduct firms and find that variation in quality and product scope explain the majority of variation in firm sales. Eckel et al. (2011) construct a model of endogenous quality choices in multiproduct firms and find that firms in differentiated sectors compete more on quality. Our work builds on their insights but we argue that firms can compete on quality by choosing a decentralized organization.

The remainder of this chapter is organized as follows. Section III.2 introduces the theoretical framework. Section III.3 describes our data sources. The empirical modeling strategy and estimation results are presented in section III.4. Section III.5 concludes.

III.2 Theoretical Framework

In this section, we present a simple theoretical framework that links the organization of the firm to its export competitiveness. Firms have two options to adjust their organization to meet competitive pressures. First, firms can offshore part of their production to low cost countries and reduce costs which increases their price competitiveness. Second, firms can reorganize towards more decentralized hierarchies and empower knowledge workers.[5] The empowerment of knowledge workers stimulates new ideas which increases the quality competitiveness of firms. We use this framework to formulate testable predictions about the competitive advantages of offshoring and decentralized organizations. Since our analysis is focused on the relationship between offshoring, headquarter organization and export competitiveness, we make a number of simplifying assumptions. First, we condition our theoretical analysis on exporting firms in a partial equilibrium and do not explicitly model entry and exit into markets. Furthermore, our model treats export destinations as a single market and all firms are considered single-product.

III.2.1 Demand

Consider a firm i in sector s that supplies its product to destination market k. Consumers in each market have a Cobb-Douglas upper-tier utility function that nests CES sub utility functions for different sectors s. The elasticity of

[5] In our data, firms are decentralized when *managers* can take autonomous decisions and are centralized when the *CEO/owner* takes most decisions. In line with the theoretical mechanisms we have in mind, we will sometimes refer to the manager as the *knowledge worker* or the *agent*, and to the CEO/owner as the *principal*.

substitution across different varieties within each sector is $\sigma > 1$.[6] Firm i faces the following demand for its product in market k:

$$x_{ksi} = \left(\frac{q_i}{p_i}\right)^{\sigma} I_{ks} P_{ks}^{\sigma-1}, \tag{III.1}$$

where x_{ksi} is the quantity demanded in market k, q_i is a firm specific quality parameter and p_i is the firm's price. The parameter P_{ks} is a quality weighted sectoral price index and I_{ks} the income share spent on sector s in destination k. The quality weighted price index is given by $P_{ks} \equiv \left[\int_{\omega} q_{\omega}^{\sigma} p_{k\omega}^{1-\sigma}\right]^{1/(1-\sigma)}$ and is an inverse measure of the degree of competition in market k and sector s.

Each firm's competitive position in the market is its market share that can be expressed as follows:

$$M_{ksi} \equiv \frac{x_{ksi} p_{ksi}}{I_{ks}} \in [0, 1]. \tag{III.2}$$

We directly observe M_{ksi} for different markets in our data and will now link it to organizational decisions to formulate testable predictions. In the light of the cost and quality channel that we propose, we can rewrite the market share as a function of marginal costs and quality alone:

$$M_{ksi} = \frac{q_i^{\sigma} c_i^{1-\sigma}}{K_{ks}}, \tag{III.3}$$

where K_{ks} measures the total amount of cost weighted quality in the market, and is defined by:

$$K_{ks} \equiv \int_{\Omega_{ks}} q_i^{\sigma} c_i^{1-\sigma} di. \tag{III.4}$$

It is easy to see from equation (III.3) that the market share is strictly increasing in quality and decreasing in marginal costs. In the following two sections we are going demonstrate how marginal costs and quality at the firm level are determined.

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[6]The sub utility functions in destination k are of the form $u_{ks} = \left[\int_{\Omega_{ks}} q_i x_i^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}}$, where Ω_{ks} is the set of varieties in sector s and market k.

III.2.2 Production and Trade in Tasks

We follow Grossman and Rossi-Hansberg (2008) in modeling the firm's decision to offshore production tasks to low cost countries. The production of one unit of output requires a continuum of intermediate tasks of measure 1 that we index by the difficulty to conduct them abroad $\gamma \in [0,1]$. The firm can perform each task in the production process either at home or import it from abroad (i.e. offshore the task). Tasks with a relatively high index value γ have higher cost requirements when they are offshored relative to tasks with a lower index γ. This is captured by the function $t(\gamma)$ that is assumed to be increasing and continuously differentiable.

The cost level in sector s of firm i's home country is given by C_s. This determines the marginal cost of a non-importing firm in sector s. Additionally, we suppose that there is an offshoring destination where the cost index is $C_s^* < C_s$. The offshoring potential of firm i is determined by its offshoring technology $\theta_i > 0$. The lower θ_i, the easier a firm can offshore production tasks abroad. When the task with index value γ is offshored abroad, it increases production costs by a factor $\theta_i t(\gamma)$, where $t'(\gamma) > 0$. This implies that it is more costly to offshore difficult tasks. The unit production costs of firm i are then given by:

$$c_i = C_s (1 - O_i) + C_s^* \int_0^{O_i} \theta_i t(\gamma)\, d\gamma. \tag{III.5}$$

It is profitable to offshore task γ if and only if there is a cost advantage when the task is conducted offshore, i.e. if $C_s > \theta_i t(\gamma) C_s^*$. Tasks with an index $\gamma \in [0, O_i]$ are offshored while the other tasks are conducted at home. Here, O_i is the marginal task where the firm is indifferent between offshoring the task or not, hence it solves $C_s = \theta_i t(O_i) C_s^*$. We can rewrite the unit production cost of firm i as:

$$c_i = \frac{C_s}{B_i}, \tag{III.6}$$

where the use of imported intermediates leads to a cost-reduction factor that captures the firm-specific productivity gains from offshoring tasks abroad:[7]

$$B_i \equiv B_i(O_i) = 1 - O_i + \frac{\int_0^{O_i} t(\gamma)\, d\gamma}{t(O_i)} \geq 1. \tag{III.7}$$

This cost-reduction factor increases in the share of tasks offshored O_i and because the market share is decreasing in marginal costs, firm competitiveness is strictly increasing in offshoring.

III.2.3 Decentralization, Ideas and Product Quality

We now endogenize the firm-specific product quality and link it to the organization of decision rights within the firm's headquarter. Firms innovate to improve their quality and the process of innovation is modeled in two stages. In the first stage knowledge workers invest into the creation of quality enhancing innovations. In the second stage promising ideas are implemented. We assume that the principal/CEO decides who implements the innovation before the agent starts looking for new ideas.[8] We call firms *decentralized* when the knowledge workers are responsible for the implementation of ideas. Similarly, *centralized* firms are the ones where the CEO decides about the implementation of ideas.

Because the principal chooses ex-ante who will be responsible for the implementation if an idea is found, we implicitly assume that the authority over the implementation choice is ex-ante contractible. Furthermore, in order to abstract from any aspect regarding performance payment, we assume that knowledge workers are infinitely risk averse with respect to income and receive a fix wage r to satisfy their participation constraint.

Before the principal makes his choice of organization, he observes a firm specific signal $\phi_i > 1$ about the value of potential ideas.[9] If an idea is found in the first stage and successfully implemented in the second stage, it increases the quality of the firm by the factor ϕ_i. If no innovation occurs, product quality remains at its basic level which is denoted by E_i.

[7] We borrow the expression of the cost-reduction factor from Marin et al. (2015).

[8] Inderst (2009) considers a similar stylized model of the firm to analyze how incentive contracts affect the organization.

[9] e.g. by market research.

Knowledge workers search for ideas with effort e and face a personal cost of effort $g(e) = \frac{g}{2}e^2$ with a sufficiently large g such that there is an interior solution for $e \in (0, 1)$, the probability of finding an idea.

The principal faces a trade-off between higher agent initiative and the cost-efficient production. We assume that knowledge workers only care about how an idea is implemented and whenever an idea is implemented in their preferred manner, they obtain private benefits b. We model the conflict of interest between principal and agent by simply assuming that, with probability $1 - \delta_i$, the knowledge worker prefers to implement the idea in a way that leads to an increase of production costs by the factor $\varphi_i > 1$. With probability δ_i there is no conflict of interest. The optimal allocation of decision authority can easily be found by solving the model backwards.

Decentralization

Suppose that knowledge workers have found an idea such that the firm's product quality is $q_i = \phi_i E_i$. Since the implementation choice was delegated to the knowledge workers, they will choose to implement the idea in their preferred way and receive the private benefits b. The CEO thus expects the following payoff after an idea is found: $\delta_i \pi(c_i, \phi_i E_i) + (1 - \delta_i) \pi(\varphi_i c_i, \phi_i E_i) - r$.

Next, consider the knowledge workers' incentives to search for an idea during the previous period. They find an idea with probability e_d and then always receive the private benefits b on top of the fix wage r. If knowledge workers do not find an idea they only receive the fixed wage. Optimizing expected outcomes leads to the optimal search effort $e_d = b/g$ for decentralized firms.

Given the search effort e_d, the principal of a decentralized firm expects the following ex-ante payoff:

$$e_d [\delta_i \pi(c_i, \phi_i E_i) + (1 - \delta_i) \pi(\varphi_i c_i, \phi_i E_i)] + (1 - e_d) \pi(c_i, E_i) - r. \qquad \text{(III.8)}$$

Centralization

Next, consider the case when the CEO decides to control the implementation of the idea himself. Suppose the knowledge workers have found an idea. Since the principal may now choose how the idea is implemented, he will always choose the low cost implementation and payoffs are given by $\pi(c_i, \phi_i E_i) - r$.

Note that the agents now have less incentives to search for an idea since the principal may ex-post choose to implement the idea in a way that is not in the agents' interest. Their optimal effort choice is now given by $e_c = (\delta_i b)/g = \delta_i e_d$.

Given the search efforts e_c, the CEO of a centralized firm expects the following ex-ante payoff:

$$\delta_i e_d \pi(c_i, \phi_i E_i) + (1 - \delta_i e_d)\, \pi(c_i, E_i) - r. \tag{III.9}$$

Choice of Decision Authority

We can now state a condition under which the CEO prefers a decentralized organization in order to foster the initiative of knowledge workers. We simply compare the payoffs under both forms of organization, i.e. (III.8) and (III.9). After plugging in the effort levels $e_d = b/g$ and $e_c = (\delta_i b)/g$ and rearranging terms, the condition for decentralization simplifies to a direct comparison of profit levels. Firms are decentralized if

$$\pi(\varphi_i c_i, \phi_i E_i) > \pi(c_i, E_i). \tag{III.10}$$

Given the residual demand function (III.1) and the constant markup pricing rule, a firm chooses to decentralize if $\phi_i^{\sigma} > \varphi_i^{\sigma-1}$.

III.2.4 Firm Organization and Competitiveness

We are now in a position where we can relate the firm's organizational choices to the market share. The expression for the market share (III.3) can be rewritten as:

$$M_{ksi} = \frac{E_i^{\sigma} c_i^{1-\sigma}}{K_{ks}} \eta_i(D_i), \tag{III.11}$$

where the function $\eta_i(D_i)$ captures the cost and quality effect of the chosen level of hierarchy on the market share:

$$\eta_i = \begin{cases} \left[1 + e_d\left(\delta_i\phi_i^{\sigma} + (1-\delta_i)\,\phi_i^{\sigma}\varphi_i^{1-\sigma} - 1\right)\right] & if\ D_i = decentralized \\ \left[1 + \delta_i e_d\left(\phi_i^{\sigma} - 1\right)\right] & if\ D_i = centralized. \end{cases}$$

Equation (III.11) shows that the market share resembles the competitive position of firm i as a function of cost, quality and the decentralization decision. Here, c_i resembles the marginal cost level after offshoring, but before taking account of the cost-increasing potential of a decentralized management. E_i is the firm specific quality level before taking account of the quality-enhancing effect of a decentralized management. We summarize the model description with the following results:

Prediction 1: *The effect of offshoring on market shares is strictly positive.*

Furthermore, it is straightforward to show that $\eta_i(d) > \eta_i(c) \iff \phi_i^{\sigma} > \varphi_i^{\sigma-1}$. Thus, whether a reorganization of the internal hierarchy leads to an increase or a decrease of the market share depends on the optimality of the organizational decision. If the value of innovations ϕ_i outweighs potential cost inefficiencies φ_i, then decentralization leads to higher competitiveness, but only then.

Prediction 2: *The effect of decentralization or centralization on the market share is a priori ambiguous.*

Comparing the optimal effort level under centralization and decentralization, we obtain $e_d = \frac{b}{g} > e_c = \frac{\delta_i b}{g}$ for the probability of innovation. Note that the actual impact of decentralization on innovativeness depends on δ_i. Remember that δ_i is the probability of agent and principal preferring the same implementation strategy. The incentivizing effect of decentralization is zero if there is no conflict of interest to begin with, because then the knowledge worker will always obtain his private benefit, irrespective of decision authority.

Prediction 3a: *The effect of decentralization on quality and innovation is posi-*

tive.

Prediction 3b: *The effect of decentralization on quality and innovation is diminishing in the congruence of interests between CEO and knowledge workers.*

In the empirical section, we will analyze how the discussed organizational choices affect the observed market shares M_{ksi} and observed product quality using information from our firm sample. Furthermore, we analyze whether decentralization is associated with innovativeness and quality q_i at the firm level. We also check if the size of the effect depends on the conflict of interest within firms.

III.3 Data

In the following section we describe our data sources and the construction of key variables. We refer to the Appendix B for a more detailed description of the variable construction. Our firm level data stem from two main sources: the *EU-EFIGE/Bruegel-UniCredit* (EFIGE) survey and Bureau van Dijk's *Amadeus* database.

III.3.1 Data Sources

The EFIGE survey dataset is at the core of our analysis. Coordinated by the European think tank Bruegel and supported by the Directorate General Research of the European Commission it is the first pan-European firm level data that combines information on firms' international activities with detailed information on organizational characteristics. The data consist of a representative sample of almost 15,000 surveyed firms with more than 10 employees in seven European economies: Germany, France, Italy, Spain, United Kingdom, Austria and Hungary.[10] Consequently, the representative nature of the survey sample allows us to make statements that are representative for the manufacturing sector in major European economies. The data were collected in 2010 and cover the years from 2007 to 2009. However, most information is collected

[10]The data are representative in terms of the firm size distribution at the country level for the manufacturing industry.

as a cross-section for the year 2008. The collection of information has been performed through a survey carried out by a professional contractor that is the fourth largest market research company in the world. See Altomonte et al. (2012) for more details on the survey method.

We match the firms in the EFIGE dataset with Bureau van Dijk's Amadeus database. The match with Amadeus gives us two important types of information. First, we obtain detailed balance sheet data and second, we use information on the set of relevant industries at the 4-digit US SIC level where the firms are active in.

Finally, we use the *UN Comtrade* data. Comtrade measures trade flows at the industry level which we can use to construct the firm specific export world market size within the industries where each firm is active in. Given the export information from the EFIGE survey, turnover data from Amadeus and the size of the world export market from Comtrade, we can construct firm specific export world market shares for each firm in the sample. We use these market shares to measure the competitive position of each firm within its respective market. We relate it to the firms' intensities of global sourcing to test how importing cheap intermediates can improve the international competitiveness of a firm.

Furthermore, EFIGE provides information on the innovation activity and product quality that firms offer. We link this information to the internal organization of decision making in firm headquarters to estimate if decentralized management improves the firms' product quality.

III.3.2 Construction of Key Variables

Export Market Share

We propose the export market share as a natural measure of export competitiveness. If firms want to stay ahead of their competitors in global markets, it is not sufficient to look at their export sales alone. What matters is how much they export *relative* to their peers. When constructing the market share, the difficulty is to get the peers right. Specifically, we want to account for the fact that many firms are active in more than one industry. Thus, we define the export market share as the ratio of total firm exports relative to all exports available to the world in the firm specific *set* of industries.

We use detailed industry information from Amadeus in order to assess the specific industry mix of each individual firm. While the average firm in our sample is active in about three distinct 4-digit US SIC industries, some firms provide up to 44 different industry codes. Because supposedly not all industries are equally important to the firm, we need to make assumptions about the relative importance of each industry. Here we use information from Amadeus and EFIGE for guidance. Amadeus divides the set of industries into primary and secondary industries. In the EFIGE survey, firms were asked about the percentage of turnover that their core business/product represented in the year 2008. Relating primary industries to the core area of business, we use this percentage share in order to weight primary industries and secondary industries differently. Thus, primary industries are weighted with the share of turnover attributed to the core business, while secondary industries are weighted with the remainder. Within the primary and secondary category, industries are equally weighted.

The peer exports to the world are constructed by applying this firm specific weighting scheme to total industry exports for an individual firm's set of industries. Total exports by industry are obtained from UN Comtrade WITS by summing up industry imports of all countries, excluding the firm's home country. For the numerator, we use survey information on the percentage of annual turnover exported in 2008 and multiply that by turnover information obtained from Amadeus.[11]

Offshoring

The theoretical mechanism we presented in section III.2 is very simple. Firms become more productive by sourcing cheaper inputs from abroad. We stick to these simplicity in the empirical section by assuming that offshoring is simply the share of intermediates purchased from abroad. This also implies that we do not care whether imported inputs origin from within or outside the boundaries of the firm. To be specific, our measure of offshoring is the response of firms to the following question in the EFIGE survey: *What percentage of the total purchased intermediate goods (from anywhere) did the intermediate goods purchased*

[11] In the appendix we present the construction of the export market share in more detail.

from abroad represent?

Decentralization

With respect to the organization of internal hierarchies, we use the following survey question in order to determine whether a firm is decentralized or not: *With reference to strategic decisions which of the following statements better describe your firm situation?* Firms are considered centralized when they choose *centralized: the CEO/owner takes most decisions in every area*. Firms that choose *decentralized: managers can take autonomous decisions in some business areas* are considered to be decentralized. In our stylized model the CEO/owner was represented by the principal while managers were represented by the agents/knowledge workers. As we believe that the implications of our model easily transcend into more general settings, we are not worried with the slightly imperfect matching between managers and knowledge workers.

Product Quality and Innovations

Our theoretical model proposes a one to one matching between innovation and quality. Whenever decentralization leads to innovation, product quality increases. In the empirical section we discard with this simplification and try to assess the effect of decentralization on both characteristics separately. For quality, we use a subjective measure from the EFIGE survey. Firms were asked to *think of the product category your main product belongs to. If we rank the maximum quality available in the market for this product equal to 100, how would you rate the quality of your own product?*. Because this measure is prone to cultural noise, we normalize the survey measure at the country level. For innovation, we use a dummy equal to one when firms *carried out any product innovation in years 2007- 2009*. Alternatively, we use the same dummy for process innovations.

III.4 Estimation

Our theoretical model predicts that the export market share of firms is a function of the firm specific cost and quality level, relative to the average costs and quality in the market. In the theoretical framework, we mapped quality and costs to specific organizational decisions to see how organizations determine firm competitiveness. The empirical setup is thereby guided by two insights from our theoretical framework. First, offshoring reduces costs and thereby unambiguously increases market shares. Second, decentralization triggers a trade-off between higher costs and higher quality. Thus, the relationship between market shares and decentralization is ambiguous. Quality itself is the factor that we expect to have an unambiguously positive effect on competitiveness and we expect that decentralized management improves product quality. This gives rise to two empirical models that we will subsequently introduce in more detail.

III.4.1 Offshoring and Market Shares

In this part of the empirical analysis we provide evidence supporting a link between offshoring and export market shares. The core empirical specification looks as follows:

$$m_{Ksi} = \alpha + \beta_1 off_i + \beta_2 qual_i + \beta_3 dec_i + \beta_4 F_i + \beta_5 X_{Ks} + \varepsilon_{Ksi}. \quad \text{(III.12)}$$

Our empirical specification closely resembles the theoretical determinants of the market share. The dependent variable m_{Ksi} is our empirical measure of firm i's export market share in industry s and destination K. The key variable of interest in the empirical model (III.12) is the offshoring intensity off_i at the firm level. We proxy off_i by the ratio of intermediates purchased from abroad relative to all intermediates purchased within each firm i. The theoretical model also predicts export market shares to increase with the degree of product quality $qual_i$ that a firm offers. Our measure of product quality is a subjective survey question that ranks the product quality of each firm i relative to its competitors. As cultural influences usually play an important role in these subjective evaluations, we normalize the measure of product quality at the country level and only employ the variation in quality within the firms' home countries (i.e. within each country the mean is 0 and the standard deviation is 1). Furthermore, we replace our quality measure with product innovation in the robustness section. The evaluation of product quality from the firm perspective might introduce measurement error since we are originally interested in the quality perceived by consumers. Due to the lack of a proper instrument, we will treat quality as a control variable rather than a variable of interest. dec_i is a dummy that indicates if managers can autonomously take strategic decisions in some business areas. This dummy is supposed to capture the potential costs and benefits of a decentralized organization as described in our theoretical framework by the term $\eta_i(D_i)$. The vector F_i contains additional firm level controls such as firm size and productivity in order to account for remaining firm heterogeneity. Finally, X_{Ks} includes a set of fixed effects at the country, region or sector level to capture different market conditions. We will consider destination K to be simply the world market.[12] The variable ε_{Ksi} is the error term.

We will first show our baseline results from ordinary least squares estimates. Then we proceed by addressing potential biases from endogeneity. Our identification strategy is based on measures of comparative advantage and cost saving potentials of offshoring at the industry level that we will use to instrument for offshoring at the firm level.

III.4.1.1 Baseline Results

Table III.1 shows the ordinary least squares estimates of the empirical model (III.12). Column (1) gives a first impression of the link between offshoring and the export market share of a firm: we ignore the set of firm controls and regress the market share on offshoring, normalized quality and fixed effects only. Both, offshoring and quality appear to be positively correlated with the market share and are highly significant.

The empirical literature on firm heterogeneity in trade has established strong connections between various firm characteristics: importing firms export more frequently, but also tend to be larger and more productive on average (see Bernard et al. (2012) for an empirical overview or Melitz (2003) for a theoret-

[12]Given that we consider the world market as destination, the only way to control for destination fixed effects is by accounting for the fact that the world market is different for German firms than it is for French firms. We therefore include *shipping* country fixed effects rather than destination effects in most specifications. Note that this also controls for all other unobserved differences between the countries in our sample. We use the 11 NACE Clio sectors provided in EFIGE to control for sector conditions because our instrumental strategy does not allow for finer sectoral controls. The results in Table III.1 are robust to the inclusion of 3digit-industry controls (US SIC).

ical framework that shows how in principal all those factors might be driven by a single factor). In principle then, it might be size or productivity rather than imports driving the export competitiveness of firms. In specification (2), we therefore control for size and productivity, using log employment and log labor productivity, in order to account for the most obvious factors that might confound our results.[13] Our coefficient of interest remains statistically significant at the 5% level but diminishes to less than half of its original size. This indicates that the size of the measured effect in specification (1) was driven to a considerable extent by the failure to account for unobserved heterogeneity across firms. As expected, controlling for productivity and size increases the explanatory power of the model considerably, raising the adjusted R^2 from 0.011 to 0.073.

Column (3) includes decentralized management as a further control. As suggested by our simple theory and the literature on firm organization, the type of decision making within a firm can have a big impact on firm performance (see Acemoglu et al. (2007) and Bloom et al. (2012)). However, according to our theory, the optimal organization of firms depends on the relative importance of quality and costs such that *a priori* we would not expect a specific sign for the coefficient on decentralization. Still, we should expect the dummy variable to control for firm specific cost and quality opportunities that are not captured by the measures of offshoring or the subjective quality, respectively. Effectively though, the inclusion of decentralization does not alter our results by much and the coefficient remains statistically insignificant.

Column (4) replaces the country dummies with finer regional controls at the NUTS-1 level.[14] Regional controls can be important as they help to absorb omitted factors at the regional level that are related to market access costs. For example, regions at the border might be especially prone to offshoring as well as exporting. Other differences between regions, such as the degree of industrialization, income or local institutions could also be important determinants of export performance at the firm level and should be controlled for. Table III.1 shows that our results are robust to these regional controls.

[13] Our estimation results are robust to using total factor productivity in most specifications, though the number of observations is significantly higher for labor productivity.

[14] The specification is also robust to region fix effects at the even more disaggregated NUTS-2 level. We obtain the NUTS-region for each firm by combining the regional information provided in EFIGE together with zip codes from Amadeus.

Note though, that regional fixed effects do not control for unobservable regional effects when the effects are specific to certain industries. In order to control for this type of unobserved covariance, we interact region and industry controls in column (5). The offshoring coefficient increases slightly.

Column (6) tries to address potential bad control problems.[15] In our case, offshoring is itself a candidate variable to explain labor productivity (the value added per employee). As we measure value added as turnover net of the value of intermediates purchased, the ratio of intermediates obtained as cheap imports clearly will have a direct impact on labor productivity. Once we control for labor productivity, our coefficient of interest supposedly measures the effect of offshoring on market shares *conditional* on a specific level of labor productivity. But as the level of labor productivity itself changes with offshoring, this potentially introduces a sort of selection bias into the model. Therefore we reestimate the model without the inclusion of labor productivity. The qualitative results remain robust and the coefficient on offshoring changes only little. Nevertheless, we prefer to keep labor productivity as a control in our model as we assume that endogeneity from omitted variables outweighs endogeneity from bad controls.

Including both exporters and non-exporters in our sample raises one further concern, namely that the correlation we measure is driven solely by the export status. Thus, *given* entry into exporting, offshoring might not have an impact on export performance at all. To rule that out, columns (7) and (8) repeat specifications (3) and (5) respectively, but only include exporters. This reduces the sample size considerably and much of the precision of our estimates is lost. Note though, that the coefficient on offshoring is still positive and significantly different from zero at the 10 and 5 percent level respectively. The magnitude of the effect slightly increases.

III.4.1.2 Instrumenting for Offshoring

The specifications of our empirical model are subject to different potential endogeneity problems. One problem could be omitted variable bias from unobservable firm characteristics that are correlated with both international activities, offshoring and exporting. Presumably, the inclusion of size and pro-

[15] See Angrist and Pischke (2009), p.64 ff for a detailed presentation of the problem.

ductivity as control variables does not fully account for all dimensions of firm heterogeneity. Furthermore, reversed causality arises if exporting itself has a positive impact on the firm's propensity to engage in offshoring leading to an upward bias of the offshoring coefficient. While empirical evidence for this channel is rare, the broader body of literature on international trade delivers reasons to be aware of the possibility. One argument that raises concerns about reversed causality is the learning-by-exporting hypothesis.[16] If exporting has a positive effect on the productivity of firms, this might very well help exporters to overcome possible fix costs of importing. A related argument could also be derived from the literature of network economics in trade. Exporters may have an advantage to find suppliers in a foreign market simply because they already possess valuable contacts to local business networks.[17] Finally, some of our explanatory variables could be measured with error. Classical measurement error would bias our coefficients towards zero.[18]

We try to respond to these concerns by employing different instrumental variables. The underlying estimation strategy is to use variation in the comparative advantage or the cost saving potential at the *input industry* level in order to instrument for offshoring at the *firm level* in the output industry. In our main specifications, we use two different instruments for offshoring: The low-skilled labor intensity at the input industry and input industry specific wages in Eastern Europe.

The low-skill intensity of intermediate production is the share of low-skilled labor that is used at the input industry level (low-skilled labor compensation in total labor compensation). The measure is obtained from the WIOD database and measures the skill intensity in input industries.[19] On the one hand, the low-skilled labor intensity resembles an endowment-type comparative advantage argument. Assuming that the endowment with skills is rel-

[16]See De Loecker (2007, 2013) for empirical evidence.

[17]See Chaney (2014) on the effects of international social networks on exports.

[18]Note that measurement error in the market share is less of a problem in terms of consistency, as long as the error is uncorrelated with any of the explanatory variables. Since our construction of the dependent variable allows for multiple sources of measurement error, we will show results for alternative measures of openness in the robustness section of this chapter.

[19]We make use of the February 2012 release of the WIOD database. For each industry, we use the midpoint between the German and the Austrian value. Our instrumental strategy is robust to using the country specific values as well as values for Eastern European countries instead of the German Austrian midpoint (unreported).

atively high for the countries in our data, traditional Heckscher-Ohlin type arguments would suggest low-skilled labor intensive intermediates to be imported more frequently. On the other hand, the instrument might also proxy the complexity of intermediates. This notion of complexity relates the skill intensity at the task level to the offshoring costs $t(\gamma)$ and θ_i in our theoretical model and we would expect less complex intermediates to be offshored more frequently.

Our second instrument are the input industry specific wages in Eastern Europe. These input wages are supposed to capture the cost saving potential from offshoring. The instrument relates to the cost index C_s^* in the offshoring regions in our model.

We expect a positive correlation between the offshoring intensity at the firm level and the low-skill intensity of the input industries and a negative correlation between the input industry wages in Eastern Europe and offshoring.

We weight input industries according to input coefficients from the OECD STAN data to determine the relevant input industries for each industry where the firm is active in.[20] Again, we use information from Amadeus to determine the firms' relevant primary and secondary industries. Weighting of the industries of activity applies as for the market shares. For each of those industries, we then determine the share of inputs provided by any other industry from the input-output table. Finally, we use these shares in order to construct our instruments as a weighted average of input industry level information.

In order for our instruments to be valid, they need to satisfy the exclusion restriction. For this purpose, they need to be conditionally uncorrelated with the export market shares of firms and other unobserved firm characteristics that determine both, offshoring and export performance.

One concern could arise if low-skill intensive input industries supply inputs with lower quality that translate to lower output quality and thus directly affect firm market shares. We account for this by including our proxy $qual_i$ that absorbs variation in the output quality of a firm. Another problem could arise if the wages in specific input industries in Eastern Europe determine world de-

[20] We use input coefficients for Germany in 2005 and apply them to all countries for simplicity. The STAN database provides input-output coefficients at the 2-digit ISIC Rev.3 level only. Both, the industries of activity for each firm as well as the information for the input industries, will therefore be restricted to the 2-digit level for the construction of our instruments.

mand. However, as our dependent variable is the export market *share* rather than the export value, this does not necessarily violate the exclusion restriction. Additionally, we use wages in input industries in India and China relative to domestic wages as an alternative instrument in the robustness section. Then, the exclusion restriction of our second instrument could be violated. An alternative concern is that firms with large market shares are also monopsonists in factor markets and can enforce low wages in input industries. As we focus on wages in relatively aggregated input industries (2-digit ISIC), the bargaining power of an individual firm on the Eastern European labor market seems rather negligible. Furthermore, we also use input wages in China and India in the robustness section which should be even less determined by individual firms.

The specifications presented in Table III.2 are the IV analogs of Table III.1. Results from the first stage are shown at the bottom of the table. Both instruments are highly significant and the coefficients have the expected signs. The first stage F-test of excluded instruments are above any of the Stock-Yogo critical values of weak identification in all specifications. As we use both instruments simultaneously, we are able to test for overidentification of our model (the Sargan-Hansen test). Reassuringly, the Hansen J-statistics do not reject the null hypothesis of exogenous instruments in any of the specifications except for the first one where we do not control for firm heterogeneity.[21]

Comparing the outcome of the instrumental variable regression with the results from Table III.1 shows that our coefficient of interest has increased significantly in size across all specifications. This indicates that attenuation bias might have been a serious issue in our previous ordinary least squares estimates. Offshoring remains highly significant in explaining the export market share in the full sample. The correlation is weaker for the restricted sample of exporters but still remains significant at the 10% level. The coefficient does not vary too much between the individual specifications. As a benchmark, specifications (3) and (5) both yield a coefficient of around 0.5. Taking that coefficient at face value would imply that the average non-offshoring exporter

[21] The specification (1) is very weakly controlled. Adding firm controls already raises the p value of the test to 0.57. Note that the Hansen J-statistic only tests the validity of one instrument against the other. Thus, it will not indicate problems if both instruments turn out to be flawed. On the other hand, if the exclusion restrictions is met for at least one of the instruments, our identification strategy should deliver causal effects.

could increase its market share by almost 230% when the firm purchased the same share of intermediates from abroad as the average offshoring export firm does (about 30%).[22] While tripling the market share appears to be a huge effect indeed, the underlying increase in the offshoring variable from 0% to 30% is very substantial. In terms of the market share, we are talking about an absolute increase in a range between 0.67 to 2.2 per mille.

III.4.1.3 Robustness

Tables B.4 (OLS), B.5 (IV) and B.6 (IV) present results to evaluate the robustness of our estimations. We choose specification (4), from Table III.1 and Table III.2 respectively, as our baseline specification. In Tables B.4 and B.5 we provide the following robustness checks: we control for more disaggregated industry fix effects, exchange the control variables, use alternative measures of offshoring and alternative dependent variables. In Table B.6 we deal with the robustness of instruments and consider how autocorrelation within standard errors affect the significance of our estimates. The robustness checks in Tables B.4 and B.5 are symmetric unless otherwise noted.

In specification (2) we begin by adding industry dummies at a finer level of detail. As our instruments varies at the industry level our IV results are not robust to the inclusion of industry dummies at the 2-digit US SIC level. As it can be seen from the first stage F-statistic this is due to the loosened grip of our instruments after absorbing industry variation across very narrow industries. The OLS estimates however are robust to the inclusion of industry fix effects up to the 3-digit US SIC level.

Specifications (3) to (6) successively replace the main control variables of our model with alternative measures. Thus, we use average total factor productivity for the years 2001 to 2007 in order substitute for our constructed measure of labor productivity in specification (3).[23] We then replace log employment by log turnover in specification (4). Subjective quality is replaced by an indicator of product innovation in specification (5). Specification (6) interchanges the full set of control variables. Using turnover as a size control in

[22]The less precise estimate for exporters in specification (7) yields an increase in the market share of slightly more than 200%, while the smallest coefficient, specification (1), implies an increase of almost 170%.

[23]We are thankful to Bruegel for providing us with this measure.

Table III.1: Offshoring and World Market Shares

dependent variable:	***world export market share (%)***							
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
offshoring	0.196***	0.0777**	0.0780**	0.0760**	0.0859**	0.0905***	0.0808*	0.105**
	(0.0384)	(0.0359)	(0.0356)	(0.0352)	(0.0348)	(0.0348)	(0.0480)	(0.0523)
product quality (normal.)	0.0109**	0.00741*	0.00743*	0.00774*	0.00759	0.00757	0.0163*	0.0175*
	(0.00497)	(0.00445)	(0.00447)	(0.00451)	(0.00483)	(0.00484)	(0.00922)	(0.0101)
ln(employment)		0.131***	0.131***	0.131***	0.133***	0.133***	0.191***	0.197***
		(0.0221)	(0.0227)	(0.0228)	(0.0237)	(0.0239)	(0.0340)	(0.0375)
ln(labor productivity)		0.0706***	0.0708***	0.0707***	0.0705***		0.121***	0.126***
		(0.0142)	(0.0144)	(0.0144)	(0.0150)		(0.0255)	(0.0285)
decentralized management			-0.00683	-0.00630	-0.0119	-0.00533	-0.0102	-0.0145
			(0.0152)	(0.0152)	(0.0172)	(0.0165)	(0.0247)	(0.0301)
industry f.e.	*yes*	*yes*	*yes*	*yes*	*no*	*no*	*yes*	*no*
country f.e.	*yes*	*yes*	*yes*	*no*	*no*	*no*	*yes*	*no*
region f.e.	*no*	*no*	*no*	*yes*	*no*	*no*	*no*	*no*
industry x region f.e.	*no*	*no*	*no*	*no*	*yes*	*yes*	*no*	*yes*
sample	*full*	*full*	*full*	*full*	*full*	*full*	*exporters*	*exporters*
observations	9,066	9,066	9,066	9,066	9,066	9,066	4,910	4,910
adjusted R^2	0.011	0.073	0.073	0.069	0.047	0.037	0.098	0.046

See Table B.1 in the Appendix for a description of the variables. All regressions include different sets of fixed effects: we employ a set of 10 industry f.e. from EFIGE, *country f.e.*, 54 *region f.e.* and 543 *industry* × *region f.e.*. Heteroscedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table III.2: Offshoring and World Market Shares - IV

dependent variable:	***world export market share (%)***							
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
offshoring	0.371**	0.500***	0.501***	0.532***	0.501***	0.464***	0.452*	0.487*
	(0.157)	(0.154)	(0.154)	(0.162)	(0.179)	(0.179)	(0.271)	(0.276)
product quality (normalized)	0.0103**	0.00624	0.00627	0.00646	0.00598	0.00613	0.0156*	0.0157*
	(0.00504)	(0.00448)	(0.00449)	(0.00451)	(0.00469)	(0.00471)	(0.00921)	(0.00913)
ln(employment)		0.114***	0.115***	0.114***	0.117***	0.118***	0.179***	0.177***
		(0.0223)	(0.0229)	(0.0227)	(0.0232)	(0.0236)	(0.0346)	(0.0345)
ln(labor productivity)		0.0690***	0.0693***	0.0690***	0.0689***		0.123***	0.123***
		(0.0141)	(0.0143)	(0.0142)	(0.0145)		(0.0258)	(0.0257)
decentralized			-0.0113	-0.0112	-0.0159	-0.00902	-0.0120	-0.0124
			(0.0154)	(0.0156)	(0.0173)	(0.0166)	(0.0248)	(0.0251)
industry f.e.	*yes*	*yes*	*yes*	*yes*	*no*	*no*	*yes*	*no*
country f.e.	*yes*	*yes*	*yes*	*no*	*no*	*no*	*yes*	*no*
region f.e.	*no*	*no*	*no*	*yes*	*no*	*no*	*no*	*no*
industry × region f.e.	*no*	*no*	*no*	*no*	*yes*	*yes*	*no*	*yes*
sample	*full*	*full*	*full*	*full*	*full*	*full*	*exporters*	*exporters*
observations	9,063	9,063	9,063	9,063	9,063	9,063	4,910	4,910
first stage results:								
IV1: foreign wage per employee	-6.85e-05***	-7.45e-05***	-7.42e-05***	-7.31e-05***	-7.27e-05***	-7.21e-05***	-8.75e-05***	-8.88e-05***
IV2: low skilled labor share in compensation	2.945***	2.737***	2.752***	2.678***	2.280***	2.312***	2.577*	2.670**
Kleibergen-Paap F-Stat	38.45	40.40	40.36	38.47	29.44	29.41	18.93	19.42
Hansen J-stat (p-val)	0.01	0.57	0.60	0.69	0.92	0.44	0.88	0.87

All regressions are second stage results of IV estimations where we use 2 instruments for *offshoring:* (1) the lowest 10th percentile wage in Eastern Europe and (2) the industry share of low-skilled employment in compensation. See Table B.1 in the Appendix for a description of the variables. All regressions include different sets of fixed effects: we employ a set of 10 industry f.e. from EFIGE, *country f.e.*, 54 *region f.e.* and 543 *industry × region f.e.*. Heteroscedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

the OLS regression leads to a coefficient that is indistinguishable from zero. We believe that this might be due to measurement error and the strong connection between turnover and the market share. Other than that, our results hold well and the absolute size and significance of the measured effect does not vary substantially across specifications.

In specifications (7) to (10) we replace our explanatory variable and see whether our results are robust to alternative measures of offshoring. The underlying hypothesis is that the effect we measure should not depend too strongly on the specific type of offshoring. As long as costs can be reduced by sourcing inputs from abroad, we expect a significant effect on our measure of competitiveness. While we use intermediates purchased from abroad as a share of all intermediates as our core measure of offshoring, specification (7) shows the results from using intermediates from abroad as a share of turnover instead. Specifications (8) to (10) proceed by replacing intermediate purchases in terms of turnover by FDI, service offshoring and outsourcing in terms of turnover, respectively. The OLS coefficients remain positive but only partly significant. Using our instruments yields positive and significant estimates across all measures of global sourcing. Naturally, the actual size of the coefficients changes. Nevertheless, the implied effect remains very close to the original effect in the case of intermediates relative to turnover. An analogous thought experiment to the one we invoked earlier implies a 223% increase in market shares. The effects are much larger for FDI, service offshoring and outsourcing, but we will not elaborate on these differences as our instruments are relatively weak for these alternative measures of offshoring.

Specifications (11) and (12) replace the dependent variable by the share of exports in turnover and the export volume, respectively. This reduces the risk of potential measurement error in the dependent variable and loosens the constructional bond between dependent variable and instrument by taking the firm specific industry-mix out of the left-hand side variable. The estimates show that our results are robust to using these alternative measures of export performance. The IV results are less clear cut, with a rejected Hansen test for the export share and huge standard errors for the export volume. Note though, that substituting the East European wage instrument, which is measured in absolute terms, by wages relative to the firm's home country increases the Hansen p-value for both specifications and renders the coefficient of interest significant even for the export volume (not reported).

In Table B.6 we elaborate more on the robustness of our instruments and check whether our results hinge on standard errors being robust to heteroscedasticity only. Specification (1) again repeats the baseline regression. In specification (2) we want to check whether our results are still robust when using the mean over Chinese and Indian input industry wages rather than wages in Eastern Europe. As the Chinese and Indian markets are less tied to the countries in our sample, the risk of reversed causality from firm's export performance to labor market conditions in the offshoring region should be reduced by using wages from these regions. The offshoring coefficient reduces in size but remains robust apart from that. In specification (3) we use wages in China and India *relative* to the firm's country of origin, as this might be the relevant characteristic from the firm's point of view.

Specifications (4), (5) and (6) introduce an alternative instrument based on an idea by Hummels et al. (2014). The alternative instrument relates to worldwide export supply in firm *i*'s input industries and is measured as the weighted sum of all intermediate exports from any country in the world to all other countries, excluding the firm's home country on both sides. The first stage has the expected sign and the new instrument works in combination with either of the original instruments. As the Hansen test of overidentifying restrictions is not rejected for any of the combinations of instruments, we conclude that all instruments are valid as long at least one of the instruments we propose is valid.

Specifications (7), (8) and (9) finally experiment with the autocorrelation structure of standard errors. Up to now, we showed results for heteroscedasticity robust standard errors, because to us it is not obvious what type of clustering to expect. As our variable of interest is measured at the firm level and we exploit cross-sectional variation between firms, autocorrelation of standard errors is not obvious. Nevertheless, standard errors could be autocorrelated between firms within one geographical region as firms with high levels of intermediate imports might cluster within border regions. Alternatively, standard errors could also be clustered within industries or at the industry-region level. We allowed for clustered standard errors at the regional level (NUTS-2), at the industry level (3-digit US SIC) and at the industry-region level. Our results are robust to all three types of clusters but standard errors tend to increase whenever we cluster at the industry level.

Overall, the coefficients remain relatively stable across all specifications and our results are robust to most of the alterations we proposed.

III.4.2 Decentralization and Product Quality

Let us now turn to the second prediction of the model. We want to analyze if there is a positive association between firms with a decentralized management and the quality of the products that these firms produce. Theoretically, we consider anything the firm can do in order to increase demand for a given price to be a realization of quality. In the empirical section we will focus on two broad measures of desirability: the quality of products relative to the market average as perceived by the firm and an indicator whether firm i has carried out a product innovation in the years 2007 to 2009.

We will use both, product and process innovations in the regressions. Note though, that the notion of non-price desirability applies mainly to product innovations, while process innovations, though still related to the incentive creating effects of decentralization, are probably more relevant for the reduction of costs.

The measure of perceived quality is an indicator, directly taken from the survey, that varies from 0 (the worst product in the market) to 100 (the best). We will use a transformation of this indicator, which is centered around 0 for each country, with the standard deviation set to 1. This normalization helps us to prevent cultural differences in perception from driving our results.

The core empirical specification looks as follows:

$$q_{csi} = \lambda + \mu_1 dec_i + \mu_2(dec_i \times coi_i) + \mu_3 F_i + \mu_4 X_{cs} + \omega_{csi}, \tag{III.13}$$

where q_{csi} is one of our three measures of firm specific product quality or innovation. The variable dec_i is our dummy indicating decentralized organizations and coi_i is a measure of the conflict of interest within firms. The vector F_i contains firm controls, X_{cs} includes industry and country or regional controls and ω_{csi} is the error term.

Two considerations determine the set of controls in equation (III.13). First, our theoretical model predicts the probability of a quality innovation to be higher for decentralized firms because knowledge workers show more initiative in those organizations (as $e_d = b/g > \delta(b/g) = e_c$). This fact resembles the higher search effort of managers once they know they can choose their preferred implementation after an idea is found and lets us expect a positive coefficient $\mu_1 > 0$ for the regressor dec_i. Note though, that the size of this positive effect depends on δ. In our theoretical model, δ measures the probability of manager and principal choosing the same implementation strategy. From the manager's point of view, a high δ implies that he has good chances of obtaining the private benefit from his preferred implementation, even if the principal chooses the strategy in a centralized organization. Therefore, the advantage of a decentralized organization in terms of higher search effort should be relatively low for high values of δ as knowledge workers expand similar efforts under both types of organizations. We try to capture this with the interaction term $dec_i \times coi_i$, where coi_i is an inverse measure of the conflict of interest. We expect the coefficient μ_2 to be negative.

The choice of a good proxy for the congruence of interests δ is crucial to measure the interaction effect $dec_i \times coi_i$. As the majority of firms in our data are private limited liability corporations who are to a substantial part family owned firms, we exploit the ownership structure of the firms to proxy for coi_i. We proxy coi_i by the share of managers (including top and middle management) that is related to the family who owns the company. The underlying assumption is that the probability of congruent interests between owner and manager should be higher when both share the same family ties. In accordance with our theory, we expect μ_1 to be positive and μ_2 to be negative.

Second, as organizational choices are not assigned randomly, we need to control for relevant factors determining whether firm i is prone to being decentralized or not. At the firm level, we add the share of high and medium skilled workers among all workers in order to proxy for the firm specific level of human capital and thus the value of empowerment due to decentralization. The underlying assumption is that innovative activities are more frequent among skilled workers and that the gains from higher effort should therefore be more important to firms with a skilled labor force. We further add a dummy indicating whether the firm is young (less than 6 years old), assuming that younger firms might be more dependent on innovations.[24] Because we do not want our proxy coi_i to pick up other specifics of family firms, we further add a dummy indicating whether the CEO himself is part of the family. As larger firms naturally tend to be more decentralized, we will also control for the number of employees. Finally, we include our measure of labor productivity in order to control for other dimensions of firm heterogeneity that affect product quality.

In order to control for the sectoral fix effects, X_{cs} contains 11 NACE Clio sector dummies.[25] X_{sc} also contains a set of country or regional fix effects. In some specifications we will use interacted sector and region fixed effects as in the regressions for the export market share. Note though, that we will instrument decentralization by regional characteristics below, preventing us from using regional fix effects. We will use regional control variables instead when it comes to instrumentation.

III.4.2.1 Baseline Results

Table III.3 shows the results from running ordinary least square variants of equation (III.13). Specifications (1) to (3) use the normalized measure of perceived quality, specifications (4) to (6) show the results for product innovation and specifications (7) to (9) use process innovations as the dependent variable.

Specification (1) shows the results when we omit to control for regional effects. As expected, the coefficient on decentralization is positive and significantly different from zero at the 5% level. We fail to establish significant results for the interaction term but the point estimate delivers the right sign. Firm size appears to be an important covariate in this specification.

Specifications (2) and (3) show whether regional effects are decisive drivers of our results. The estimates in Table III.3 indicate that our coefficients are relatively robust when controlling for unobservable characteristics at the regional or sector-regional level. This is an important finding as we will not be able to control for regional unobservables once instrumenting at the regional level. Additionally, it might be counted as a good sign for the exclusion restriction we propose.

[24]See Acemoglu et al. (2007) for empirical evidence on the relation between firm age and decentralized management.

[25]The specifications are robust to using 3-digit US SIC industry controls.

The results are very similar but more robust when using product innovation instead of perceived quality as our dependent variable.[26] Product innovations are very close in spirit to the theory we proposed. Product innovations are usually thought to be improving the objective characteristics of the product, potentially leaving production costs unaltered. The utility of costumers then rises without the necessity of a decrease in prices. This is exactly the notion of quality we proposed in the theoretical section.

Note that while their absolute size has not changed by much, the coefficients on the interaction are now significant up to the 1% level, suggesting that an increase in the share of family executives renders the impact of decentralized management less important. Finally, the existence of a family CEO as well as the share of high- and medium skilled employees do now appear to be significant covariates of the model.

In specifications (7) to (9) we replace product by process innovations. Innovations in the production process are often related to the cost of the product rather than to its qualitative characteristics. While this is less in line with the theoretical model we proposed, the effort argument remains valid for any type of innovation and therefore we should in general expect to find similar effects in line with our model.

Nevertheless, the results are slightly different for process innovations. The coefficient on the interaction turns out indifferent from zero in a statistical sense. Furthermore, family firms are not as different from other firms when it comes to process innovation. The coefficient on the share of high and medium skilled workers is now negative. Instead, labor productivity shows up to be an important covariate of innovation for the first time.

It is not quite clear what explains these deviations, especially the missing effect on the interaction. As you will note in the next section, some of the differences in the results for product and process innovations will disappear as soon as we try to identify effects with our instrumentation strategy. The interaction effect for example will show up again significantly and with a negative sign. Others, like the coefficient on the share of high-skilled workers, remain significantly different for process innovations. One explanation would be that

[26] Here we are showing results for the linear probability model. Running Probit estimations does not alter the results significantly but makes the interpretation of the coefficients much harder, given that we are dealing with an interaction term.

process innovations are more important for production intensive firms, where the share of low-skilled rather than high-skilled employees is supportive of innovation.

We will briefly return to the differences for varying dependent variables when we have seen results from the instrumental variable estimations.

III.4.2.2 Instrumenting for Decentralization

Again, the set of control variables we added to equation (III.13) might not suffice to prevent omitted variable bias. Additionally, measurement error appears to be important given the survey nature of our data. Finally, innovation itself potentially has a substantial impact on the organization of firms, leading to reverse causality issues.[27]

The literature on firm organization proposes different determinants for decentralization in firms. For example, Bloom et al. (2012) propose the rule of law, product market competition, hierarchical religion and the level of trust in a region as potential determinants for decentralized management within firms.

Rule of law or the degree of product market competition are probably important determinants of innovation and quality in their own right and thus not exogenous in our empirical model. We focus on the other two determinants: regional variation of religious faith and trust levels across Europe and argue that this variation is better suited for instrumentation given that a direct impact on product quality is less likely. If the notion of trust and religion were relevant determinants of product quality or innovation, then the effect would rather work via trust levels *within* firms. However we try to account for that by controlling for the conflict of interest within firms.

In our main specifications we use measures of religion rather than trust because we assume that religious beliefs are less likely to be shaped by the professional setting which again could have a direct impact on product quality. We will add trust as an instrument in the robustness section.[28]

[27]The survey specifically asks firms to indicate whether product or process innovation implied organizational innovation. Almost a third of the firms gave an affirmative answer.

[28]Our measure of *trust* in a region is the share of people responding "most people can be trusted" when asked whether generally speaking, most people can be trusted or alternatively, "one can't be to careful in dealing with people".

Our instruments are constructed at the regional level (NUTS-1) where regional averages are obtained from the 2008 European Values Study (EVS).[29] We will use instruments from the EVS for both endogenous variables, the level of decentralization and its interaction with family managers. As you will see in the robustness section, using religion, our instrument for decentralization, interacted with the share of family members as an instrument for the interaction term has two disadvantages. First, the covariation between the instruments and decentralization is very weak when both instruments contain the same variable from the value survey. And second, testing overidentifying restrictions with a larger set of instruments shows that the simple interaction between religion and the share of family members is not exogenous. Results appear to be less problematic when using two distinct instruments based on religion for both endogenous variables, acknowledging that the relevance of the instruments is then based on decentralization alone.

Our first measure of *religion* is the share of people that mentioned “religious faith” when asked about especially important qualities which children can be encouraged to learn at home. La Porta et al. (1997) and Bloom et al. (2012) also propose the regional influence of “hierarchical religions” as a determinant for decentralization which we will use as our second instrument.[30] We argue that both instruments are relevant by arguing that religious believes might be negatively correlated with a taste for autonomy and positively with the submission to authority.

Figures B.1a, B.1b and B.1c in the appendix show the regional variation in the average values of decentralization and our instruments. Three facts are noteworthy: First, much of the variation can be found between countries. This explains why the inclusion of country fixed effects renders our instruments weak. Second, there is indeed a correlation between decentralization and our instruments. For example, Italy is clearly a country where religion is highly important and the level of decentralization is relatively low. Also the levels of decentralization are much higher for Germany and the UK where hierarchical

[29] The EVS is a large-scale, cross-national and longitudinal value survey, covering 47 European countries or regions with a number of roughly $70,000$ interviewees. We use Version 3.0.0 of the Integrated Dataset (Study No. $ZA4800$). Note that our results are robust to using instruments at the NUTS-2 level, though the instruments become weaker.

[30] We refer to Roman Catholic, Muslim or Orthodox believes when talking about hierarchical religions.

religions play less of a role. Third, religious faith and hierarchical religions are clearly not the same thing. This is important because we need distinct variation in order to employ both instruments at the same time.

Our exclusion restriction requires that religious beliefs have no direct impact on the product quality that firms offer, other than through their influence on firm organization. Again, our claim is that the exclusion restrictions holds after controlling for the relevant covariates. One concern is that religious beliefs could be associated with economic activity and income. This association was proposed by the sociologist Max Weber who claimed that there is a positive link between *protestant ethic* and economic activity.[31] However, Cantoni (2013) does not find evidence for this effect in German-speaking regions. Furthermore, empirical findings by Becker and Woessmann (2009) suggest that the effect of protestantism on economic growth vanishes once they control for human capital accumulation. This effect should be absorbed by our control for human capital at the firm level. We also control for per capita income to absorb variation in demand that stems from variation in income. A problem with the exclusion restriction would persist if religious beliefs affect the preferences for quality besides through differences in income.

Table III.4 shows the results from the instrumental variable regression. Results from the first stage are shown at the bottom. As expected, the coefficients on both measures of religion are negatively correlated with decentralization and are highly significant. This is true for decentralization in the level as well as in the interaction with the conflict of interest proxy. The Angrist-Pischke F-statistic indicates strong instruments in both first stages and the Kleibergen-Paap F-statistic shows that the instruments are overall not weak.

Specification (1) shows results for the normalized measure of product quality. Neither the level effect nor the interaction effect appear to be significantly different from zero. This is due to the normalization of perceived quality, which virtually forces the cross country variation of our measure to zero. Given that our instrumental strategy then can work through within-country variation only, the explanatory power of our variable of interest is largely reduced. Specification (2), where we use the non-normalized version of perceived quality, confirms this interpretation. Now the level effect is positive

[31] See *"The Protestant Ethic and the Spirit of Capitalism"*.

and highly significant, though the interaction is still insignificant.

The problem with using non-normalized quality as perceived by the firm is that our coefficient might pick up cultural differences in perception between countries rather than differences in actual quality. Country fixed effects would help here, but are not viable given that we use regional variation for identification. In specification (3) we add regional controls to account for at least some of the unobserved heterogeneity across countries and regions. Following Bloom et al. (2012) we control for GDP per capita, population and an index of the rule of law.[32]

In principal, we could include all three measures at the regional level. Unfortunately, too much controls at the regional level restrict the amount of variation left for identification. Consequentially, our instruments are rendered weak when we include all three measures at the regional level. We therefore tried to use either the Eurostat variables or the governance index at the regional (NUTS-2) level and included the remaining control(s) at the country level. When both variants turned out to deliver similar results, we decided to stick with quality of governance at the regional level. Assuming that rule of law is potentially easier to causally connect to the organization of firms, we preferred to rule out the alternative channel that firms are more decentralized and produce higher quality because contracts are better enforceable. As column (3) shows, adding regional controls reduces the size of the coefficient on decentralization slightly but in turn renders the interaction significant at the 10% level.

Though our regional controls might pick up some of the cultural differences between countries it is clear that none of the controls is predestined for that task. We therefore transformed the normalized measure of perceived quality into a dummy that indicates whether the perceived product quality of a firm is above the country mean in specification (4) and (5). The advantage of this transformation is that it amplifies the response of the dependent variable with respect to a given regional variation in instrumented decentralization. As Table III.4 shows, both coefficients are now highly significant and have the expected signs. Again, including regional controls slightly diminishes the

[32]GDP per capita and population are taken from Eurostat while we take the European Quality of Governance Index (EQI) from 2010 as our measure of the rule of law. See Charron et al. (2014).

coefficients but does not alter the general finding.

In specifications (6) to (9), we show results for product and process innovations with and without country controls respectively. The expected results are valid for both types of innovation. The coefficients are very similar for product and process innovations but smaller than for product quality. Still, the size of the coefficients increases a lot when compared to the ordinary least squares estimates, indicating that our previous results might have been attenuated by measurement error in the explanatory variable.

To provide an idea about the magnitude of the coefficients, we calculate the effect of decentralization on quality and innovation if our results were to be interpreted literally. This exercise is to be taken with caution because we have included an interaction term and the estimated effects depend a lot on the point of evaluation. Using specification (5) and evaluating the effect at the average number of family members (13.7%) for firms where the CEO is not a family member, decentralized management increases the probability of producing quality above the country mean by 70.1 percentage points.

III.4.2.3 Robustness

In Tables B.7 and B.8 of the appendix, we test the robustness of our results for quality and production innovation respectively. We evaluate the robustness of our estimates with respect to different instrumentation, industry fix effects and clustering of standard errors. The point of departure is specification (5) of Table III.4 for quality and specification (7) for product innovations. As the results are similar for both dependent variables, the following discussion applies to both dependent variables.

In specifications (2) to (6) in both tables, we try different combinations of instruments. Specification (2) replaces religious faith by trust. The results remain qualitatively similar but now the first stage results indicate that our instruments are slightly weak, predominantly due to the interaction. Using the three instruments jointly in specification (3) improves the strength again and allows us to test overidentifying restrictions. The Hansen J-statistic implies that all three instruments are exogenous, given that at least two of them are valid instruments.

In specification (4) we try to instrument the interaction $dec_i \times coi_i$ with

Table III.3: Decentralization, Quality and Innovation

dependent variable:	***product quality (normal.)***			***product innovation***			***process innovation***		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
decentralized	0.0734**	0.0662**	0.0639*	0.0939***	0.0878***	0.0836***	0.0942***	0.0693***	0.0658***
	(0.0316)	(0.0323)	(0.0334)	(0.0157)	(0.0160)	(0.0166)	(0.0161)	(0.0163)	(0.0169)
decentralized $\times$ *share of family board members*	-0.0831	-0.0757	-0.0677	-0.0774***	-0.0633**	-0.0506*	-0.00822	0.00674	0.0186
	(0.0594)	(0.0599)	(0.0625)	(0.0294)	(0.0297)	(0.0305)	(0.0301)	(0.0300)	(0.0308)
share of family board members	0.0477	0.0433	0.0368	0.0222	0.00707	0.00839	0.0271*	-0.00321	-0.00666
	(0.0333)	(0.0359)	(0.0369)	(0.0162)	(0.0171)	(0.0176)	(0.0162)	(0.0171)	(0.0176)
family CEO	0.0313	0.0305	0.0255	0.0404***	0.0431***	0.0423***	0.0162	0.0218*	0.0257*
	(0.0262)	(0.0270)	(0.0278)	(0.0126)	(0.0129)	(0.0134)	(0.0129)	(0.0131)	(0.0135)
young	-0.0484	-0.0451	-0.0418	-0.00464	-0.00691	-0.0136	0.0173	0.0185	0.0221
	(0.0449)	(0.0455)	(0.0470)	(0.0215)	(0.0215)	(0.0222)	(0.0218)	(0.0218)	(0.0225)
share of high- and med. skilled emp.	0.0548	0.0602*	0.0729*	0.0229	0.0418**	0.0456**	-0.0571***	-0.0119	-0.00794
	(0.0349)	(0.0361)	(0.0376)	(0.0177)	(0.0185)	(0.0191)	(0.0178)	(0.0185)	(0.0190)
ln(employment)	0.0394***	0.0403***	0.0384***	0.0698***	0.0664***	0.0677***	0.0632***	0.0664***	0.0664***
	(0.0104)	(0.0107)	(0.0112)	(0.00522)	(0.00531)	(0.00553)	(0.00540)	(0.00544)	(0.00568)
ln(labor productivity)	-0.00444	-0.00387	-0.00106	0.00947	0.00413	0.00571	0.0138**	0.0122**	0.0129**
	(0.0115)	(0.0119)	(0.0125)	(0.00582)	(0.00612)	(0.00641)	(0.00576)	(0.00598)	(0.00623)
industry f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
region f.e.	*no*	*yes*	*no*	*no*	*yes*	*no*	*no*	*yes*	*no*
industry $\times$ *region f.e.*	*no*	*no*	*yes*	*no*	*no*	*yes*	*no*	*no*	*yes*
observations	9,013	9,013	9,013	9,013	9,013	9,013	9,013	9,013	9,013
adjusted R^2	0.004	0.003	0.003	0.064	0.067	0.067	0.028	0.042	0.043

See Table B.1 in the Appendix for a description of the variables. All regressions include different sets of fixed effects: we employ a set of 10 industry f.e. from EFIGE, 54 *region f.e.* and 543 *industry* $\times$ *region f.e.*. Heteroscedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table III.4: Decentralization, Quality and Innovation - IV

dependent variable:	***product quality***			***product quality (normal.)***		***product***		***process***	
	(normal.)	***(not normal.)***		***above country mean***		***innovation***		***innovation***	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
decentralized	-0.0421	96.72***	71.71***	1.451***	1.220***	0.379*	0.647***	0.335	0.679***
	(0.436)	(17.52)	(11.55)	(0.449)	(0.303)	(0.228)	(0.205)	(0.231)	(0.208)
decentralized × share of family board members	-0.417	-44.02	-51.15*	-5.568***	-3.791***	-1.379***	-1.472***	-1.313**	-1.231**
	(0.935)	(36.66)	(27.08)	(1.042)	(0.745)	(0.517)	(0.501)	(0.517)	(0.498)
share of family board members	0.0872	16.70*	16.17***	1.294***	0.900***	0.299**	0.340***	0.295**	0.305***
	(0.216)	(8.528)	(6.184)	(0.234)	(0.167)	(0.118)	(0.114)	(0.119)	(0.113)
family CEO	0.00272	11.28***	7.876***	0.00331	0.0449	0.0198	0.0493**	-0.00649	0.0453*
	(0.0431)	(1.724)	(1.255)	(0.0472)	(0.0347)	(0.0234)	(0.0230)	(0.0239)	(0.0232)
young	-0.0354	-0.735	-0.515	0.0395	0.0166	0.0126	0.0125	0.0264	0.0242
	(0.0496)	(2.017)	(1.494)	(0.0542)	(0.0404)	(0.0263)	(0.0268)	(0.0267)	(0.0267)
share of high- and med. skilled emp.	0.0400	1.255	0.589	-0.0238	0.00112	0.0199	0.0239	-0.0596***	-0.0438**
	(0.0383)	(1.490)	(1.120)	(0.0449)	(0.0336)	(0.0219)	(0.0224)	(0.0221)	(0.0219)
ln(employment)	0.0469**	-3.143***	-1.972***	0.0170	0.0117	0.0658***	0.0547***	0.0628***	0.0477***
	(0.0189)	(0.767)	(0.545)	(0.0192)	(0.0141)	(0.00978)	(0.00954)	(0.00991)	(0.00963)
ln(labor productivity)	0.00388	-2.314***	-1.672***	-0.00799	0.00132	0.000196	-0.00726	0.00710	0.00496
	(0.0143)	(0.615)	(0.457)	(0.0160)	(0.0120)	(0.00841)	(0.00850)	(0.00831)	(0.00842)
industry f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
regional controls	*no*	*no*	*yes*	*no*	*yes*	*no*	*yes*	*no*	*yes*
observations	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780	7,780

first stage results:	***without country controls***		***with country controls***	
	decentralized	*interaction*	*decentralized*	*interaction*
IV1: hierarchical religion	-0.136***	-0.015	-0.184***	-0.031***
IV2: religious faith	-0.163***	-0.181***	-0.198***	-0.232***
A-P F-Stat	25.98	22.23	33.06	23.12
Kleibergen-Paap F-Stat (joint)	18.089	18.089	17.07	17.07

All regressions are second stage results of IV estimations where we use 2 instruments for *decentralized* and *decentralized×share of family board members:* (1) the share of people with a hierarchical religion and (2) the share of people who value religious faith. See Table B.1 in the Appendix for a description of the variables. All regressions include a set of 10 industry f.e. from EFIGE, some regressions include regional control variables. Heteroscedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

$IV_{dec} \times coi_i$. Remember that we used two instruments for decentralization in order to instrument for both, decentralization and the interaction with the share of family members among executives. Often researchers would interact the exogenous part of the interaction (family members) with the instrument for the endogenous part in order to obtain an instrument for the interaction. But as the results in Tables B.7 and B.8 show, applying this to religious faith renders our instruments weak and the coefficients of interest insignificant.

We therefore add the other instruments in specification (5) and do now obtain satisfying F-statistics and significant coefficients with the right sign. However, the Hansen overidentification test indicates a strong endogeneity problem with this set of instruments. Fortunately, the number of instruments allows us to run statistical tests on subsets of instruments. Doing this indicates that the instrument causing problems is precisely the interaction with the share of family members.

In specification (6) we go one final step further and add the share of family members to the list of endogenous regressors. An additional instrument is obtained by interacting our main instruments, religious faith and hierarchical religion. The results persist in terms of significant coefficients although the instrumentation becomes weak.

Overall, our results are relatively robust with respect to different instrumental approaches. The standard approach for the instrumentation of interactions is problematic in our case, as both components appear to be endogenous. The size of the coefficients varies for different specifications but the qualitative predictions are always met.

Finally, in specifications (7) to (9) we include industry dummies at a finer level of detail, exchange covariates and see whether two-way clustering at the region-industry level has any effect on our results. As it seems, neither of these changes has a big impact on the measured effects, neither in size nor in significance.

III.5 Conclusion

In this study we analyze how firm organization affects the international competitiveness of firms with representative data on 15,000 European manufacturing plants. We motivate our empirical analyses with a stylized model where firms can source inputs internationally to lower their costs and decentralize decision making to foster ideas and produce higher quality products. In order to identify the effects of offshoring, we exploit variation in foreign input wages and input skill intensity to instrument for offshoring at the firm level. We identify the effects of decentralized management by instrumenting the decentralization choice with regional variation in religious beliefs and trust. We find that the average offshoring firm obtains a world market share that is about three times larger than the average market share of non-offshoring firms. Furthermore, we find that decentralized management increases the probability of producing quality above the country mean by 70.1 percentage points in firms where the CEO is not a family member. However, this effect becomes smaller as firms are managed by a larger fraction of managers with family ties.

CHAPTER IV

Executive Compensation and the Global Division of Labor - Evidence from Matched Manager-Firm Data

IV.1 Introduction

The compensation of managers is a controversial and complex subject. The fast growth of executive compensation between 1970 and 2000 has triggered intense debates about the nature of the pay-setting process and its outcomes for society.[1] Although the explosion of earnings slowed down in the U.S. after the end of the twentieth century,[2] the high level of inequality between executive earnings and average wage bills remains an arguable topic. At the same time, the shape of compensation contracts and the nature of incentives remain opaque from a public perspective.

One cause of the rise in executive compensation that has been discussed

[1]See Frydman and Jenter (2010) for a survey on executive compensation in the U.S.

[2]Kaplan (2013) shows that the average level of CEO compensation in U.S. public companies was approximately at the same level in the year 2010 as it was during the end of the 1990s. He argues that real compensation in other occupations such as top lawyers or sport stars has been growing much faster since 2000. This statement is also supported by the BoardEx compensation data used in this chapter: while real executive compensation has been increasing in Europe, executive compensation remained rather flat in the U.S. between 1998 and 2012 (see Figure IV.3 for the development of executive compensation in the U.S., the U.K. and continental Europe).

in the literature is globalization. A number of theoretical papers illustrate the relationship between international trade and executive pay and show that globalization induces "superstar" effects shifting gains from trade disproportionately towards top earners (e.g. Wu (2011), Monte (2011), Manasse and Turrini (2001), Marin and Verdier (2012b), Gersbach and Schmutzler (2014)). Furthermore, Cuñat and Guadalupe (2009) provide empirical evidence that increases in the global integration of goods markets affect the compensation of managers through tougher import competition.

An important similarity of these papers is their focus on the superstar effects of final goods trade.[3] However, the nature of international trade has been changing vastly during the last two decades. While international trade was traditionally based on the exchange of final goods, the key feature of modern world trade is trade in intermediate inputs (see Figure IV.2 and for example Hummels et al. (2001) and Hanson et al. (2005)). Improvements in information technologies, better infrastructure and the growth of emerging economies like Eastern Europe, India and China have contributed to the fractionation of value chains across the world economy. This rise of "trade in tasks" has triggered changes in labor markets of industrialized countries and modern production is characterized by international teams, both within and across firm boundaries (e.g. Antràs et al. (2006)).

How does executive compensation interact with the global integration of production and the rapid growth of intermediate goods trade? The goal of this chapter is to provide evidence on changes in executive compensation following shifts in the international division of labor.[4]

To address this question, I employ matched manager-firm data, covering executive boards in public companies that are listed among one of the major stock indices in the U.S. and Europe. I link the compensation of executives to their exposure to intermediate goods trade using information at the firm specific industry level. In order to isolate changes in task trade that are exogenous to executive compensation and uncorrelated with potential omitted variables, I follow Hummels et al. (2014) and Autor et al. (2013a) and exploit variation

[3]One exception is Marin et al. (2015) who study the responses of relative wages to trade in production and managerial tasks.

[4]I will apply the terms *international division of labor*, *trade in tasks*, *offshoring* and *intermediate goods trade* interchangeably in the remainder of the chapter.

in the global export supply of inputs in the rest of the world to instrument for the offshoring intensity.[5] Variation in the world supply of inputs captures changes in the comparative advantages of sourcing countries that might arise from changes in production prices, production variety or product quality. The world export supply of inputs is a persuasive source of variation as it differs across inputs, countries and time. Furthermore, it is arguably exogenous to executive compensation. As the matched manager-firm data contain information on executive payments and firm level performance, I can directly estimate how performance sensitivity and wage inequality react to changes in offshoring.

I find that managers face stronger monetary incentives when their companies are more exposed to trade in tasks. Executive compensation becomes more elastic with respect to firm performance when a larger fraction of intermediates is imported. This result is valid for short term indicators of firm performance such as annual earnings but also robust to stock market responses, capturing expected future cash flows.

As changes in the incentive structure of compensation due to trade in tasks might not be exclusively specific for managers, I proceed by analyzing how task trade has contributed to wage inequality between executives and the workforce in a firm. The estimates reveal that the effects of trade in tasks on the incentive provision have contributed to more wage inequality between executives and the workforce within firms.

The remainder of the chapter is organized as follows. Section IV.2 surveys the literature and discusses theoretical channels that link offshoring to the compensation of managers. Section IV.3 presents the data, discusses the empirical modeling strategy and presents the results. Section IV.4 concludes.

IV.2 Background and Related Literature

Trade in tasks is likely to affect executive compensation in various ways. First, the rise in offshoring alters the demand for different tasks and can therefore affect the *level* of executive compensation and *relative wages* between managers

[5]The world export supply is the total supply of an input from origin countries to the world market net of the supply to and from the importing country under consideration.

and workers. Second, the rise in offshoring has changed the nature of hierarchies in firms, as teams can form across countries. This development creates new *matching* opportunities for workers in industrialized countries and thus affects patterns of specialization. Changes in the hierarchical organization of firms are then also likely to affect executive compensation and relative wages. Third, *agency problems* in firms could change if production occurs across national borders. Consequently, this can affect the role of *incentives* in managerial compensation contracts. In this section, I discuss the implications of these three channels on managerial compensation and relate them to the literature.

IV.2.1 Shifts in the Skill Demand

The geographic separation of production has altered the demand for different tasks at different geographical production locations. From a theoretical perspective the direction of wage movements is ambiguous and likely depends on the type of labor that is offshored and the onshore composition of tasks and skills. For instance, Grossman and Rossi-Hansberg (2008) propose a theory of global production and investigate how falling offshoring costs affect factor prices. They show that offshoring labor induces three different effects leading to ambiguous overall effects on wages. First, falling offshoring costs increase firm productivity, working to the benefit of workers. Second, an ambiguous relative price effect occurs when offshoring alters the terms of trade. Third, offshoring of labor increases labor supply in the importing countries. If jobs of the least educated workers are also the most offshorable ones, one might expect a widening of the wage gap between managers and production workers.[6]

Feenstra and Hanson (1999) estimate the influence of trade in tasks and technological advancements on the wage gap between high and low skilled U.S. workers between 1979 and 1990. They argue that offshoring explains about 40 percent of the increase in relative wages during that period resulting in real wage losses for low skilled workers. Becker et al. (2013) analyze the relation between offshoring and the onshore composition of tasks and skills in German multinationals. They find that offshoring shifts the wage bill towards

[6] To the extent that offshoring is associated with reductions in consumer prices, less skilled workers may still benefit from increases in real wages.

the more non-routine and more interactive tasks benefiting highly educated workers. Along this line of argument, Hummels et al. (2014) and Baumgarten et al. (2013) investigate the relationship between offshoring and wages for different skills and occupational tasks at the individual level.[7] Both argue that the wage effects of offshoring vary across task characteristics. Hummels et al. (2014) find that offshoring has the largest positive effect on tasks that require communication and language, followed by social sciences and maths. Notably, all these skills are categorical for managerial tasks. Overall, shifts in the skill demand due to offshoring are likely to have an impact on earnings differentials between top managers and workers within firms, an hypothesis that can be tested with the data at the manager-firm level.

IV.2.2 Hierarchies and the Matching of Workers

The rising globalization of goods production has also contributed to changes in the nature of firms. The geographical separation of production promotes the formation of cross-country teams. Antràs et al. (2006) propose a hierarchical assignment theory based on Garicano (2000), where heterogeneous workers form hierarchical teams across borders. While the less skilled agents specialize in production activities, the more skilled agents focus on problem solving, i.e. management. They model offshoring as the opportunity of agents in industrialized countries to match with agents from other countries that differ in skill endowments. The availability of more matching opportunities due to globalization implies that offshoring leads to higher wage inequality in the domestic country if the sourcing partner country specializes on the relatively unskilled tasks or if communication costs are low. Antràs et al. (2008) use this model to illustrate that offshoring firms may introduce layers of middle managers in host countries to foster the transmission of knowledge across countries and to shield the top management in the home country. In that spirit, Gumpert (2014) argues that falling communication costs increase the leverage of managerial knowledge leading to a larger wage premium on knowledge in multinational headquarters.

[7]Hummels et al. (2014) use data covering the universe of workers in Danish private sector firms, Baumgarten et al. (2013) employ representative German individual data from the Socio-Economic Panel.

IV.2.3 Agency Problems

Trade in tasks is likely to affect agency problems within firms through a number of different channels. First, task trade can affect the effectiveness of managerial effort. If offshoring implies that managerial decisions are scaled up, yielding improvements of managerial effectiveness, it is rational for principals to provide more incentives to managers in order to raise managerial effort. Second, trade in tasks can also affect the uncertainty of managerial performance. On the one hand, the opportunity to import inputs from foreign sources could reduce the uncertainty of firm performances if trade in tasks can be used to hedge against risks regarding the supply or quality of intermediates. On the other hand, global sourcing can increase the uncertainty about managerial performances if production processes become more complex. If shareholders observe managerial effort with more noise due to more uncertainty, compensation is likely to react less sensitive to the noisy performance signal. In the Appendix C.1, I illustrate these effects in a textbook principal-agent framework with linear contracts, normally distributed performance signals and exponential utility.

An alternative channel through which offshoring influences incentive provisions is product market competition. Data from input-output tables suggest that a large fraction of inputs is within the same industry as the output good which implies that the imported intermediates naturally compete with domestic goods.[8] Furthermore, increases in the availability of cheap inputs raise the productivity of downstream firms and thus also leads to tougher competition between domestic producers. Theoretical papers by Schmidt (1997) and Raith (2003) analyze the role of competition on managerial incentives. Raith (2003) studies competition effects on incentive contracts in an equilibrium model with free firm entry and exit. Tougher competition increases the role of production costs which induces principals to provide stronger incentives that make agents work harder. Schmidt (1997) considers the implicit effects of competition on the behavior of managers. On the one hand, competition might make managerial effort more valuable from the principal's perspective leading to steeper incentive compensation. On the other hand, when

[8] A fact that explains the large correlation coefficient of 0.7 between task trade and the degree of downstream import competition in the manager-firm sample.

managers themselves fear tougher competition due to a greater threat of job loss, this might implicitly incentivize them to work harder inducing principals to offer flatter payment schemes.

Cuñat and Guadalupe (2005) and Cuñat and Guadalupe (2009) investigate the effects of tougher import competition on managerial incentive provisions from an empirical perspective. They find that increases in import competition within the same output industry contribute to steeper compensation contracts for managers. Their estimation results indicate that controlling for the degree of downstream import competition might be important if one wants to isolate the relationship between executive compensation and a larger supply of upstream inputs.

IV.3 Empirical Analysis

IV.3.1 Data Sources

Compensation and Firm Level Information

The results in this chapter are based on the BoardEx database that contains information on executive compensation. BoardEx is a business intelligence service company that collects remuneration details on business leaders across the world. The employed sample covers top executives in public companies listed in one of the major stock indices in the U.S., U.K. or continental Europe but the coverage of BoardEx also includes managers from other American or Asian countries. The sample almost compiles the full population of executive board members of index quoted companies in the U.S. and the U.K.[9] Table C.3 in the Data Appendix lists the covered stock market indices and Table C.4 lists the covered countries in the sample. The sample spans the period from 1998 to 2012. The compensation data is split into direct compensation, including fixed and variable components, and equity-linked compensation.

Since the original data are mostly formatted for business client applications, the following steps were taken in preparation to make the data usable

[9] As BoardEx collects these data sequentially and updates them on a rolling basis, there is some selection bias as there is less information on compensation during the most current and the first sample years. The regressions account for this by controlling for individual manager fix effects.

in an empirical study.[10] First, since the focus of the chapter is on executives in Europe and the United States, all observations from supervisory directors and other countries were excluded from the sample. Second, compensation data from individual managers that simultaneously held several positions within a firm in a given year were aggregated. Third, information from quarterly announcements was excluded when annual reports were available to avoid double entries. In a further step, reporting periods were converted from accounting periods that vary across firms to consistent calendar years. A final step involved currency conversion and deflation to real U.S. Dollars with the base period in January 2000.

The managerial remuneration data are matched with firm level information from the Thomson Worldscope database. Worldscope provides detailed financial statement and profile data on public companies. It includes public companies domiciled outside of the United States and also contains a complete coverage of U.S. companies that are filing with the Securities Exchange Commission (with the exception of closed end investment companies). The total universe of covered companies represents approximately 95% of global market capitalization. Since BoardEx covers managers in quoted companies across the world, Worldscope allows to match firm information to most of the managers in the sample. I use information on assets, earnings, market capitalization, employment, the wage bill and industry information at the 4-digit SIC level with up to 8 industries per firm.

Measuring Trade Exposure

The trade data in this study stem from the World Input Output Database (WIOD). WIOD tracks the flow of intermediate and final products across countries and industries.[11] Specifically, I make use of the international supply and use tables that provide trade information for each individual country and 35 NACE industries. The tables are available on an annual basis between 1995 and 2011.[12] The 35 industries span all types of economic activity including agriculture, mining, construction, utilities, manufacturing industries and ser-

[10] I am indebted to Thomas Neuber who provided great assistance in the preparation of the compensation data.

[11] The data is available at http://www.wiod.org

[12] See Timmer (2012) for a detailed description of the data.

vice industries. Furthermore, WIOD provides information of the gross output and final goods consumption as well as socio-economic accounts that contain information on value added and employment at the industry-country level.

Measuring the exposure of an individual manager i to trade in tasks in a given year t is a crucial step for identification. The constructed measure of trade in tasks takes into account that a firm may operate in various industries. It is a firm specific average across all the industries of a firm's business segments. To obtain the offshoring indicator for an individual output industry s, I define the industry level task trade exposure as the share of imported intermediates relative to the total intermediate consumption in the firm's home country c during year t and take its deviation with respect to the country-industry mean between 1998 and 2011 $\emptyset_{sc}^{tt}$. This variable measures variation in the exposure to trade in tasks at the output industry level. Taking deviations from the country-industry mean instead of using the levels helps to ensure that the estimated task trade coefficients do not capture other unobserved differences at the country-industry level.[13]

Since firms operate in different output industries, I match the 4-digit SIC industries of each firm to the 2-digit NACE output industries as they are used in WIOD. These industries are then weighted at the firm level according to the firm's individual exposure measured by the composition of its business activities (the fraction of sales that each business segment contributes to the total sales of the firm λ_{fs}).[14] Since these industry weights might change endogenously over time due to production decisions, I obtain fix industry weights based on the pre sample year 1997. One potential concern of these time invariant industry weights is that they might introduce measurement error when the production activities of a firm considerably change during the sample period.

[13]The included manager fix effects in the estimations absorb differences of the task trade level. This approach is similar to industry trade exposure measured by Cuñat and Guadalupe (2009).

[14]Business segments in Worldscope do not correspond perfectly to the mentioned SIC industry codes of each firm since some distinct segments might operate within identical SIC industries. In order to use the sales from business segments to weight industries, business segments with identical SIC codes had to be consolidated first.

To summarize, the proxy for trade in tasks is computed as follows:

$$task\ trade_{sct} = \sum_s \lambda_{fs} \left[\frac{imported\ inputs_{sct}}{total\ inputs_{sct}} - \emptyset^{tt}_{sc} \right],\ \sum_s \lambda_{fs} = 1.$$

One further potential concern with the trade in tasks measure arises from the fact that task trade is strongly correlated with import competition at the output industry level. As input-output tables suggest, a large fraction of inputs typically stems from the same downstream industry which implies a high correlation between both measures.

Previous literature has identified a causal impact of import competition on wages (Autor et al. (2013b)) and in particular on executive compensation (Cuñat and Guadalupe (2005, 2009)). Therefore, it is appealing to be able to isolate the effects of task trade that appear beyond a pure increase in competition. I disentangle the effects of trade in tasks from pure competition effects by controlling for the degree of import penetration within downstream industries s in some empirical specifications. My measure of a firm's exposure to import competition is the import penetration at the country-industry-year level. Import penetration is calculated as total imports relative to the sum of domestic output and total imports, where total imports is the sum of imported intermediates and imported final goods. Equivalently to the trade in tasks variable, I take deviations from the country-industry means of import penetration between 1998 and 2011 $\emptyset^{ip}_{sc}$ and weight industries according to the firm weights λ_{fs}:

$$imp\ pen_{sct} = \sum_s \lambda_{fs} \left[\frac{imports_{sct}}{gross\ output_{sct} + imports_{sct}} - \emptyset^{ip}_{sc} \right].$$

IV.3.2 Empirical Modeling Strategy

The empirical models analyze how executive compensation adjusts to changes in the extent of task trade. The first set of specifications investigates adjustments in the payment structure of executive compensation with regard to the strength of performance related payments. In the second set of specifications, I estimate how wage inequality between managers and workers within a firm changes due to trade in tasks.

Trade in Tasks and Payment Structures

The basic empirical model evaluates the effect of offshoring on the compensation structure of a manager i in firm f within sectors s in country c at year t. I run regressions of the following form:

$$w_{ifsct} = \beta_0 + \beta_1\, task\, trade_{sct} + \beta_2\, task\, trade_{sct} \times perf_{ft} + \delta' F_{ifsct} + u_{ifsct}. \quad \text{(IV.1)}$$

This empirical model estimates the effects of offshoring on the level and the steepness of compensation contracts, where β_1 captures the level effect of task trade on executive compensation and β_2 measures the influence on the performance elasticity of compensation. The dependent variable executive compensation w_{ifsct} is measured as the natural logarithm of the total annual compensation in real 1000 U.S. Dollars, where the base period is January 2000.

The variable $task\, trade_{sct}$ is the exposure of a firm to imported intermediates as discussed in subsection IV.3.1. I proxy the firm performance in a given year $perf_{ft}$ with the natural logarithm of earnings before interest and tax payments (EBIT) or alternatively the natural logarithm of the market value of the outstanding shares.

The vector F_{ifsct} includes a set of fix effects and control variables. All estimations include individual manager fix effects η_i. These manager fix effects control for unobservable and time invariant factors such as the ability or individual management style.[15] Furthermore, the individual effects capture time invariant characteristics at the firm, industry and country levels where the manager is employed.[16] Additionally, all estimations include year fix effects interacted with fix effects of the region where the firm is located. Regions are the United States, the United Kingdom and continental Europe. The purpose of these region-year fix effects is to control for unobservable shocks at the macroeconomic level that are correlated with executive compensation and

[15] See Bertrand and Schoar (2003) who identify manager fix effects from executive turnovers as a measure of management style.

[16] One potential concern could arise if there is a large turnover rate of managers between firms in the data such that the individual fix effects capture mere *averages* of firm, country and industry characteristics where the managers are working in. However, the turnover rate of managers in the data is rather small as only about 9% of the managers in the sample are switching jobs between occupations. Alternatively, to evaluate the robustness of the estimation results, I also estimate specifications that include firm fix effects instead of individual fix effects. The results are qualitatively similar.

trade in tasks. Consequently, the exploited source of variation is across time within the managers in a firm after netting out differences in the average level of task trade and executive compensation at the region-year level. Moreover, the vector F_{ifsct} contains the natural logarithm of value added and employment at the country-industry level (industries are again weighted according to the firm weights λ_{fs}). At the firm level, the vector F_{ifsct} includes the respective firm performance variable $perf_{ft}$ (natural logarithm of EBIT or market capitalization) and the natural logarithm of total assets to control for firm size.

Trade in Tasks and Wage Inequality between Workers and Managers

The estimated effects of trade in tasks in model (IV.1) could hold for any set of occupations in a firm. In order to investigate whether the effects on the compensation structure are distinct for managers, I estimate the same specifications as in (IV.1) but instead use the relative wage between a manager and the average salary per worker as the dependent variable. The basic empirical model for the wage inequality between an executive i and the average salaries and benefits paid at the firm f within sector s in country c at year t is:

$$g_{ifsct} = \gamma_0 + \gamma_1\, task\, trade_{sct} + \gamma_2\, task\, trade_{sct} \times perf_{ft} + \theta' F_{ifsct} + v_{ifsct}. \quad \text{(IV.2)}$$

The aim of this empirical specification is to measure if increases in task trade drive a wedge between the earnings of managers and workers in a firm and if this depends on the level of firm performance. The coefficient γ_1 captures the level effect of task trade on earnings inequality and γ_2 measures how trade in tasks changes the relationship between firm performance and earnings inequality. The employed dependent variable g_{ifsct} is the aggregate compensation of an executive i relative to the average salary and benefit payments per employee in a firm f at year t. Since the distribution of this relative wage measure is highly skewed, I use the relative wage in natural logarithms. Again, the vector F_{ifsct} includes the controls which resemble those in model (IV.1). All models control for individual and region-year fix effects. Furthermore, I control for total assets and performance at the firm level and for value added and employment at the sector level.

Sources of Endogeneity and Discussion of the Instrument

The identification in the models (IV.1) and (IV.2) arises from variation in task trade over time. There is rich variation of trade in tasks and executive compensation in the panel and all empirical models control for various changes in firm and industry characteristics as well as unobserved heterogeneity from time invariant manager, sector and country characteristics. However, the use of variation is still subject to possible endogeneity issues.

One potential concern is reversed causality. Reversed causality arises if executive compensation contracts determine offshoring decisions in an industry. One could argue for example that changes in the level and structure of executive pay affect the incentives for managers to exploit differences in labor costs by importing more inputs from low wage countries. Reversed causality could also arise if increases in the performance sensitivity of executive payments could evoke adverse behavior of managers. For example, managers might try to segregate production chains in order to make their decisions and effort provision more opaque which increases agency problems inside firms and thus affects compensation (see for example Biais and Landier (2013) who endogenize the severeness of agency problems by technological choices of managers).

Endogeneity might also arise from unobservable demand or productivity shocks that affect the share of imported intermediates and labor market outcomes and are not captured by the control variables.

An additional source for biased estimates are measurement errors in the employed trade in tasks variable. One source for this measurement error could come from the firm specific weighting of industries. If the calculated industry weights do not mirror the economic exposure of firms to industries as firms might adjust their production activities over time, this will lead to an attenuation bias.

In order to address these concerns and establish a causal link between trade in tasks and executive compensation, I instrument $\textit{task trade}_{sct}$ with the world export supply of inputs $supply_{sct}$.[17] A valid instrument should be correlated with trade in tasks but conditionally uncorrelated with changes in firm productivity and executive compensation.

[17]This idea is based on Hummels et al. (2014) who also instrument offshoring with the world export supply of inputs.

The variable $supply_{sct}$ is the total value of intermediate goods that is produced in the world (excluding country c) and exported to other countries (again excluding country c) in a year t. These inputs are weighted according to input coefficients for each output industry s in the country c. I obtain fix input coefficients from the year 1995. Similar to the trade in tasks and import competition variables, I weight the output industries at the firm level according to the firm specific industry weights λ_{fs}.

The instrument captures developments of comparative advantages of the input producing countries, weighted according to the historical relevance of those inputs for the output industries of a firm where a given manager is employed. These shifts in input specific comparative advantages should only have an impact on the compensation of executives through the task trade channel which ensures that $supply_{sct}$ is a valid instrument.

IV.3.3 Results

Trade in Tasks and Payment Structures

I use the total sum of executive compensation that contains the sum of direct compensation (both, fix and variable) and equity-linked compensation in natural logs (in 1000 real January 2000 USD) as the preferred dependent variable and estimate how it adjusts to changes in firm performance and task trade. A typical executive contract specifies fix and variable parts of compensation. From the perspective of an econometrician it is difficult to directly disentangle the strength of incentives from the level of fix and variable payments. Even if detailed information on the individual payment components such as the base salary, bonus payments, equity payments, retirement savings etc. is available, they are spurious measures of incentives. For example, promotions are an instrument to incentivize executives and typically, promotions also imply the adaptation of the fix payments. On the other hand, a bonus payment or the disbursement of shares can be offered as a sign-in bonus without creating strong incentives for managers. [18]

To estimate the empirical model in equation (IV.1), I employ EBIT and mar-

[18] The robustness section also presents results with respect to equity-linked part of compensation.

ket capitalization as two alternative measures of firm performance.[19] EBIT is a useful proxy for firm performance as it measures *realized* firm profits in the current year and thus gives a direct impression on the short term performance of a manager. The correction for any interest or tax payments is helpful as those payments are rather exogenous from the perspective of managers and thus provide little information on managerial effort. Furthermore, since interest and tax payments can be deferred, they would introduce potential sources of endogeneity and add more noise on the performance measure.

Changes in market capitalization provide an alternative signal on changes in firm performance. As market capitalization is the expected present value of all *future* cash flows going to the shareholders, it proxies long term firm performance and thus also captures the value of managerial decisions that have been taken with respect to future profits (such as R&D and investment decisions that might only pay off at a later stage). One potential concern with market capitalization as performance measure arises if firms decide to do a share buy-back that is based on outside debt financing. This would reduce the firm's market capitalization and raise its leverage without any relation to performance.

Empirical studies on executive compensation have used both measures to evaluate the performance sensitivity of compensation and I will present results based on both proxies.[20] All specifications control for firm assets, value added and employment at the industry level, individual manager fix effects and region specific year fix effects.

I cluster the standard errors of the regressors at the firm level to allow for autocorrelation within firms throughout all specifications. As some managers in the sample transfer between firms, I cluster on the firm where a manager has been working for the longest time to ensure that managers are nested within clusters and do not move between clusters.

Table IV.1 presents ordinary least squares estimation results with the effects of trade in tasks on executive compensation in accordance with the empirical model (IV.1).

[19] EBIT are "earnings before interest and tax payments" and market capitalization is defined as the average stock price times the number of issued stocks.

[20] For example Bertrand and Mullainathan (2001) also use performance variables based on either accounting or stock market measures to estimate incentives in executive compensation contracts.

Generally, the results suggest that increases in task trade are associated with significantly higher executive compensation. An effect that arises because compensation becomes more sensitive to firm performance when the firm is more exposed to trade in tasks at the industry level. Columns (1) to (3) present results using EBIT to proxy for firm performance, columns (4) and (5) use market capitalization instead.

Column (1) provides a first impression of the association between compensation and trade in tasks. The coefficient for $perf$ suggests that the average elasticity of executive compensation with respect to EBIT is 0.058. Hence, an increase of EBIT from its mean by one standard deviation within managers (i.e. from 610.12 to 1800.09 real million USD) raises the total level of executive compensation by 6.5%. The coefficient estimate for the regressor *task trade* suggests that trade in tasks has a sizable effect on total executive pay: an increase of imported intermediates by 1 percentage point (relative to the total consumption of intermediates) raises compensation of executives by 0.8% on average.

In order to evaluate if trade in tasks raises executive compensation via rises in fix payments or through an increase in the performance sensitivity, I include the interaction term *task trade* × *perf* in the remaining columns (2) to (5). The coefficient is positive and sizably significant in all columns. In column (2), the estimated coefficient of 0.363 for β_2 suggests that the average rise of the exposure to trade in tasks between 1998 and 2011 has contributed to an increase of the average compensation elasticity with respect to EBIT of about 39% from 0.050 to 0.070.[21]

As it has already been discussed in the data description IV.3.1, *task trade* is strongly correlated with import competition since many inputs are within the same industry as the output good. The intention of column (3) is to separate competition effects from the estimated effects for trade in tasks. Cuñat and Guadalupe (2009) have shown that compensation becomes more elastic with respect to firm performance if firms face tougher competition at the industry level. In order to account for this effect, I include *import pen* and *import pen*× *perf* to control for downstream import penetration. The trade in tasks

[21]Calculation: the annual mean of the *task trade* variable increased from -0.019 in the year 1998 to 0.034 in the year 2011. This translates to an increase of the elasticity from 0.050 (= 0.0569 + 0.363 × (-0.019)) to 0.070 (= 0.0569 + 0.363 × 0.034), i.e. 39%.

regressors remain at a similar size and the competition regressors turn out to be insignificant. This result suggests that the effect of foreign competition on agency problems is relatively small once we control for intermediate good imports.

Columns (4) and (5) replicate the specifications from columns (2) and (3) but use market capitalization as the proxy for firm performance. The estimated coefficients yield qualitatively similar results. In column (4), the coefficient estimate of 0.204 for β_2 suggests that the average rise of the exposure to trade in tasks between 1998 and 2011 has contributed to an increase of the average compensation elasticity with respect to stock market capitalization of about 8% from 0.135 to 0.146.

To address endogeneity from omitted variables or reversed causality and to correct for attenuation bias from measurement errors, I estimate the effect of trade in tasks with two stage least squares, where I instrument *task trade* with the variable *supply*, the world export supply of intermediate goods. As *task trade* is the endogenous regressor in the empirical model, the interaction $supply \times perf$ is used as an instrument for the interaction term *task trade* $\times$ $perf$. Table IV.2 presents the estimation results of the first stage regressions. The first stage estimates show that input supply is strongly associated with a larger share of imported intermediates. As there are either one or two endogenous regressors, Table IV.2 reports the Angrist-Pischke version of first stage F-statistics[22] which are between 59.62 and 588.61 in all specifications and thus the null hypothesis of insignificant instruments can be rejected for any common significance level. Furthermore, the joint Kleibergen-Paap F-statistics between 104.20 and 588.61 reject the null hypothesis of weak identification for any common significance level.

The instrumental variable results from the second stage regressions are provided in Table IV.3. The specifications resemble those presented for the ordinary least squares estimations in Table IV.1. Columns (1) to (3) again present results using EBIT to proxy for firm performance and columns (4) and (5) use market capitalization instead. The two stage least squares estimation results are qualitatively similar to the ordinary least squares estimates. However, the

[22] Instead of testing whether the equation is identified as a whole, the Angrist-Pischke statistic tests the null hypothesis whether one of the endogenous regressors is under- or weakly identified (see Angrist and Pischke (2009)).

estimated coefficients for *task trade* and *task trade* $\times$ $perf$ tend to be larger in absolute terms compared to their ordinary least squares counterparts which could be due attenuation bias.

Column (1) estimates the direct effect of trade in tasks on the level of executive compensation. A one percentage point increase of the fraction of imported intermediates raises executive compensation by 1.34%. The estimated elasticity of compensation with respect to changes in EBIT is 0.058 and thus very close the coefficient estimate from ordinary least squares.

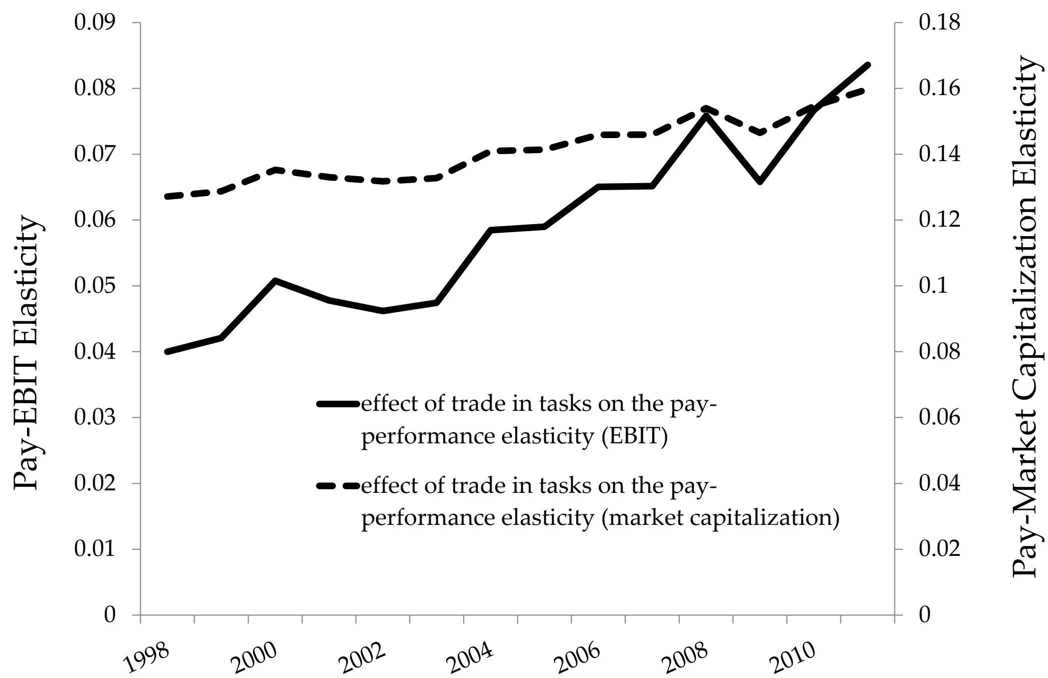
Column (2) estimates the influence of task trade on performance sensitivity. The coefficient estimate of the interaction *task trade* $\times$ *perf* suggests that a one percentage point raise in *task trade* increases the performance payment elasticity by 0.005. In column (3) I include *import pen* and *import pen*$\times$ *perf* to control for effects from tougher import competition. The affect of foreign competition on executive compensation appears to be insignificant but the coefficient for *task trade* $\times$ *perf* increases from 0.539 to 0.810.

Columns (4) and (5) again use market capitalization as performance measure. The estimates in column (4) suggest that a one percentage point increase in task trade increases the performance payment elasticity by 0.03. Similar to the specification with EBIT in column (3), this effect is enhanced when controlling for import competition in column (5).

Figure IV.1 provides an illustration how the growth of intermediate goods trade has shaped incentives in executive compensation over time. The graph plots the effects of trade in tasks on the development of the compensation elasticity to firm performance over the sample period. The graphs are based on annual sample averages of *task trade* and the estimated IV coefficients in columns (3) and (5) of Table IV.3 to calculate $\hat{\beta}_2 task\ trade + \hat{\delta}_{perf}$, where $\hat{\delta}_{perf}$ is the coefficient estimate for $ln\ perf$. The solid line plots the effect of trade in tasks on the elasticity of compensation to changes in EBIT. On average, the increase of intermediate imports between 1998 and 2011 has led to considerable increases in managerial incentives. While a 1% increase of EBIT raised executive compensation by 0.04% in 1998, the growth of task trade increased this effect by 109% to an 0.084% compensation increase in 2011. The dashed line plots the effect of trade in tasks on the elasticity of compensation to changes in market capitalization. While a 1% increase of market capitalization raised executive compensation by 0.13% in 1998, the growth of task trade increased

Figure IV.1: Trade in Tasks and Pay-Performance Elasticity

The graph illustrates the effects of the increase in intermediate goods trade on managerial incentive compensation over time. The calculation of the effects is based on the estimates of the coefficients for *task trade* $\times$ *ln perf* and *ln perf* from columns (3) and (5) in Table IV.3. The solid line plots the effect of trade in tasks on the evolution of the payment elasticity with respect to changes in EBIT. The dashed line plots the effect of trade in tasks on the evolution of the payment elasticity with respect to changes in market capitalization.



this effect by 26% to an 0.16% compensation increase in 2011.

Trade in Tasks and Wage Inequality between Workers and Managers

Table IV.4 presents the ordinary least squares estimates of model (IV.2). Table IV.5 presents first stage results and Table IV.6 the second stage estimations from two stages least squares. The number of observations is smaller compared to the estimation sample for the model (IV.1) as the dependent variable g_{ifsct} requires additional information on employment and the aggregate wage bill at the firm level. All specifications only differ in the dependent variable compared to those in model (IV.1). The measures of firm performance are either the natural logarithm of EBIT in columns (1) to (3) or the natural logarithm of market capitalization in columns (4) and (5). Again, all specifications control for firm size (assets), industry value added, industry employment, region-year fix effects and manager fix effects. Standard errors are clustered at the firm level to allow for autocorrelation of the error terms within firms.

Column (1) in Table IV.4 estimates the average effect of trade in tasks on the wage inequality between executives and the aggregate workforce. The coefficient for *task trade* is not significantly different from zero. The elasticity of manager-worker wage inequality with respect to EBIT is 0.0229 (the coefficient for $ln\ perf$) and is significant at the one percent significance level. This suggests that increases in EBIT also raise the wage inequality between managers and workers. Potentially, this results from performance payments for managers. The average salary at the firm level reacts less to changes in firm performance as executive compensation (the corresponding coefficient estimate for the compensation of executives in Table IV.1 was 0.0582).

Column (2) additionally includes the interaction term $task\ trade \times perf$. The interaction term reveals that trade in tasks affects the wage inequality between workers and managers via the performance channel. While the level effect is negative (-1.796) and significant at the 5% level, increases in task trade raise wage inequality for sufficiently high levels of EBIT (the coefficient for the interaction term is 0.419 and significant at the 1% level). This again suggests that performance related payments for executives are an important determinant of the wage inequality between executives and average firm wages. As the estimates of the executive payment structure in model (IV.1) already have

Table IV.1: Trade in Tasks and Executive Pay Structure

	dependent variable: ln total compensation				
performance measure:	*EBIT*			*market capitalization*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
task trade × *ln perf*		0.363***	0.350***	0.204**	0.233*
		(0.0997)	(0.129)	(0.0875)	(0.124)
task trade	0.822***	-1.020*	-0.885	-0.977	-0.860
	(0.316)	(0.572)	(0.735)	(0.610)	(0.884)
ln perf	0.0582***	0.0569***	0.0569***	0.139***	0.140***
	(0.00617)	(0.00620)	(0.00620)	(0.00851)	(0.00851)
ln assets	0.0827***	0.0839***	0.0839***	0.0398***	0.0399***
	(0.0148)	(0.0148)	(0.0148)	(0.0118)	(0.0118)
import pen			-0.208		-0.0934
			(0.748)		(0.893)
import pen× *ln perf*			0.0117		-0.0779
			(0.148)		(0.135)
industry controls	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes
observations	78,320	78,320	78,320	98,161	98,161
no. of managers	16,808	16,808	16,808	19,288	19,288
R^2	0.107	0.108	0.108	0.100	0.100

All columns report ordinary least square results from manager fix effects models. Columns *(1)* - *(3)* report results with *ln EBIT* as measure of firm performance while columns *(4)* - *(5)* report results with *ln market capitalization* as measure of firm performance. All specifications additionally include region-year fix effects. Industry controls include value added and employment. Standard errors are cluster robust. *** p<0.01, ** p<0.05, * p<0.1

Table IV.2: First Stage Results - Executive Pay Structure

first stage dependent variable:	*task trade*	*task trade*	*task trade × ln EBIT*	*task trade*	*task trade × ln EBIT*	*task trade*	*task trade × ln mrkt cap*	*task trade*	*task trade × ln mrkt cap*
	(1)	(2)		(3)		(4)		(5)	
supply	2.46e-07***	2.13e-07***	1.69e-07***	1.38e-07***	2.57e-07***	2.10e-07***	1.55e-07***	1.04e-07***	9.37e-08
	(1.02e-08)	(1.14e-08)	(4.82e-08)	(1.16e-08)	(5.23e-08)	(1.10e-08)	(5.80e-08)	(1.16e-08)	(6.67e-08)
supply × ln EBIT		6.29e-09***	2.08e-07***	5.38e-09***	1.28e-07***				
		(1.40e-09)	(1.01e-08)	(1.85e-09)	(1.31e-08)				
supply × ln mrkt cap						5.45e-09***	2.23e-07***	7.07e-09***	1.47e-07***
						(1.30e-09)	(1.10e-08)	(1.75e-09)	(1.50e-08)
ln EBIT	7.98e-05	-0.00125***	-0.0401***	-0.00114***	-0.0244***				
	(0.000172)	(0.000336)	(0.00226)	(0.000411)	(0.00278)				
ln mrkt cap						-0.000822**	-0.0417***	-0.00152***	-0.0289***
						(0.000370)	(0.00320)	(0.000414)	(0.00356)
ln assets	-0.000377	-0.000262	-0.00111	-0.000392	-0.00167	-0.000145	-0.000888	-0.000315	-0.00147
	(0.000374)	(0.000373)	(0.00187)	(0.000337)	(0.00176)	(0.000299)	(0.00208)	(0.000255)	(0.00173)
import pen				0.384***	-0.570***			0.414***	-0.515**
				(0.0530)	(0.162)			(0.0500)	(0.228)
import pen × ln EBIT				0.0115	0.564***				
				(0.0101)	(0.0502)				
import pen × ln mrkt cap								0.00561	0.541***
								(0.00756)	(0.0511)
industry controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes	yes	yes	yes	yes
observations	78,320	78,320	78,320	78,320	78,320	98,161	98,161	98,161	98,161
no. of managers	16,808	16,808	16,808	16,808	16,808	19,288	19,288	19,288	19,288
Kleibergen-Paap F-statistic	588.61	288.34		104.69		410.54		104.20	
Angrist-Pischke F-statistic	588.61	296.48	359.02	89.08	70.41	318.78	339.11	64.89	59.62

Table IV.3: Trade in Tasks and Executive Pay Structure - IV

	dependent variable: ln total compensation				
performance measure:	*EBIT*			*market capitalization*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
task trade × *ln perf*		0.539***	0.810**	0.316**	0.605*
		(0.177)	(0.374)	(0.149)	(0.354)
task trade	1.339*	-1.469	-2.589	-1.960*	-3.677
	(0.726)	(1.202)	(2.486)	(1.183)	(2.940)
ln perf	0.0579***	0.0560***	0.0557***	0.139***	0.139***
	(0.00619)	(0.00629)	(0.00636)	(0.00862)	(0.00859)
ln assets	0.0832***	0.0848***	0.0849***	0.0394***	0.0393***
	(0.0148)	(0.0148)	(0.0148)	(0.0118)	(0.0118)
import pen			1.069		1.722
			(1.577)		(1.920)
import pen× *ln perf*			-0.335		-0.336
			(0.280)		(0.261)
industry controls	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes
observations	78,320	78,320	78,320	98,161	98,161
no. of managers	16,808	16,808	16,808	19,288	19,288

All columns report instrumental variable results from manager fix effects models. Columns *(1)* - *(3)* report results with *ln EBIT* as measure of firm performance while columns *(4)* - *(5)* report results with *ln market capitalization* as measure of firm performance. All specifications additionally include region-year fix effects. Industry controls include value added and employment. Standard errors are cluster robust. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

revealed that trade in tasks increases the elasticity of executive compensation with respect to firm performance, this drives a wedge between the salaries of managers and workers since the latter are less compensated for performance at the firm level. Column (3) controls for changes in import penetration. The estimates for import competition are insignificant and the coefficients for *task trade* $\times$ *perf* and *task trade* remain at a similar level.

Column (4) and (5) use market capitalization to measure the performance of firms based on stock market responses. The estimation results suggest similar conclusions. The coefficient of *task trade* $\times$ *perf* is again positive and significant at the 5% level, while the level effect *task trade* remains negative at -1.916 and is also significant at the 5% level. Column (5) includes the control variables for import competition. The inclusion of import penetration turns the coefficients for *task trade* $\times$ *perf* and *task trade* toward zero and increases their standard errors such that both coefficient remain not significantly different from zero. Also the import penetration coefficients remain insignificant.

Tables IV.5 and IV.6 present the two stage least squares estimation results. As the specifications of the explanatory variables are similar to those in model (IV.1), the first stage estimations in Table IV.5 only differ in the smaller sample size. Table IV.6 presents the second stage estimation results. The average level effect of *task trade* in column (1) again turns out insignificant and the elasticity of wage inequality with respect to firm performance equals 0.0226 and is significant at the 1% level. The inclusion of the interaction term *task trade* $\times$ *perf* in column (2) indicates that trade in tasks increases wage inequality via the performance channel: the coefficient for the interaction term equals 0.901 and is significant at the 1% level while the level effect is -3.750 and is significant at the 5% level. This suggests that the increase in task trade over time had two implications for the wage inequality between workers and managers within firms. First, it reduced wage inequality as the average salaries tended to increase faster than the fix part of executive compensation (the coefficients for *task trade* in column (2) and (3) are smaller in Table IV.6 than in Table IV.3). Second, as trade in tasks makes executive compensation more elastic with respect to firm performance, wage inequality between managers and workers becomes larger. These results also remain valid if market capitalization is employed as performance measure in columns (4) and (5). While the interaction term *task trade* $\times$ *perf* is positive and significantly different from zero, the level effect of *task trade* is negative.

Robustness

I conduct two robustness exercises to evaluate the robustness of the presented evidence. The first robustness check replaces the compensation variable and uses information on equity-linked compensation as the alternative dependent variable. Since equity is the largest component of executive compensation and potentially the majority of it is paid to incentivize managers, I focus here solely on equity to estimate the effects of trade in tasks on incentives. The second robustness check employs firm fix effects instead of individual manager fix effects. Although individual fix effects control for any time invariant heterogeneity at the individual level such as ability, there is room for alternative interpretations of the regression estimates. For example, if the identification works within managers that switch jobs from smaller to larger firms (in terms of EBIT or market capitalization), the performance term $perf$ captures a wage premium that is paid for managers when they switch occupations towards larger firms. Such a wage premium from job turnovers also creates incentives for managers as these become more motivated to expend effort in order to be hired by larger firms. However, the estimated coefficients do not only capture the direct response of compensation due to performance improvements *within* firms but also the indirect incentives from movements of managers *between* firms. Furthermore, a positive interaction term *task trade* $\times$ $perf$ could be interpreted as a larger wage premium from job turnovers in more task trade intensive sectors. The application of firm fix effects isolates the former effect as identification works between managers *within* a firm across time. Table C.5 in the Appendix presents the robustness estimates.

Columns (1) to (4) present estimations with equity compensation as the dependent variable. The positive effect of trade in tasks on the performance elasticity of executive compensation remains valid. However, the coefficient estimates for the interaction term *task trade* $\times$ $perf$ tend to be larger for equity compensation compared to the effects on total executive compensation. This is consistent with the interpretation that task trade increases the monetary incentives that managers face.

Columns (5) to (12) show evidence from estimations with firm fix effects

Table IV.4: Trade in Tasks and Manager-Worker Wage Inequality

	dependent variable: ln (executive compensation / wage bill per employee)				
performance measure:	*EBIT*			*market capitalization*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
task trade × ln perf		0.419***	0.414***	0.284**	0.162
		(0.127)	(0.157)	(0.119)	(0.159)
task trade	0.248	-1.796**	-1.418*	-1.916**	-0.436
	(0.398)	(0.700)	(0.821)	(0.888)	(1.120)
ln perf	0.0229***	0.0209**	0.0211**	0.0508***	0.0520***
	(0.00875)	(0.00880)	(0.00880)	(0.0113)	(0.0113)
ln assets	0.0988***	0.0997***	0.0999***	0.0970***	0.0972***
	(0.0196)	(0.0196)	(0.0196)	(0.0170)	(0.0169)
import pen			-0.625		-1.814
			(0.839)		(1.164)
import pen× ln perf			-0.0202		0.104
			(0.183)		(0.175)
industry controls	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes
observations	54,037	54,037	54,037	68,324	68,324
no. of managers	12,609	12,609	12,609	14,737	14,737
R^2	0.075	0.076	0.076	0.062	0.063

All columns report ordinary least square results from manager fix effects models. Columns *(1)* - *(3)* report results with *ln EBIT* as measure of firm performance while columns *(4)* - *(5)* report results with *ln market capitalization* as measure of firm performance. All specifications additionally include region-year fix effects. Industry controls include value added and employment. Standard errors are cluster robust. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table IV.5: First Stage Results - Manager-Worker Wage Inequality

first stage dependent variable:	*task trade*	*task trade*	*task trade × ln EBIT*	*task trade*	*task trade × ln EBIT*	*task trade*	*task trade × ln mrkt cap*	*task trade*	*task trade × ln mrkt cap*
	(1)	(2)		(3)		(4)		(5)	
supply	2.08e-07***	1.72e-07***	1.40e-08	1.06e-07***	1.54e-07**	1.83e-07***	-2.86e-08	7.34e-08***	-7.27e-08
	(1.56e-08)	(1.57e-08)	(6.09e-08)	(1.51e-08)	(6.55e-08)	(1.40e-08)	(7.10e-08)	(1.42e-08)	(8.15e-08)
supply × ln EBIT		7.36e-09***	2.06e-07***	4.28e-09*	1.11e-07***				
		(1.92e-09)	(1.46e-08)	(2.45e-09)	(1.78e-08)				
supply × ln mrkt cap						4.67e-09**	2.14e-07***	6.29e-09***	1.35e-07***
						(1.82e-09)	(1.63e-08)	(2.30e-09)	(2.01e-08)
ln EBIT	0.000294	-0.00134***	-0.0395***	-0.000828	-0.0210***				
	(0.000237)	(0.000481)	(0.00334)	(0.000559)	(0.00384)				
ln mrkt cap						-0.000213	-0.0369***	-0.00126**	-0.0265***
						(0.000550)	(0.00495)	(0.000587)	(0.00514)
ln assets	-0.000831*	-0.000702	-0.00256	-0.000714*	-0.00246	-0.000522	-0.00304	-0.000457	-0.00143
	(0.000462)	(0.000463)	(0.00233)	(0.000415)	(0.00218)	(0.000393)	(0.00273)	(0.000329)	(0.00223)
import pen				0.380***	-0.500***			0.433***	-0.433
				(0.0578)	(0.175)			(0.0552)	(0.270)
import pen × ln EBIT				0.0178	0.593***				
				(0.0110)	(0.0563)				
import pen × ln mrkt cap								0.00527	0.550***
								(0.00866)	(0.0616)
industry controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes	yes	yes	yes	yes
observations	54,037	54,037	54,037	54,037	54,037	68,324	68,324	68,324	68,324
no. of managers	12,609	12,609	12,609	12,609	12,609	14,737	14,737	14,737	14,737
Kleibergen-Paap F-statistic	176.76	92.47		34.16		140.53		39.70	
Angrist-Pischke F-statistic	176.76	118.78	178.87	37.52	31.57	174.95	155.24	32.12	32.04

Table IV.6: Trade in Tasks and Manager-Worker Wage Inequality - IV

	dependent variable: ln (executive compensation / wage bill per employee)				
performance measure:		*EBIT*		*market capitalization*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
task trade × ln perf		0.901***	1.799***	0.689***	1.242**
		(0.267)	(0.587)	(0.214)	(0.514)
task trade	0.651	-3.750**	-7.833*	-4.544**	-7.120
	(1.313)	(1.910)	(4.001)	(1.820)	(4.559)
ln perf	0.0226**	0.0183**	0.0175*	0.0465***	0.0484***
	(0.00880)	(0.00891)	(0.00901)	(0.0114)	(0.0114)
ln assets	0.0992***	0.101***	0.100***	0.0967***	0.0954***
	(0.0198)	(0.0198)	(0.0200)	(0.0171)	(0.0173)
import pen			3.422		2.676
			(2.234)		(2.791)
import pen× ln perf			-0.972**		-0.654*
			(0.400)		(0.365)
industry controls	yes	yes	yes	yes	yes
manager f.e.	yes	yes	yes	yes	yes
region x year f.e.	yes	yes	yes	yes	yes
observations	54,037	54,037	54,037	68,324	68,324
no. of managers	12,609	12,609	12,609	14,737	14,737

All columns report instrumental variable results from manager fix effects models. Columns *(1)* - *(3)* report results with *ln EBIT* as measure of firm performance while columns *(4)* - *(5)* report results with *ln market capitalization* as measure of firm performance. All specifications additionally include region-year fix effects. Industry controls include value added and employment. Standard errors are cluster robust. *** p<0.01, ** p<0.05, * p<0.1

instead of manager fix effects. Consequently, the source of variation that is exploited in these specifications is variation across managers and time within individual firms. The results are qualitatively similar to the estimations with manager fix effects.

IV.4 Conclusion

Using data on the compensation of executives in European and U.S. companies, I analyze how the exposure to intermediate good imports affects executive compensation.

In order to identify the effects of trade in tasks on executive compensation, I exploit variation in the world export supply of intermediate goods to instrument for changes in intermediate good imports.

I find that more trade in tasks leads to more incentives in the compensation of executives. Increases in the share of imported intermediates at the industry level make executive compensation more elastic to changes in firm earnings and market capitalization.

Additionally, the estimates suggest that increases in the share of imported intermediates raise the earnings inequality between executives and the firm workforce, in particular when firms have higher earnings or market capitalization.

Figure IV.2: Growth of Intermediate and Final Goods Trade (in millions of USD)

The graphs plot imports of intermediate and final goods (in million USD) in continental Europe (blue), the U.K. (red) and the U.S. (green). European imports include intra-European trade.

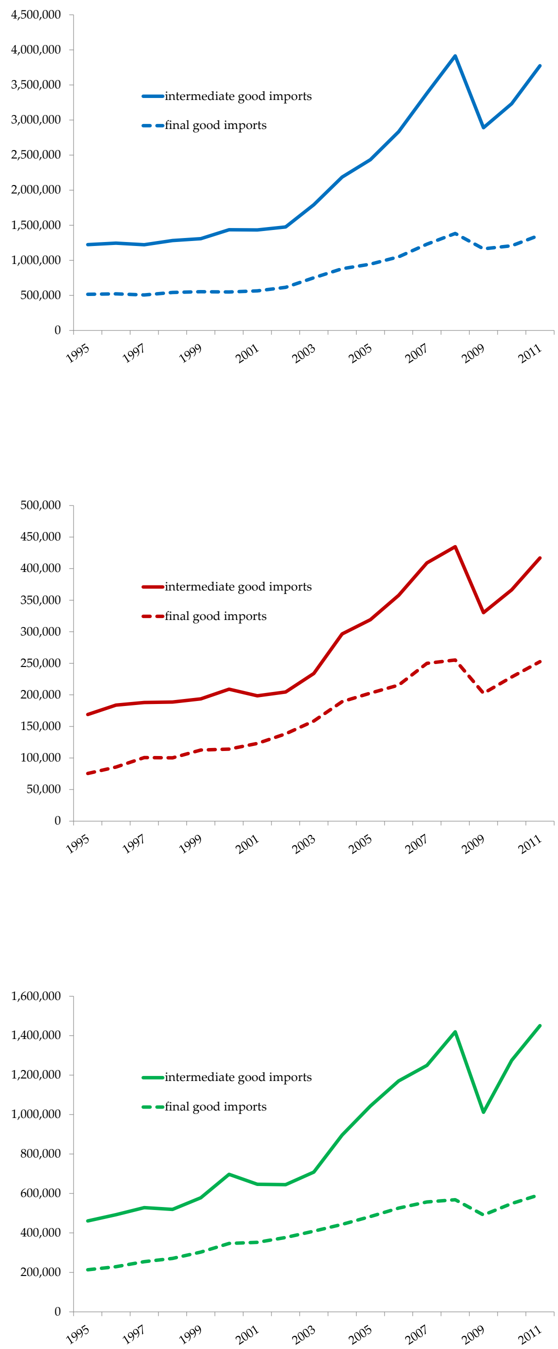
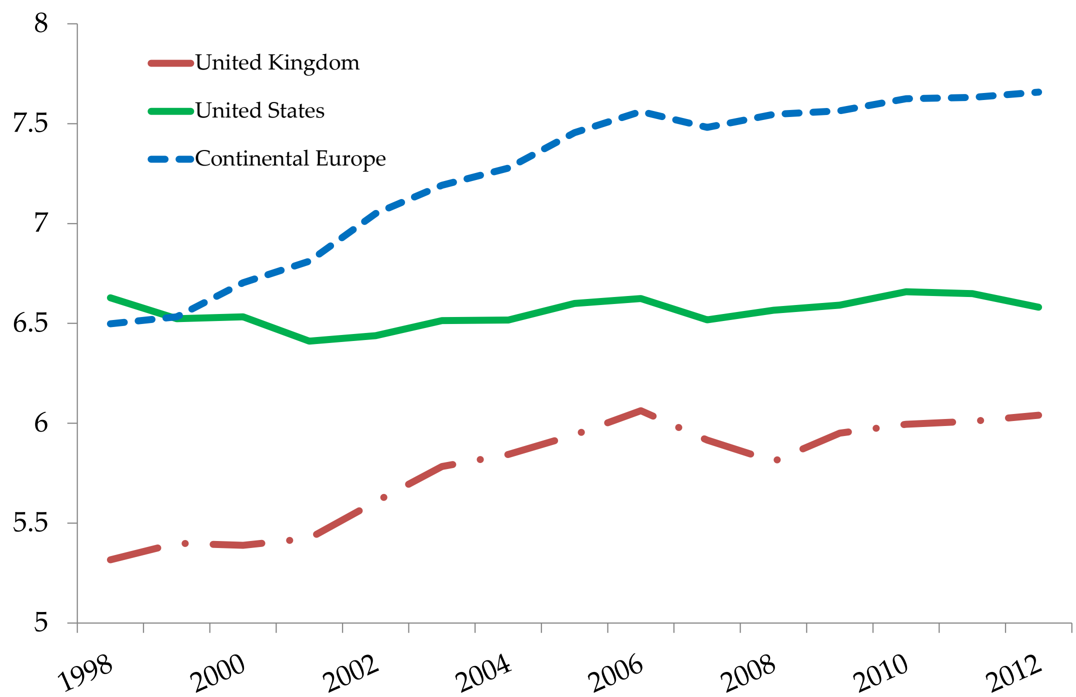


Figure IV.3: Dynamics of Executive Compensation

The graph plots the evolution of average total executive compensation in natural logarithms of real 1,000 USD (base period is January 2000) after netting out individual manager fix effects to correct for selection effects. Although the average level of compensation is absorbed by the fix effects, the slopes allow to compare the dynamics of compensation in the U.S., U.K. and continental Europe.



CHAPTER A

Appendix Chapter II

A.1 Theory Appendix

The Optimal Choice of Governance and Performance Pay

The owner's problem is

$$\max_{w,g} \varepsilon\left(Y-w\right)+\left(1-\varepsilon\right)gR\underline{w}-C\underline{w}g$$
$$s.t.$$
$$\varepsilon w \geq \left(1-g\right)B$$
$$\varepsilon w \geq \overline{W}$$

with $C\underline{w} \in \left(\left(1-\varepsilon\right)R\underline{w}, \left(1-\varepsilon\right)R\underline{w}+B\right)$. This assumption ensures that the choice of governance is nontrivial. Governance would be always $g^* = 1$ if $C\underline{w} < \left(1-\varepsilon\right)R\underline{w}$ and $g^* = 0$ if $C\underline{w} > \left(1-\varepsilon\right)R\underline{w}+B$. A case distinction is necessary to find the optimal contract.

Case *i)* $\overline{W} > B$: In that case the incentive constraint is slack whenever the participation constraint is satisfied. Consequently, the incentive constraint may be neglected and the agent receives a bonus $w = \overline{W}/\varepsilon$. Since incentives do not matter and to save on governance costs, the principal leaves all the power to the CEO and chooses $g^* = 0$ (since $\left(1-\varepsilon\right)R\underline{w} - C\underline{w} < 0$).

Case *ii)* $\overline{W} \leq B$: This case is somewhat less trivial since here it depends on the level of governance g which constraint will bind. More governance increases the expected liquidation value ($(1-\varepsilon)\, gR\underline{w}$) and rises monitoring costs ($C\underline{w}g$). Since $C\underline{w} > (1-\varepsilon)\, gR\underline{w}$, more governance costs the principal. Nevertheless, there is a positive effect of governance: stricter governance creates incentives for the agent to behave (exert effort). Suppose that the principal sets governance so weak such that $g < 1 - \frac{\overline{W}}{B}$. Then, the incentive constraint would require that $w \geq (1-g)\, \frac{B}{\varepsilon}$. Thus, it is inefficient to reduce governance because it requires a relatively stronger increase in performance pay w. Next, suppose that $g > 1 - \frac{\overline{W}}{B}$ such that only the participation constraint binds. Since governance bears a cost for the principal, she can improve by reducing g such that both constraints are still satisfied.

Credibility of CEO Reservation Wages

Suppose the infinitesimally smaller firm with production technology z_0 is not willing to offer a bonus payment that equals the current CEO's bonus plus his additional marginal benefit for the firm $\partial\left(\varepsilon Y\left(z, s\right)\right)/\partial s$. Then, the CEO could choose to go to the next infinitesimally smaller firm $z_{00} \rightarrow z_0^-$ and try to get an offer there and if not, proceed to the next smaller firm and so on. The last firm that the CEO could address is the marginal firm with production technology $z_c = ts_c$ which pays an expected CEO wage of $\varepsilon w\left(s_c\right) = \underline{w}$. It would be unambiguously beneficial for this marginal firm to employ the CEO with skill s and pay him a little $\epsilon \rightarrow 0$ more compared to the bonus of the currently employed marginal CEO. Then again, the firm that is marginally more productive than the marginal firm would benefit from paying the CEO 2ϵ more and so on until we are back at the firm with production technology z_0 that is willing to pay its current CEO's bonus plus the additional marginal benefit of the more skilled CEO $\frac{\partial \varepsilon Y(z,s)}{\partial s}_{|z=z(s)}$ to prevent him from leaving. Hence, the derived outside option is subgame-perfect and therefore credible.

Closed Economy Equilibrium

The equilibrium in the closed economy is found in two steps. In a first step, the managerial cutoff skill s_c and the aggregate expenditure X are determined. Afterwards, the critical cutoff skill $\widetilde{s}$ can be found. Firms with managerial skills

$s > \widetilde{s}$ choose the weakest level of governance $g = 0$. Firms with managerial skills $s \in [s_c, \widetilde{s}]$ use stricter governance to incentivize their CEOs, instead. The equilibrium solution (X, s_c) is pinned down by the zero cutoff earnings and the labor market clearing curve: the marginal firm with skill level s_c just breaks even and the aggregate expenditure on production labor must equal the aggregate production labor earnings.

Closed Economy Price Index

The price index can be restated in terms of the model fundamentals and the cutoff talent level s_c. After exchanging variables and integrating over the skill distribution, the price index P may be written as follows:

$$\begin{aligned} P &= \left[\int_{s_c}^{\infty} \left(\frac{\sigma}{\sigma - 1} w t^{-\kappa} s^{-(\kappa+\mu)} \right)^{1-\sigma} d\varepsilon L (1 - s^{-1}) \right]^{1/(1-\sigma)} \\ &= \frac{\sigma}{\sigma - 1} t^{-\kappa} w \left(\frac{\psi}{\varepsilon L} \right)^{1/(\sigma-1)} s_c^{\psi/(\sigma-1)}, \end{aligned}$$

where $\psi \equiv 1 - (\sigma - 1)(\kappa + \mu)$. In order to ensure existence of the improper integral, I need to assume that $(\sigma - 1)(\kappa + \mu) < 1$ which intuitively means that there does not exist any firm that is sufficiently efficient to bring the price index down to zero.

Zero Cutoff Earnings Condition

The expected operating profits can be written in terms of X and s_c such that the ZCE curve is a decreasing function $X(s_c)$: The zero cutoff earnings condition requires that the marginal firm is indifferent between entering or leaving the market. Since $W(s_c) = \underline{w} < B$ and thus $g(s_c)* = 1 - \frac{w}{\varepsilon B}$ we have

$$\begin{aligned}
\varepsilon M \left(\frac{t^{\kappa} s_c^{\kappa+\mu}}{\underline{w}} \right)^{\sigma-1} &= \left(1 - \frac{\underline{w}}{\varepsilon B}\right) \left(C - (1-\varepsilon) R\right) \underline{w} + \underline{w} \\
X &= \frac{\sigma L \left(\left(1 - \frac{\underline{w}}{\varepsilon B}\right) \left(C - (1-\varepsilon) R\right) + 1\right) \underline{w}}{\psi} s_c^{-1}. \\
X &= \frac{\sigma L \lambda \underline{w}}{\psi} s_c^{-1}.
\end{aligned}$$

Labor Market Clearing Condition

The labor market clearing condition requires that the aggregate expenditure on production labor is equal to the aggregate earnings of the production workers. The aggregate expenditure on production workers is equal to $L\underline{w}(1 - s_c^{-1})$. The aggregate demand for production workers can be obtained by integrating up the demand of an individual firm over all producing firms in the economy. A firm uses $1/\varphi_j$ units of labor per unit of output and produces q_j units of output with probability ε. The demand for production labor of an individual firm can be written in terms of prices since $q_j = x_j/p_j = XP^{\sigma-1}p_j^{-\sigma}$ and $1/\varphi_j = \frac{\sigma-1}{\sigma} p_j$. Demand for production labor is thus given by

$$\varepsilon \frac{q_j}{\varphi_j} = \varepsilon \left[\frac{\sigma-1}{\sigma} X P^{\sigma-1} p_j^{1-\sigma} \right].$$

Integrating the production labor demand for the individual firm over all active firms of the economy yields

$$\begin{aligned}
\int_0^{Ls_c^{-1}} \left[\varepsilon \frac{\sigma-1}{\sigma} X P^{\sigma-1} p_j^{1-\sigma} \right] dj &= \varepsilon \frac{\sigma-1}{\sigma} X P^{\sigma-1} \int_0^{Ls_c^{-1}} p_j^{1-\sigma} dj \\
&= \varepsilon \frac{\sigma-1}{\sigma} X.
\end{aligned}$$

Setting this expression equal to the aggregate supply from above gives the labor market clearing condition

$$X = \frac{L}{\varepsilon} \frac{\sigma}{\sigma-1} \underline{w}(1 - s_c^{-1}).$$

Explicit Equilibrium Solution for $(X, s_c, \widetilde{s})$ in the Closed Economy

Solving for the cutoff skill s_c^{-1} by setting the two conditions equal yields

$$\frac{L}{\varepsilon}\frac{\sigma}{\sigma-1}\underline{w}\left(1-s_c^{-1}\right)=\frac{\sigma L\lambda\underline{w}}{\psi}s_c^{-1} \quad\Leftrightarrow\quad s_c=1+\frac{\varepsilon\left(\sigma-1\right)\lambda}{\psi}.$$

Solving for the expenditure share X by plugging the solution for s_c into the labor market clearing condition yields

$$X=\frac{L}{\varepsilon}\frac{\sigma}{\sigma-1}\underline{w}\left[1-\left(1+\frac{\varepsilon\left(\sigma-1\right)\lambda}{\psi}\right)^{-1}\right] \quad\Leftrightarrow\quad X=\frac{\sigma L\lambda\underline{w}}{\psi+\varepsilon(\sigma-1)\lambda}.$$

The equilibrium market size M of a firm can be stated as follows:

$$\begin{aligned} M &\equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}XP^{\sigma-1} \\ &= \frac{\lambda}{\varepsilon}\underline{w}^{\sigma}t^{-\kappa(\sigma-1)}s_c^{\psi-1} \end{aligned}$$

Consider next the critical cutoff skill level $\widetilde{s}$. This cutoff is implicitly defined by

$$\varepsilon M\left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1}\frac{\mu}{\kappa+\mu}\left(\widetilde{s}^{(\kappa+\mu)(\sigma-1)}-s_c^{(\kappa+\mu)(\sigma-1)}\right)+\underline{w}=B.$$

Plugging in M and the equilibrium solution for s_c gives

$$\left(\frac{\widetilde{s}}{s_c}\right)^{1-\psi} = \left(1+\frac{\left(\kappa+\mu\right)\left(B-\underline{w}\right)}{\lambda\mu\underline{w}}\right)^{\frac{1}{1-\psi}}s_c.$$

There is a mass of Ls_c^{-1} firms in equilibrium and a mass of $L\widetilde{s}^{-1}$ firms choose the weakest corporate governance $g=0$. Hence, the share of power organizations is given as follows:

$$\theta = \frac{L\widetilde{s}^{-1}}{L\underline{s}^{-1}}=\left(1+\frac{\left(\kappa+\mu\right)\left(B-\underline{w}\right)}{\lambda\mu\underline{w}}\right)^{\frac{1}{\psi-1}}.$$

The Effects of Skill-Biased Technological Change

Consider the effects of an increase in κ in the model. While the labor market clearing condition is left unaffected, there are two opposing effects on the zero cutoff earnings conditions: a positive productivity effect and a negative price index effect. Since an increase in κ disproportionally benefits the productivity of the competing firms, skill-biased technological change toughens selection. Consider the selection effect $\partial s_c / \partial \kappa$:

$$\begin{aligned}
\frac{\partial s_c}{\partial \kappa} &= \frac{\partial \psi}{\partial \kappa}\frac{\partial s_c}{\partial \psi} \\
&= \frac{\partial \left[1-(\sigma-1)(\kappa+\mu)\right]}{\partial \kappa}\frac{\partial \left[1+\psi^{-1}\left(\varepsilon\left(\sigma-1\right)\lambda\right)\right]}{\partial \psi} \\
&= \left[-(\sigma-1)\right]\left[-\psi^{-2}\left(\varepsilon\left(\sigma-1\right)\lambda\right)\right] \\
&= \varepsilon\lambda\left(\frac{\sigma-1}{\psi}\right)^2 > 0.
\end{aligned}$$

Next consider the effect of skill-biased technological change on the expenditure level:

$$\begin{aligned}
\frac{\partial X}{\partial \kappa} &= \frac{\partial \psi}{\partial \kappa}\frac{\partial X}{\partial \psi} \\
&= \frac{\partial \left[1-(\sigma-1)(\kappa+\mu)\right]}{\partial \kappa}\frac{\partial \left[\sigma\lambda L\left(\psi+\varepsilon\lambda(\sigma-1)\right)^{-1}\right]}{\partial \psi} \\
&= \left[-(\sigma-1)\right]\left[-\sigma\lambda L\left(\psi+\varepsilon\lambda(\sigma-1)\right)^{-2}\right] \\
&= \frac{\sigma\lambda L(\sigma-1)}{\left(\psi+\varepsilon\lambda(\sigma-1)\right)^2} > 0.
\end{aligned}$$

In order to evaluate how skill-biased technological change affects the share of organizations with weakest governance, the effects on θ needs to be analyzed. Consider how a change in κ affects θ. The share θ can be restated in the following way

$$\theta = \left(\frac{\lambda\mu\underline{w}}{\lambda\mu\underline{w}+(\kappa+\mu)\left(B-\underline{w}\right)}\right)^{\frac{1}{(\kappa+\mu)(\sigma-1)}}.$$

A rise in κ has two effects on θ: a negative bargaining effect and a positive productivity effect. The negative bargaining effect is captured by an increase of the denominator such that θ decreases. The positive productivity effect is captured by the decrease of the exponent such that θ rises.
In order to evaluate the sign of the overall effect, I take the logarithm of θ and consider its derivative $\nabla(\kappa)$:

$$\begin{aligned}\nabla(\kappa) &= \frac{\partial \ln(\theta)}{\partial\kappa} \\ &= \frac{\partial\left(\ln\left(\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right)^{-\frac{1}{(\kappa+\mu)(\sigma-1)}}\right)\right)}{\partial\kappa} \\ &= \frac{\partial\left(\frac{1}{-(\kappa+\mu)(\sigma-1)}\ln\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right)\right)}{\partial\kappa}.\end{aligned}$$

Using the product and chain rule gives

$$\frac{\partial\left(\frac{1}{-(\kappa+\mu)(\sigma-1)}\ln\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right)\right)}{\partial\kappa}$$
$$=$$
$$\frac{1}{(\kappa+\mu)(\sigma-1)}\left(\frac{1}{(\kappa+\mu)}\ln\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right)-\frac{B-\underline{w}}{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}\right),$$

where the term $(\kappa+\mu)^{-2}(\sigma-1)^{-1}\ln\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right)$ captures the positive productivity effect while the term $-\frac{1}{(\kappa+\mu)(\sigma-1)}\frac{B-\underline{w}}{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}$ corresponds to the negative bargaining effect. The positive productivity effect outweighs the negative bargaining effect if and only if

$$\begin{aligned}\frac{1}{(\kappa+\mu)}\ln\left(\frac{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right) &> \frac{B-\underline{w}}{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})} \\ \ln\left(\frac{\lambda\mu+(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}\right) &> \frac{(B-\underline{w})(\kappa+\mu)}{\lambda\mu\underline{w}+(\kappa+\mu)(B-\underline{w})},\end{aligned}$$

which is always true since the left hand side is strictly larger than one while the right hand side is always strictly smaller than one. Consequently, skill-biased technological change unambiguously increases the share of organizations with $g=0$ in equilibrium.

Open Economy Equilibrium

Marginal Exporters and Marginal Local Firms

Since firms face identical demand elasticities in both markets, the operating profit ratio of a marginal exporter and a marginal local firm can be stated as

$$\frac{\varepsilon Y_x(s_x)}{\varepsilon Y_d(s_d)} = \frac{\varepsilon\tau^{1-\sigma} M \left(\frac{t^\kappa s_x^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1}}{\varepsilon M \left(\frac{t^\kappa s_d^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1}} = \frac{f\underline{w}}{\left(\left(1-\frac{w}{\varepsilon B}\right)\left(C-(1-\varepsilon)R\right)+1\right)\underline{w}}$$

which yields

$$s_x = \left(\frac{\tau^{\sigma-1} f}{\lambda}\right)^{\frac{1}{1-\psi}} s_d.$$

Open Economy Price Index

After exchanging variables and integrating over the skill distribution, the price index P in the open economy with two identical countries can be written as

$$\begin{aligned} P &= \left[\int_{s_d}^{\infty}\left(\frac{\sigma}{\sigma-1}\underline{w}t^{-\kappa}s^{-(\kappa+\mu)}\right)^{1-\sigma} d\varepsilon L(1-s^{-1}) \right. \\ &\quad \left. + \int_{s_x}^{\infty}\left(\tau\frac{\sigma}{\sigma-1}\underline{w}t^{-\kappa}s^{-(\kappa+\mu)}\right)^{1-\sigma} d\varepsilon L(1-s^{-1})\right]^{1/(1-\sigma)}. \\ &= \underline{w}t^{-\kappa}\frac{\sigma}{\sigma-1}\left(\frac{\psi}{\varepsilon L}\right)^{\frac{1}{\sigma-1}} s_d^{\frac{\psi}{\sigma-1}}\left[1+\tau^{-\frac{1}{\kappa+\mu}} f^{\frac{-\psi}{1-\psi}}\lambda^{\frac{\psi}{1-\psi}}\right]^{1/(1-\sigma)}. \end{aligned}$$

Next, use the index of bilateral distance $\Delta \equiv \tau^{\frac{1}{\kappa+\mu}} f^{\frac{\psi}{1-\psi}}$ to restate the open economy version of P as follows:

$$P = \frac{\sigma}{\sigma-1}\underline{w}t^{-\kappa}\left(\frac{\psi}{\varepsilon L}\right)^{\frac{1}{\sigma-1}} s_d^{\frac{\psi}{\sigma-1}}\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]^{1/(1-\sigma)}.$$

Labor Market Clearing Condition in the Open Economy

The aggregate earnings of production workers remains unchanged compared to the closed economy case at $L\underline{w}(1-s_d^{-1})$. The expenditure on production labor now is comprised of three components: *(i)* labor expenditure required to produce for the domestic market, *(ii)* labor expenditure required to produce for the foreign market, and *(iii)* labor expenditure to cover the fixed export investment:

$$\int_0^{Ls_d^{-1}} \left[\varepsilon\frac{\sigma-1}{\sigma}XP^{\sigma-1}p_j^{1-\sigma}\right]dj + \int_0^{Ls_x^{-1}} \left[\varepsilon\frac{\sigma-1}{\sigma}XP^{\sigma-1}\tau^{1-\sigma}p_j^{1-\sigma}\right]dj + f\underline{w}Ls_x^{-1}.$$

This term for the aggregate production labor expenditure may be simplified as follows:

$$\begin{aligned}
&= \varepsilon\frac{\sigma-1}{\sigma}XP^{\sigma-1}\left[\int_0^{Ls_d^{-1}} p_j^{1-\sigma}dj + \tau^{1-\sigma}\int_0^{Ls_x^{-1}} p_j^{1-\sigma}dj\right] + f\underline{w}Ls_x^{-1} \\
&= \varepsilon\frac{\sigma-1}{\sigma}XP^{\sigma-1}\left[\left(\frac{\sigma}{\sigma-1}\underline{w}t^{-\kappa}\right)^{1-\sigma}\left(\frac{\psi}{\varepsilon L}\right)^{-1}s_d^{-\psi}\left(1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right)\right] + f\underline{w}Ls_x^{-1} \\
&= \varepsilon\frac{\sigma-1}{\sigma}X + f\underline{w}Ls_x^{-1}
\end{aligned}$$

Setting supply and demand equal leads to

$$\varepsilon\frac{\sigma-1}{\sigma}X + f\underline{w}Ls_x^{-1} = L\underline{w}(1-s_d^{-1});$$

and after replacing s_x one obtains

$$\begin{aligned}
\varepsilon\frac{\sigma-1}{\sigma}X + f\underline{w}L\left(\frac{\tau^{\sigma-1}f}{\lambda}\right)^{\frac{1}{\psi-1}}s_d^{-1} &= L\underline{w}(1-\underline{s}_d^{-1}) \\
X &= \frac{\sigma}{\sigma-1}\frac{L}{\varepsilon}\underline{w}\left(1-\underline{s}_d^{-1}\left(1+\lambda^{\frac{1}{1-\psi}}\Delta^{-1}\right)\right).
\end{aligned}$$

Zero Cutoff Earnings Condition in the Open Economy

Again, the marginal firm is an incentive organization and just breaks even such that

$$\varepsilon Y(s_d) = \left(1-\frac{w}{\varepsilon B}\right)\left(C-(1-\varepsilon)\,R\right)\underline{w} + \underline{w}.$$

The expected operating profits can be written in terms of X and s_d such that the zero cutoff curve is a decreasing function in the $X(s_d)$ locus:

$$\begin{aligned}\varepsilon Y(s_d) &= \varepsilon M\left(\frac{t^{\kappa}s_d^{\kappa+\mu}}{\underline{w}}\right)^{\sigma-1}\\ &= X\frac{\psi}{\sigma L}\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]^{-1}s_d.\end{aligned}$$

Setting this equal to $\left(1-\frac{\underline{w}}{\varepsilon B}\right)\left(C-\left(1-\varepsilon\right)R\right)\underline{w}+\underline{w}$ yields the zero cutoff condition for the open economy

$$\begin{aligned}X\frac{\psi}{\sigma L}\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]^{-1}s_d &= \left(\left(1-\frac{\underline{w}}{\varepsilon B}\right)\left(C-\left(1-\varepsilon\right)R\right)+1\right)\underline{w}\\ X &= \frac{\sigma L\lambda\underline{w}}{\psi}\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]s_d^{-1}.\end{aligned}$$

Explicit Equilibrium Solution for (X, s_d) in the Open Economy

Solve first for the cutoff s_d:

$$\begin{aligned}\frac{\sigma L\lambda\underline{w}}{\psi}\left[1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right]s_d^{-1} &= \frac{\sigma}{\sigma-1}\frac{L}{\varepsilon}\underline{w}\left(1-\underline{s}_d^{-1}\left(1+\lambda^{\frac{1}{1-\psi}}\Delta^{-1}\right)\right)\\ s_d &= 1+\frac{\varepsilon\lambda\left(\sigma-1\right)}{\psi}+\left(1+\frac{\varepsilon\left(\sigma-1\right)}{\psi}\right)\lambda^{\frac{1}{1-\psi}}\Delta^{-1}\end{aligned}$$

Note that $\lim_{\Delta\to\infty} s_d = s_c$.
Plug the solution for s_d into the zero cutoff earnings condition:

$$\begin{aligned}X &= \frac{\sigma L\lambda\underline{w}}{\psi}\left(1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right)\left(1+\frac{\varepsilon\lambda\left(\sigma-1\right)}{\psi}+\left(1+\frac{\varepsilon\left(\sigma-1\right)}{\psi}\right)\lambda^{\frac{1}{1-\psi}}\Delta^{-1}\right)^{-1}\\ X &= \frac{\sigma L\lambda\underline{w}\left(1+\lambda^{\frac{\psi}{1-\psi}}\Delta^{-1}\right)}{\psi+\varepsilon\lambda\left(\sigma-1\right)+\left(\psi+\varepsilon\left(\sigma-1\right)\right)\lambda^{\frac{1}{1-\psi}}\Delta^{-1}}.\end{aligned}$$

Also the aggregate expenditure level equals the expenditure level in the closed economy case when the index of economic distance Δ approaches infinity.

Additionally, note that $\frac{\partial X}{\partial \Delta} > 0$ since

$$\frac{\partial X}{\partial \Delta} = \frac{\lambda L \sigma \psi \underline{w} \left(\lambda^{\frac{1}{1-\psi}} - \lambda^{\frac{\psi}{1-\psi}} \right)}{\left(\Delta \left(\varepsilon \lambda \left(\sigma - 1 \right) + \psi \right) + \lambda^{\frac{1}{1-\psi}} \left(\psi + \varepsilon \left(\sigma - 1 \right) \right) \right)^2}.$$

The Size of the Market Share M in the Open Economy Equilibrium

The equilibrium market share M of a firm can again be stated as follows:

$$\begin{aligned} M &\equiv \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} X P^{\sigma - 1} \\ &= \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} \left[\frac{\sigma L \lambda \underline{w} \left(1 + \lambda^{\frac{\psi}{1-\psi}} \Delta^{-1} \right)}{\psi + \varepsilon \lambda \left(\sigma - 1 \right) + \left(\psi + \varepsilon \left(\sigma - 1 \right) \right) \lambda^{\frac{1}{1-\psi}} \Delta^{-1}} \right] \times \\ & \quad \left[\frac{\sigma}{\sigma - 1} \underline{w} t^{-\kappa} \left(\frac{\psi}{\varepsilon L} \right)^{\frac{1}{\sigma - 1}} s_d^{\frac{\psi}{\sigma - 1}} \left[1 + \lambda^{\frac{\psi}{1-\psi}} \Delta^{-1} \right]^{\frac{1}{1-\sigma}} \right]^{\sigma - 1} \\ &= \frac{\lambda}{\varepsilon} \underline{w}^{\sigma} t^{-\kappa(\sigma - 1)} s_d^{\psi - 1} \end{aligned}$$

Effects of a Trade Integration

Consider the effect of a trade integration ($\Delta \downarrow$) on the share of organizations with no investment in corporate governance θ. I distinguish between two different scenarios, here:

1. low trade openness: the fix and/or variable trade costs are large that only the must productive firms choose to serve the export markets such that the sorting of cutoff skill levels is $s_d < \widetilde{s} < s_x$.

2. high trade openness: the fix and/or variable trade costs are sufficiently small that relatively many firms choose to serve the export markets such that the sorting of cutoff skill levels is $s_d < s_x < \widetilde{s}$.

Low Trade Openness

The organizational cutoff $\widetilde{s}$ can be evaluated as in the closed economy case

$$\begin{aligned}
\varepsilon M\left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1}\frac{\mu}{\kappa+\mu}\left(\widetilde{s}^{(\kappa+\mu)(\sigma-1)}-s_d^{(\kappa+\mu)(\sigma-1)}\right)+\underline{w} &= B\\
\left(\frac{\widetilde{s}}{s_d}\right)^{1-\psi} &= 1+\frac{(\kappa+\mu)\left(B-\underline{w}\right)}{\lambda\mu\underline{w}}\\
\widetilde{s} &= \left(1+\frac{(\kappa+\mu)\left(B-\underline{w}\right)}{\lambda\mu\underline{w}}\right)^{\frac{1}{1-\psi}}s_d
\end{aligned}$$

High Trade Openness

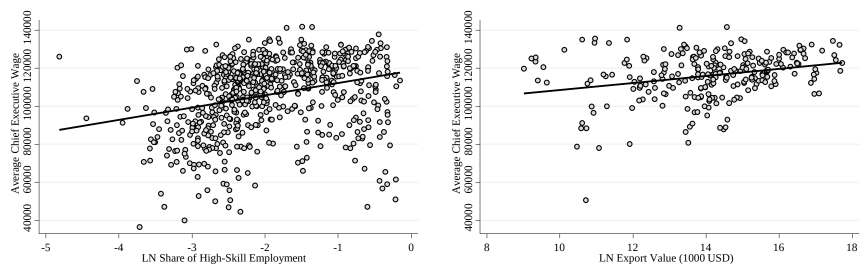
The organizational cutoff $\widetilde{s}$ in the open economy case is

$$\varepsilon M\left(\frac{t^{\kappa}}{\underline{w}}\right)^{\sigma-1}\frac{\mu}{\kappa+\mu}\left(\left(\widetilde{s}^{1-\psi}-s_d^{1-\psi}\right)+\tau^{1-\sigma}\left(\widetilde{s}^{1-\psi}-s_x^{1-\psi}\right)\right)+\underline{w}=B$$
$$\left(\frac{\widetilde{s}}{s_d}\right)^{1-\psi}\left(1+\tau^{1-\sigma}\right)=\left(\frac{(\kappa+\mu)(B-\underline{w})}{\lambda\mu\underline{w}}-\frac{\lambda}{\tau^{2(\sigma-1)}f}+1\right)$$

such that $\widetilde{s}$ and the share of organizations that choose $g=0$ are equal to

$$\begin{aligned}
\widetilde{s} &= \left(\left(\frac{(\kappa+\mu)\left(B-\underline{w}\right)+\lambda\mu\underline{w}}{\lambda\mu\underline{w}}-\frac{\lambda}{\tau^{2(\sigma-1)}f}\right)\left(\frac{1}{1+\tau^{1-\sigma}}\right)\right)^{\frac{1}{1-\psi}}s_d\\
\theta &= \left(\left(\frac{(\kappa+\mu)\left(B-\underline{w}\right)+\lambda\mu\underline{w}}{\lambda\mu\underline{w}}-\frac{\lambda}{\tau^{2(\sigma-1)}f}\right)\left(\frac{1}{1+\tau^{1-\sigma}}\right)\right)^{-\frac{1}{(\kappa+\mu)(\sigma-1)}}.
\end{aligned}$$

Figure A.1: CEO Wages, Skill-Intensity and Export Activity across U.S. industries 1999 - 2001



A.2 Data Appendix

Preparation of the BoardEx Data

Before equity compensation from BoardEx could be applied in the empirical models, a number of preparation steps were necessary. Since BoardEx includes both, executives and supervisory managers, the latter were excluded from the sample throughout. Furthermore, BoardEx reports several distinct incomes for some executives that hold different positions within the board of the same firm. Those incomes have been aggregated at the manager-firm-year level to obtain the aggregate executive compensation. The next step of preparation involved the deletion of double entries: Although most data items stem from annual report data, there is also some reporting from quarterly announcements included. Those data points from quarterly announcements have been excluded. Furthermore, reporting periods have been assimilated by switching from accounting periods which start at different months depending on each firm in the sample to calendar years. Since job titles are not perfectly consistent, CEOs were identified as the highest paid executive in each firm in a given year.

Construction of the Instrumental Variable

The variable that I use as an instrument for trade openness is the weighted average of real effective exchange rates $r_t(c)$ of the top 5 U.S. export destinations c: Canada, Mexico, Great Britain, China and Japan. Each weight $\alpha_j(c)$ is the average country c's share of exports relative to the total exports of those five countries from the U.S. during 1991 - 1995 at the industry level j (at the SIC 4-digit level):

$$\begin{aligned} \alpha_j(c) &= \frac{\varnothing\, exports_j(c)}{\sum_{c=1}^{5} \varnothing\, exports_j(c)} \\ IV_{jt} &= \sum_{c=1}^{5} \alpha_j(c)\, r_t(c) \end{aligned}$$

Table A.1: Summary Statistics

variable	*observations*	*mean*	*min*	*max*	*std. dev.*
		Entrenchment Panel			
entrenchment index	13732	2.32	0	6	1.34
openness	7588	0.18	-51.64	55.89	1.93
ln openness	7132	2.52	-4.54	8.63	1.59
ICT contribution %	25272	0.94	-0.51	6.44	0.89
employment	17123	12719.22	0	1900000	40318.54
ln employment	17123	8.02	0	14.46	1.76
assets	17561	7305301	1	1460000000	41200000
ln assets	17561	13.84	0.69	21.10	1.82
total investment return	16730	48.26	-99.99	159400.00	1905.39
tfp index	19540	2.26	0.47	44.24	5.91
REER basket	20332	99.48	72.25	157.90	8.80
		Equity Compensation Panel			
CEO equity compensation	12185	6382.44	0	1322156	18775.78
ln CEO equity compensation	12067	7.64	-1.29	14.09	1.68
openness	4726	0.23	-21.23	13.96	1.34
ln openness	4401	2.66	-3.31	7.24	1.58
ICT contribution %	13528	0.75	-0.51	6.44	0.89
employment	13206	18763.49	0	1900000	58450.28
ln employment	13195	8.33	0.69	14.46	1.82
assets	13380	17203290	3.815	1884318000	87481700
ln assets	13380	14.48	1.34	21.36	1.85
total investment return	13028	26.63	-97.50	159400.00	1406.45
tfp index	5366	4.28	9.98	0.47	44.24
REER basket	5607	100.03	74.97	151.88	7.56

Table A.2: Description of Variables

variable	*description*
E-index	Entrenchment index from Bebchuk et al. (2009). The index ranges from 0 (good corporate governance - little entrenchment) to 6 (bad corporate governance - large entrenchment) and counts how many of the following attributes are applied in a company in a given year: staggered boards, limits to shareholder bylaw amendments, poison pills, golden parachutes, and supermajority requirements for mergers as well as for charter amendments. Information on the six different governance attributes is provided by the IRRC and includes S&P 500 firms and other large U.S. firms. Data source: http://www.law.harvard.edu/faculty/bebchuk/data.shtml
ln CEO equity compensation	Natural logarithm of the equity-linked compensation in 1000 USD of the highest-paid officer in the firm during a given year. Data source: BoardEx database
ln openness	Natural logarithm of openness in %, where openness is *exports/(gross output - imports)*. Gross output is approximated as the sum of value added, material costs, energy costs and labor compensation. All variables are at the 4-digit SIC industry level for the main industry of each firm in the sample. Data sources: exports and imports are obtained from the UN COMTRADE WITS database http://wits.worldbank.org/; gross output is calculated with data from the NBER CES Manufacturing Industry database http://www.nber.org/nberces/
tfp index	Total factor productivity index on the SIC 4-digit level based on 4 factors of production (production workers, non-production workers, material inputs, capital) with the base year 1987, where the index takes the value 1. Data source: NBER-CES Mft. Industry database http://www.nber.org/nberces/
ICT contribution %	Contribution of information and communication technology (ICT) capital services to value added growth in percentage points for the main industry of the firm at the ISIC Rev. 3 level. Data source: http://www.euklems.net/
ln employment	Natural logarithm of the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets in 1000 USD. Data source: Thomson Worldscope database
ln assets	Stock return in % corrected for dividend payments. total investment return = 100% x ((market price year end + dividends p. share + special dividends) / last year's market price year end) - 1) Data source: Thomson Worldscope database
total investment return	Total factor productivity index on the SIC 4-digit level based on 4 factors of production (production workers, non-production workers, material inputs, capital) with the base year 1987, where the index takes the value 1. Data source: NBER-CES Mft. Industry database http://www.nber.org/nberces/
REER basket	weighted average of the real effective exchange rates of top 5 U.S. trading partners Canada, Mexico, Great Britain, China and Japan. Weights are the country share of U.S. imports during 1991-1995 at the SIC 4-digit level. REER are domestic prices relative to the world price (larger REER means greater comparative advantage for the U.S.) Data source: weights are obtained from COMTRADE WITS; exchange rate from the BRUEGEL REER database.

CHAPTER B

Appendix Chapter III

B.1 Data Appendix

Construction of Export Market Shares

We define the export market share of firm i in country c as the ratio of firm exports to export competition in destination region K:

$$m_{Ki_c} = \frac{exports_{Ki_c}}{comp_{Ki_c}},$$

where $exports_{Ki_c}$ are firm exports from country c to region K and $comp_{Ki_c}$ is the export competition of firm i in region K. We measure export competition as a weighted average of industry imports into region K, where the set of industries considered is firm specific. Note that we only look at competition by other exporters and do not consider domestic supply in destination K. One effect of this simplification is that destination specific effects, such as a strong preference for domestic goods, are partly muted. The ranking we obtain then resembles a ranking within exporters and not within firms in general.

Export competition is constructed as follows:

$$comp_{Ki_c} = w_i \frac{1}{N_{1i}} \sum_{s \in S_{1i}} \sum_{k \in K \setminus \{c\}} imports_{ks} + (1 - w_i) \frac{1}{N_{2i}} \sum_{s \in S_{2i}} \sum_{k \in K \setminus \{c\}} imports_{ks},$$

where w_i is the proportion of turnover related to firm i's core business obtained from EFIGE, serving us as a weight for primary industries. N_{1i} and S_{1i} are the number and set of distinct primary industries respectively and are obtained from Amadeus. k are the individual countries in region K and $imports_{ks}$ are all industry s imports into country k which we obtain from the UN Comtrade WITS database. Secondary industry characteristics are defined analogically.[1]

When summing up the industry imports in destination region K, we have to account for the fact that the home country c of firm i might be part of that region. Thus, when we define the world to be the region of interest, we subtract imports into country c from the sum of imports over all countries in order to obtain the relevant export market. Naturally, the world export market is different for France than it is for Germany.

[1] Besides the four digit primary and secondary codes, Amadeus provides a three digit core code for each firm. If no information on primary and secondary industries was provided, we use the core code information in order to construct the export competition. To avoid scaling issues, we construct the core code trade flow as an average over all lower-level four digit trade flows. If firms did not provide information on the share of turnover they relate to the core business, we use the sample average (90%) for weighting. Note that about two thirds of the firms in our sample assign all their activity to the core business line. Of those, many still provide information on distinct primary and secondary industries. As this might cast doubt on our weighting scheme, we also tried using only the core code industry or only primary industries for calculations. Our results were robust to such alterations.

Table B.1: Summary Statistics

variable	*observations*	*mean*	*min*	*max*	*std. dev.*
world export market share	9807	0.0590	0	33.450	0.548
export volume EXPvol	10255	10698.02	0	4827955	105146.4
exports / turnover EXPshare	13988	0.179	0	1	0.263
offshoring (relative to all intermediates purchased)	14031	0.107	0	1	0.214
offshoring (relative to turnover)	13856	0.0397	0	1	0.102
FDI (relative to turnover)	14146	0.014	0	1	0.085
service offshoring (relative to turnover)	14631	0.003	0	1	0.0231
decentralized management	14138	0.291	0	1	0.454
product quality (relative to highest quality in the market 100)	14653	87.38	0	100	15.34
product quality (normalized)	14653	0.00	-8.40	1.37	1.00
product innovation	14654	0.491	0	1	0.50
process innovation	14654	0.441	0	1	0.497
employment	14654	92.80838	10	30000	502.1967
turnover	10781	32012.23	0.0266	2.06×10^7	295586.1
labor productivity	10622	192.9212	0	14524.92	374.312
tfp (avg: 2001 - 2007)	10158	-0.0934	-6.616	2.632	0.454
share of family board members	12522	0.435	0	1	0.418
family CEO	14654	0.623	0	1	0.485
young firm	14654	0.070	0	1	0.256
share of high- and medium skilled employees	12813	0.741	0	1	0.295
EQI 2010 (NUTS-2 level)	13060	0.467	-2.284	1.456	0.654
GDP per capita	14654	27695.83	10500	34000	3890.071
population	14654	59779.06	8322	82120	16964.83
foreign wage per employee (Eastern Europe, abs.)	13761	6244.87	2158.28	7174.23	383.72
foreign wage per employee (China & India, abs.)	13761	2585.32	897.58	3105.86	157.69
foreign wage per employee (China & India, rel.)	13761	0.0668	0.0180	0.251	0.0287
low skilled labor share in total compensation	13761	0.116	0.0350	0.145	0.00722
world export supply of intermediates	13190	412723	136306.6	1311349	165574
hierarchical religion	14556	0.729	0	0.997	0.298
religious faith	14556	0.163	0	0.468	0.102
trust	14556	0.346	0.165	1	0.0871

Table B.2: Descriptions of Variables

variable	***description***
world export market share	share of firm exports to export market competition in the world in %. See B.1 for detailed information
export volume EXPvol	percentage of 2008 annual turnover represented by exports (*EFIGE*) × operating revenue in 2008 in th. USD (*Amadeus*)
exports / turnover EXPshare	percentage of 2008 annual turnover represented by exports (*EFIGE*)
offshoring	share of 2008 total purchased intermediate goods (from anywhere) represented by intermediate goods purchased from abroad (*EFIGE*)
offshoring / intermediates	share of 2008 annual turnover represented by purchased intermediates goods (from anywhere)× offshoring (relative to all intermediates purchased) (*EFIGE*)
FDI	percentage of 2008 annual turnover represented by production activities through direct investment (*EFIGE*)
service offshoring	percentage of 2008 annual turnover represented by purchased services (from anywhere)× percentage of 2008 total purchased services (from anywhere) represented by services purchased from abroad (*EFIGE*)
decentralized management	dummy indicating that with reference to strategic decisions the firm is decentralized, i.e. managers can take autonomous decisions in some business areas (*EFIGE*)
product quality	index indicating how firms would rank their main product in terms of quality, when the maximum quality available in the market equals 100 (*EFIGE*)
product quality (normalized)	index indicating how firms would rank their main product in terms of quality, when the country average in the market is set equal to 0 and the standard deviation of individual firms is set to 1 (based on *EFIGE*)
product innovation	dummy for firms that carried out any product innovation in years 2007-2009 (*EFIGE*)
process innovation	dummy for firms that carried out any process innovation in years 2007-2009 (*EFIGE*)
employment	total number of employees in the firm's home country (*EFIGE*)
turnover	operating revenue in 2008 in th. USD (*Amadeus*)
labor productivity	value added per employee: operating revenue in 2008 in th. USD× (1 - offshoring (relative to turnover)) / employment
tfp	total factor productivity (*EFIGE*)
share of family board members	ratio of entrepreneurs/executives (included middle management) who are related to the family who owns the company to total number of entrepreneurs/executives (*EFIGE*)
family CEO	dummy for firms where the chief executive officer (CEO)/company head is the individual who owns or controls the firm or is a member of the family that owns/controls it (*EFIGE*)
young firm	dummy indicating young innovative companies (year of establishment less than 6 years before survey was taken) (*EFIGE*)
share of high- and medium skilled employees	ratio of white and skilled blue collars to white, skilled blue, unskilled blue collars and apprentices (*EFIGE*)
EQI 2010	European Quality of Government Index 2010, see Charron et al. (2014). Due to data limitations we use the NUTS-2 level for Austria, Spain, France and Italy and the NUTS-1 level for Germany, UK and Hungary
GDP per capita	gross domestic product per capita (in Euro) at the country level 2008, (*Eurostat*, nama_r_e2gdp)
population	population in thousand at the country level (*Eurostat*, nama_r_e3popgdp)

Table B.3: Descriptions of Variables - Instrumental Variables

variable	*description*
foreign wage per employee (Eastern Europe, absolute)	ratio of wage (in USD) to employment from *INDSTAT4 2013* at the industry-country level (average 2005 to 2007). The region East consists of Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Czech Republic, Romania, Slovakia, Slovenia and Hungary (this resembles the group "other UE countries" in *EFIGE*). We use the value at the 10th percentile of these countries in order to guarantee a low wage value for each industry. We then connect these values at the ISIC input industry level to output industries via input coefficients from the IO table (*OECD Stan*, Germany 2005). This results in IO weighted average values at the output industry level. Using industry correspondence tables from *Eurostat*, we can link these ISIC output industry values to the primary, secondary and core code industries from *Amadeus* (US SIC). Then the weighting applies as for the market share.
foreign wage per employee (China & India, absolute)	ratio of wage (in USD) to employment from *INDSTAT4 2013* at the industry-country level (average 2005 to 2007). We use the average of the Chinese and the Indian value (China and India also define a country group in *EFIGE*). We then connect these values at the ISIC input industry level to output industries via input coefficients from the IO table (*OECD Stan*, Germany 2005). This results in IO weighted average values at the output industry level. Using industry correspondence tables from *Eurostat*, we can link these ISIC output industry values to the primary, secondary and core code industries from *Amadeus* (US SIC). Then the weighting applies as for the market share.
foreign wage per employee (China & India, relative)	ratio of wage (in USD) to employment from *INDSTAT4 2013* at the industry-country level (average 2005 to 2007). We use the ratio of the average Chinese and Indian value (China and India also define a country group in *EFIGE*) to the value of firm's home country. We then connect these values at the ISIC input industry level to output industries via input coefficients from the IO table (*OECD Stan*, Germany 2005). This results in IO weighted average values at the output industry level. Using industry correspondance tables from *Eurostat*, we can link these ISIC output industry values to the primary, secondary and core code industries from *Amadeus* (US SIC). Then the weighting applies as for the market share.
low skilled labor share in total compensation	low-skilled labor compensation (share in total labor compensation) from *WIOD* database, February 2012 release at the industry-country level (average 2004-2007). We use the median of the Austrian and the German value. We then connect these values at the ISIC input industry level to output industries via input coefficients from the IO table (*OECD Stan*, Germany 2005). This results in IO weighted average values at the output industry level. Using industry correspondance tables from *Eurostat*, we can link these ISIC output industry values to the primary, secondary and core code industries from *Amadeus* (US SIC). Then the weighting applies as for the market share.
world export supply of intermediates	intermediate exports by country pair (in million USD) from *WIOD*, see Timmer (2012). For each country in our sample, we add up exports from any country in the world to all other countries, excluding the firm's home country on both sides. This gives us the world export supply of intermediates in a specific industry for each of the countries in our sample. Weight industry export supply of intermediates with IO coefficients in order to obtain weighted intermediate export supply for a given output industry. Concordance from NACE to US SIC (by hand). Link these output industry values to the primary, secondary and core code industries from Amadeus. Then the weighting applies as for the market share. Compare Hummels et al. (2014).
hierarchical religion	share of people belonging to a hierarchical religion (Roman Catholic, Muslim or Orthodox) in a specific NUTS-1 region (*European Value Survey 2008*)
religious faith	share of people who think that generally speaking most people can be trusted in a specific NUTS-1 region (*European Value Survey 2008*)
trust	share of people who consider it to be especially important that children are encouraged to learn religious faith at home in a specific NUTS-1 region (*European Value Survey 2008*)

Table B.4: Offshoring and World Market Shares - Robustness I

dependent variable	**EMS** *(1)*	**EMS** *(2)*	**EMS** *(3)*	**EMS** *(4)*	**EMS** *(5)*	**EMS** *(6)*	**EMS** *(7)*	**EMS** *(8)*	**EMS** *(9)*	**EMS** *(10)*	**EXPshare** *(11)*	**EXPvol** *(12)*
offshoring	0.0757**	0.0693*	0.0682*	0.0179	0.0737**	0.0141					0.207***	12,739***
	(0.0354)	(0.0386)	(0.0391)	(0.0392)	(0.0357)	(0.0464)					(0.0148)	(4,394)
product quality (normalized)	0.00793*	0.00710	0.00731	0.00626			0.00779*	0.0105**	0.00831*	0.00846*	0.00528**	1,014
	(0.00458)	(0.00499)	(0.00538)	(0.00443)			(0.00463)	(0.00415)	(0.00455)	(0.00456)	(0.00247)	(626.3)
ln(employment)	0.132***	0.137***	0.141***		0.132***		0.133***	0.119***	0.134***	0.134***	0.0583***	23,897***
	(0.0231)	(0.0243)	(0.0282)		(0.0230)		(0.0234)	(0.0207)	(0.0229)	(0.0228)	(0.00294)	(3,445)
ln(labor productivity)	0.0714***	0.0698***		-0.0328***	0.0713***		0.0727***	0.0667***	0.0715***	0.0710***	0.0326***	10,893***
	(0.0146)	(0.0160)		(0.00732)	(0.0146)		(0.0143)	(0.0145)	(0.0146)	(0.0146)	(0.00317)	(1,922)
decentralized	-0.00626	-0.00568	-0.00210	-0.00403	-0.00677	-0.00156	-0.00579	-0.000214	-0.00539	-0.00555	0.0173***	-3,105
	(0.0154)	(0.0143)	(0.0170)	(0.0148)	(0.0155)	(0.0169)	(0.0155)	(0.0157)	(0.0155)	(0.0156)	(0.00603)	(2,155)
tfp (avg. 2001 - 2007)			0.0616***			0.00477						
			(0.0186)			(0.0203)						
ln(turnover)				0.123***		0.124***						
				(0.0205)		(0.0250)						
product innovation					0.0126*	0.0172**						
					(0.00676)	(0.00870)						
offshoring (% of turn)							0.133**					
							(0.0672)					
FDI (% of turn)								0.491**				
								(0.235)				
service offshoring (% of turn)									0.676			
									(0.436)			
outsourcing (% of turn)										0.147		
										(0.170)		
industry f.e.	*yes*	*SIC 3dig*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
region f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
observations	8,931	8,928	7,162	8,931	8,931	7,162	8,931	8,648	8,928	8,931	8,931	8,931
adjusted R^2	0.069	0.089	0.077	0.069	0.069	0.084	0.069	0.071	0.069	0.069	0.203	0.119

Table B.5: Offshoring and World Market Shares - Robustness II

dependent variable:	***EMS*** (1)	***EMS*** (2)	***EMS*** (3)	***EMS*** (4)	***EMS*** (5)	***EMS*** (6)	***EMS*** (7)	***EMS*** (8)	***EMS*** (9)	***EMS*** (10)	***EXPshare*** (11)	***EXPvol*** (12)
offshoring	0.532***	-0.546	0.590***	0.505***	0.537***	0.530**					1.578***	15,354
	(0.162)	(0.631)	(0.210)	(0.161)	(0.171)	(0.222)					(0.203)	(19,228)
product quality (normalized)	0.00646	0.00923*	0.00572	0.00538			0.00404	0.00929**	0.0121*	0.0118**	0.00119	973.2
	(0.00451)	(0.00516)	(0.00538)	(0.00441)			(0.00465)	(0.00450)	(0.00712)	(0.00522)	(0.00379)	(603.4)
ln(employment)	0.114***	0.157***	0.118***		0.114***		0.109***	0.0699**	0.0767**	0.128***	0.00583	23,541***
	(0.0227)	(0.0367)	(0.0283)		(0.0227)		(0.0233)	(0.0322)	(0.0380)	(0.0222)	(0.00883)	(3,460)
ln(labor productivity)	0.0690***	0.0739***		-0.0127	0.0690***		0.0819***	0.0567***	0.0609***	0.0622***	0.0273***	10,727***
	(0.0142)	(0.0154)		(0.0103)	(0.0142)		(0.0152)	(0.0146)	(0.0185)	(0.0140)	(0.00475)	(1,868)
decentralized	-0.0112	0.000293	-0.00777	-0.00619	-0.0110	-0.00519	-0.00933	-0.0185	-0.0111	-0.00747	0.00321	-3,201
	(0.0156)	(0.0165)	(0.0176)	(0.0149)	(0.0156)	(0.0173)	(0.0156)	(0.0202)	(0.0213)	(0.0158)	(0.00940)	(2,141)
tfp (avg. 2001 - 2007)			0.0594***			0.0194						
			(0.0188)			(0.0211)						
ln(turnover)				0.0960***		0.100***						
				(0.0203)		(0.0251)						
product innovation					-0.00295	0.000213						
					(0.00983)	(0.0124)						
offshoring (% of turn)							1.497***					
							(0.455)					
FDI (% of turn)								3.773**				
								(1.868)				
service offshoring (% of turn)									27.47*			
									(14.04)			
outsourcing (% of turn)										1.918**		
										(0.746)		
industry f.e.	*yes*	*SIC 2dig*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
region f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	9,063	9,063	7,201	9,063	9,063	7,201	9,063	8,778	9,060	9,063	9,063	9,063
first stage results:												
IV1: foreign wage per employee	×	×	×	×	×	×	×	×	×	×	×	×
IV2: low skilled labor share in compensation	×	×	×	×	×	×	×	×	×	×	×	×
Kleibergen-Paap F-Stat	38.47	3.809	27.5	38.947	35.473	23.36	28.818	3.23	4.334	8.049	38.47	38.47
Hansen J-stat (p-val)	0.694	0.7198	0.2795	0.9687	0.6515	0.8606	0.714	0.1457	0.3785	0.0642	0.0445	0.1609

Table B.6: Offshoring and World Market Shares - Robustness III

dependent variable:	***world export market share (%)***								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
offshoring	0.532***	0.387***	0.626***	0.495***	0.668**	0.538***	0.532*	0.549***	0.549*
	(0.162)	(0.128)	(0.222)	(0.178)	(0.273)	(0.160)	(0.285)	(0.184)	(0.295)
product quality (normalized)	0.00646	0.00687	0.00620	0.00730	0.00690	0.00720	0.00646	0.00657	0.00657
	(0.00451)	(0.00457)	(0.00466)	(0.00466)	(0.00491)	(0.00472)	(0.00467)	(0.00402)	(0.00415)
ln(employment)	0.114***	0.119***	0.110***	0.119***	0.113***	0.117***	0.114***	0.114***	0.114***
	(0.0227)	(0.0234)	(0.0241)	(0.0222)	(0.0264)	(0.0229)	(0.0276)	(0.0222)	(0.0271)
ln(labor productivity)	0.0690***	0.0695***	0.0687***	0.0730***	0.0725***	0.0729***	0.0690***	0.0698***	0.0698***
	(0.0142)	(0.0144)	(0.0144)	(0.0149)	(0.0151)	(0.0150)	(0.0173)	(0.0140)	(0.0171)
decentralized	-0.0112	-0.00966	-0.0122	-0.0124	-0.0144	-0.0129	-0.0112	-0.0115	-0.0115
	(0.0156)	(0.0153)	(0.0154)	(0.0166)	(0.0155)	(0.0162)	(0.0149)	(0.0159)	(0.0152)
industry f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
region f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
cluster robust	*no*	*no*	*no*	*no*	*no*	*no*	*industry*	*region*	*twoway*
observations	9,063	9,063	9,063	8,764	8,764	8,764	9,063	8,928	8,928
first stage results:									
IV1: foreign wage per employee	*abs East*	*abs China/India*	*rel China/India*	*abs East*		*abs East*	*abs East*	*abs East*	*abs East*
IV2: low skilled labor share in compensation	×	×	×		×	×	×	×	×
IV3: intermediates supply				× (+)	×	×			
Kleibergen-Paap F-Stat	38.47	36.65	21.85	25.62	20.37	26.24	15.90	33.56	15.94
Hansen J stat (P-val)	0.69	0.21	0.44	0.64	0.67	0.83	0.80	0.71	0.78

Table B.7: Decentralization, Quality and Innovation - Robustness I

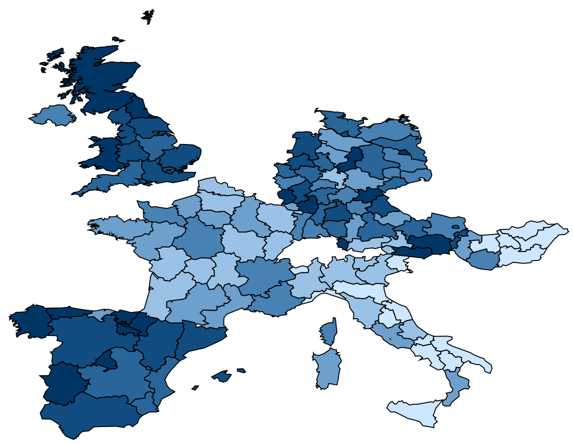
dependent variables:	*product quality (normal.) above ctry. mean*								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
decentralized	1.220***	1.479***	1.402***	-9.865	1.005***	0.789***	1.557***	1.510***	1.333***
	(0.303)	(0.309)	(0.254)	(15.32)	(0.177)	(0.249)	(0.415)	(0.555)	(0.443)
decentralized × share of family board members	-3.791***	-5.206***	-4.058***	6.604	-1.999***	-1.665*	-4.513***	-4.382***	-3.908***
	(0.745)	(1.653)	(0.734)	(12.13)	(0.330)	(0.959)	(1.012)	(1.403)	(1.152)
share of family board members	0.900***	1.204***	0.968***	-2.062	0.525***	1.079***	1.070***	1.094***	0.942***
	(0.167)	(0.344)	(0.161)	(3.642)	(0.0762)	(0.121)	(0.227)	(0.331)	(0.235)
family CEO	0.0449	0.0274	0.0569*	-0.879	0.0801***	-0.191**	0.0522	-0.0503	0.0489
	(0.0347)	(0.0549)	(0.0338)	(1.360)	(0.0238)	(0.0826)	(0.0406)	(0.0416)	(0.0460)
young	0.0166	0.0334	0.0178	0.0297	-0.00623	0.000336	0.0337	0.0241	0.0230
	(0.0404)	(0.0549)	(0.0425)	(0.192)	(0.0300)	(0.0304)	(0.0464)	(0.0543)	(0.0516)
share of high- and med. skilled emp.	0.00112	-0.000806	0.00177	-0.0551	0.00442	0.0373	0.0129	0.0201	0.0142
	(0.0336)	(0.0430)	(0.0350)	(0.165)	(0.0244)	(0.0275)	(0.0384)	(0.0433)	(0.0279)
ln(employment)	0.0117	0.0137	0.00579	0.430	0.00383	0.0627***	-0.000837		-0.00371
	(0.0141)	(0.0185)	(0.0134)	(0.603)	(0.00997)	(0.0196)	(0.0171)		(0.0252)
ln(labor productivity)	0.00132	-0.00192	-0.00257	0.251	0.00263	0.0173*	-0.00421		-0.00739
	(0.0120)	(0.0144)	(0.0119)	(0.354)	(0.00847)	(0.0100)	(0.0138)		(0.0162)
foreign group								-0.173**	
								(0.0788)	
ln(turnover)								0.0215	
								(0.0135)	
tfp (avg 01-07								-0.0518	
								(0.0443)	
industry f.e.	yes	yes	yes	yes	yes	yes	SIC 3dig	SIC 3dig	SIC 3dig
regional controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
cluster robust	*no*	*no*	*no*	*no*	*no*	*no*	*no*	*no*	*twoway*
observations	7,780	7,780	7,780	7,780	7,780	7,780	7,772	5,776	7,646
first stage results:									
IV1: hierarchical religion	×	×	×		×	×	×	×	×
IV2: religious faith	×		×	×	×	×	×	×	×
IV3: trust		×	×		×	×			
IV4: religious faith × share of family board members				×	×				
IV5: religious faith × hierarchical religion						×			
A-P F-Stat (decentralized)	33.06	47.27	24.39	0.36	19.42	13.29	22.63	10.89	9.58
A-P F-Stat (decentralized × share of family board members)	23.12	7.30	12.38	6.65	13.40	5.55	15.56	8.89	6.25
A-P F-Stat (share of family board members)						107.47			
Kleibergen-Paap F-Stat (joint)	17.07	4.55	11.14	0.22	16.56	3.81	12.57	6.03	8.82
Hansen J stat (P-val)			0.32		0.00	0.31			

Table B.8: Decentralization, Quality and Innovation - Robustness II

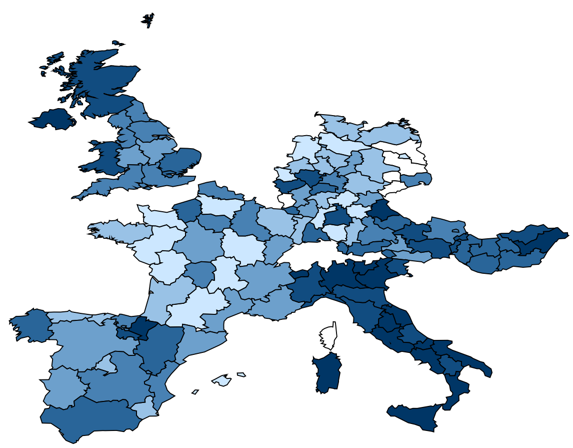
dependent variables:	*product quality (normal.) above ctry. mean*								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
decentralized	0.647***	0.801***	0.755***	-4.828	0.557***	1.048***	0.940***	0.855**	0.938***
	(0.205)	(0.192)	(0.171)	(7.814)	(0.144)	(0.265)	(0.270)	(0.372)	(0.340)
decentralized × share of family board members	-1.472***	-2.317**	-1.631***	3.662	-0.604**	-2.745***	-1.946***	-1.825**	-1.942***
	(0.501)	(0.997)	(0.483)	(6.200)	(0.280)	(1.023)	(0.654)	(0.913)	(0.672)
share of family board members	0.340***	0.521**	0.381***	-1.123	0.159**	0.330**	0.449***	0.438**	0.451***
	(0.114)	(0.209)	(0.108)	(1.861)	(0.0657)	(0.138)	(0.148)	(0.217)	(0.146)
family CEO	0.0493**	0.0388	0.0564**	-0.407	0.0680***	0.173**	0.0724***	0.0334	0.0704***
	(0.0230)	(0.0331)	(0.0221)	(0.693)	(0.0198)	(0.0881)	(0.0259)	(0.0261)	(0.0259)
young	0.0125	0.0224	0.0132	0.0189	0.00117	0.0212	0.0183	-0.0251	0.0134
	(0.0268)	(0.0331)	(0.0276)	(0.0961)	(0.0247)	(0.0345)	(0.0298)	(0.0361)	(0.0335)
share of high- and med. skilled emp.	0.0239	0.0228	0.0243	-0.00385	0.0256	0.00787	0.0229	0.0247	0.0230
	(0.0224)	(0.0259)	(0.0229)	(0.0830)	(0.0207)	(0.0308)	(0.0245)	(0.0276)	(0.0217)
ln(employment)	0.0547***	0.0559***	0.0512***	0.261	0.0502***	0.0244	0.0418***		0.0429***
	(0.00954)	(0.0114)	(0.00899)	(0.308)	(0.00825)	(0.0214)	(0.0112)		(0.0133)
ln(labor productivity)	-0.00726	-0.00919	-0.00958	0.116	-0.00698	-0.0190	-0.00781		-0.00803
	(0.00850)	(0.00933)	(0.00840)	(0.180)	(0.00751)	(0.0120)	(0.00920)		(0.0105)
foreign group								-0.0703	
								(0.0530)	
ln(turnover)								0.0376***	
								(0.00893)	
tfp (avg 01-07)								-0.0761***	
								(0.0291)	
industry f.e.	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*SIC 3dig*	*SIC 3dig*	*SIC 3dig*
regional controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
cluster robust	*no*	*no*	*no*	*no*	*no*	*no*	*no*	*no*	*twoway*
observations	7,780	7,780	7,780	7,780	7,780	7,780	7,772	5,776	7,646
first stage results:									
IV1: hierarchical religion	×	×	×		×	×	×	×	×
IV2: religious faith	×		×	×	×	×	×	×	×
IV3: trust		×	×		×	×			
IV4: religious faith × share of family board members				×	×				
IV5: religious faith × hierarchical religion						×			
A-P F-Stat (decentralized)	33.06	47.27	24.39	0.36	19.42	13.29	22.63	10.89	9.58
A-P F-Stat (decentralized × share of family)	23.12	7.30	12.38	6.65	13.40	5.55	15.56	8.89	6.25
A-P F-Stat (share of family board members)						107.47			
Kleibergen-Paap F-Stat (joint)	17.07	4.55	11.14	0.22	16.56	3.81	12.57	6.03	8.82
Hansen J-stat (p-val)			0.36		0.01	0.36			

Figure B.1: Decentralized Organizations and Religious Beliefs Across European Regions

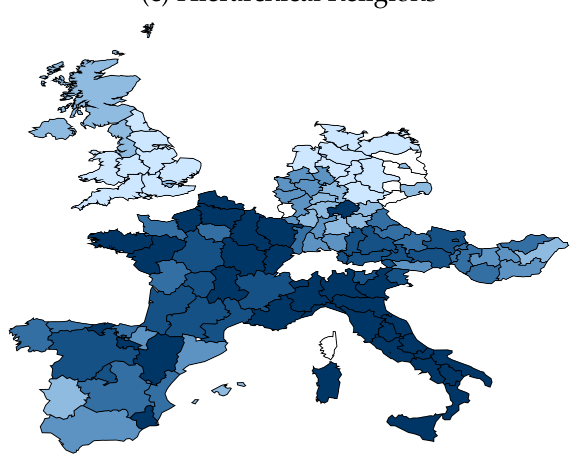
(a) Decentralized Organizations



(b) Religious Faith



(c) Hierarchical Religions



CHAPTER C

Appendix Chapter IV

C.1 Theory Appendix

A Simple Illustration of Trade in Tasks and Agency Problems

Consider the following textbook hidden action problem of a firm (see for example Bolton and Dewatripont (2005)). A risk neutral firm owner employs a manager with constant absolute risk aversion (CARA). The manager's preferences are described by the following negative exponential utility function:

$$u\left(w,a\right)=-e^{-\eta\left[w-\psi(a)\right]},$$

where w is the manager's monetary compensation and $\eta = -u''/u' > 0$ his constant rate of risk aversion. The manager needs to expand effort a and his costs to expand effort are quadratic and can be described as $\psi\left(a\right) = 0.5ca^2$ (measured in monetary units). The firm owner can only write a linear contract that takes the following form:

$$w=f+sq.$$

The variable f denotes the fixed part of compensation and sq is the variable part of compensation. Variable s measures the slope of the contract which indicates how sensitive compensation reacts to changes in performance q. The performance of a manager is assumed to be equal to effort plus noise:

$$q = a + \varepsilon,$$

where the noise term ε is normally distributed with zero mean and variance σ^2. As discussed in Section IV.2, trade in tasks t can potentially reduce the costs of managerial effort ($c = c(t)$, $c'(t) < 0$) and can have an influence on the uncertainty in the performance of the firm either by creating hedging opportunities or by making production more complex and opaque ($\sigma = \sigma(t)$, $\sigma'(t) \gtreqless 0$).

The firm owner maximizes his expected profit $E(q-w)$ subject to the manager's incentive compatibility constraint and the participation constraint, where $u(\underline{w})$ is the manager's reservation utility level:

$$\begin{gathered} \max_{a,t,s} E(q-w) \\ s.t. \\ a \quad a \in \arg\max_a E\left(-e^{-\eta[w-\psi(a)]}\right) \\ E\left(-e^{-\eta[w-\psi(a)]}\right) \geq u(\underline{w}). \end{gathered}$$

Since the performance signal is normally distributed, maximizing his expected utility is equal to maximizing the term $-e^{-\eta\left[t+sa-0.5ca^2-0.5\eta s^2\sigma^2\right]}$, where $t + sa - 0.5ca^2 - 0.5\eta s^2\sigma^2$ is the manager's certainty equivalent. Consequently, the manager will expend effort $a = s/c$ and if $c'(t) < 0$ trade in tasks will increase his effort level for a given slope s. Given that $a = s/c$, the firm owner chooses the slope to equal:

$$s = \frac{1}{1 + \eta c(s)\,\sigma(s)^2}.$$

This illustrates how trade in tasks can affect the performance sensitivity in executive compensation. If trade in tasks makes managers more productive and reduces their effort costs $c(s)$, they will face steeper incentive schemes. Furthermore, if trade in tasks reduces uncertainty as firms can hedge between more input suppliers and $\sigma(s)$ decreases, executive compensation is also likely to become more sensitive to firm performance. However, if trade in tasks increases uncertainty, the steepness of compensation contracts is likely to decrease.

C.2 Data Appendix

Table C.1: Summary Statistics

variable	*observations*	*mean*	*min*	*max*	*std. dev.*
total compensation	115,388	2,598.2	0.8	3,474,515	15,781.15
ln total compensation	115,388	6.6	-0.2	15.1	1.5
equity-linked compensation	80,730	2,657.8	0.0	3,473,921	18,483.3
ln equity-linked compensation	77,761	6.1	-5.0	15.1	2.3
executive compensation / wage bill per employee	72,803	99.8	-17,420.2	389,224.2	2,665.3
ln (executive compensation / wage bill per employee)	72,792	2.3	-6.3	12.9	1.5
task trade	132,306	0.006	-0.2	0.3	0.03
import competition	132,332	0.003	-0.2	0.2	0.02
world export supply of inputs	132,332	219,186.2	34,714.9	1,179,208	117,917.2
market capitalization	129,646	5,536.0	0.03	606,203.2	19,429.52
ln market capitalization	129,646	6.3	-3.3	13.3	2.4
EBIT	130,649	610.1	-72,165.6	96,135.8	2,590.1
ln EBIT	104,043	4.5	-9.6	11.5	2.3
assets	133,999	21,261.8	0.0	3,074,215	113,338.2
ln assets	133,994	6.6	-11.3	14.9	2.7
industry value added	132,332	226,674	24.6	2,096,215	383,081.6
ln industry value added	132,332	11.2	3.2	14.6	1.6
industry employment	132,332	2,606.4	0.3	19,599.5	4,117.1
ln industry employment	132,332	6.9	-1.2	9.9	1.6

Table C.2: Description of Variables

variable	***description***
ln total compensation	natural logarithm of real total executive compensation (the sum of direct and equity-linked compensation) in 1000 USD (base period: January 2000) Source: BoardEx and own calculations as described in IV.3.1
ln equity-linked compensation	natural logarithm of real equity-linked executive compensation in 1000 USD (base period: January 2000) Source: BoardEx and own calculations as described in IV.3.1
ln (executive compensation / wage bill per employee)	natural logarithm of total executive compensation relative to firm level salary and benefit payments per employee Source: Thomson Worldscope, BoardEx and own calculations as described in IV.3.1
task trade	share of imported intermediates relative to the total intermediate consumption in deviations from the country-industry specific mean between 1998 and 2011 at the 2-digit NACE output industry level, averaged over all 4-digit SIC output industries according to firm business segment sales (see IV.3.1 for details) Source: trade flows from WIOD, business segment sales and firm SIC codes from Thomson Worldscope
import competition	imports relative to the sum of gross output and imports in deviations from the country-industry specific mean between 1998 and 2011 at the 2-digit NACE output industry level, averaged over all 4-digit SIC output industries according to firm business segment sales (see IV.3.1 for details) Source: trade flows and output from WIOD, business segment sales and firm SIC codes from Thomson Worldscope
world export supply of inputs	total sum of exported intermediates from and to third party countries in million USD weighted according to fix input coefficients from 1995, data are measured at the country-industry level for each year at the 2-digit NACE output industry level, averaged over all 4-digit SIC output industries according to firm business segment sales (see IV.3.1 for details) Source: trade flows from WIOD, business segment sales and firm SIC codes from Thomson Worldscope
ln market capitalization	natural logarithm of real stock market capitalization in million USD (base period: January 2000), market capitalization = market price year end × common shares outstanding Source: Thomson Worldscope
ln EBIT	natural logarithm of earnings before interest and taxes in million USD (base period: January 2000), EBIT = pre-tax income + interest expense on debt - capitalized interest Source: Thomson Worldscope
ln assets	natural logarithm of total assets in million USD (base period: January 2000), total assets = current assets + long term receivables + investment in unconsolidated subsidiaries + other investment + net property plant and equipment + other assets Source: Thomson Worldscope
ln industry value added	natural logarithm of industry value added in million USD weighted according to fix input coefficients from 1995, data are measured at the country-industry level for each year at the 2-digit NACE output industry level, averaged over all 4-digit SIC output industries according to firm business segment sales (see IV.3.1 for details) Source: value added from WIOD socio-economic accounts, business segment sales and firm SIC codes from Thomson Worldscope
ln industry employment	natural logarithm of industry employment in thousands of employees weighted according to fix input coefficients from 1995, data are measured at the country-industry level for each year at the 2-digit NACE output industry level, averaged over all 4-digit SIC output industries according to firm business segment sales (see IV.3.1 for details) Source: employment numbers from WIOD socio-economic accounts, business segment sales and firm SIC codes from Thomson Worldscope

Table C.3: List of Covered Stock Market Indices

(a) Continental Europe	
AEX	MDAX
AEX MidCap	MIBTEL
BCN GLOBAL 100	MIDEX
BEL 20	OBX
BEL 20 INSTITUTIONAL	OMX
CAC 40	OMX 20
DAX	PSI 20
EUROTOP 100	SBF 120
FTSE/MIB	SMF
IGBM	TecDAX
ISEQ OVERALL	WIG 20
LUXX	
(b) United Kingdom	
FTSE 100	FTSE SMALL CAP
FTSE 250	FTSE TECHMARK ALL SHARE
FTSE AIM	JSE ALL SHARE
FTSE FLEDGLING	
(c) United States	
DOW JONES INDUSTRIAL AVG	S&P MidCap 400
NASDAQ 100	S&P/TSX COMPOSITE
S&P 500	S&P/TSX 60

Table C.4: List of Covered Countries

Country	*Obs.*	*Country*	*Obs.*
Austria	524	Netherlands	4,204
Belgium	1,856	Norway	506
Bulgaria	16	Poland	120
Croatia	29	Portugal	1,087
Cyprus	195	Rep. of Ireland	2,998
Denmark	708	Romania	12
Finland	224	Spain	2,069
France	8,140	Sweden	1,655
Germany	11,126	Switzerland	1,778
Greece	1,245	U.K. - England	59,669
Italy	3,565	U.K.- Scotland	2,986
Luxembourg	336	U.K.- Wales	741
Malta	26	United States	44,885

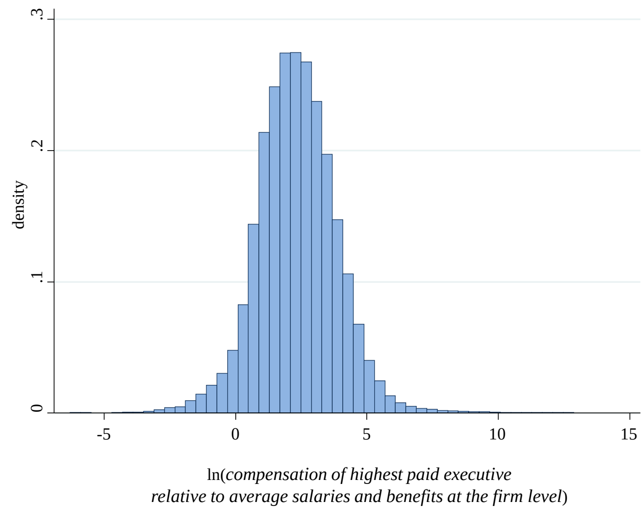


Figure C.1: Distribution of Manager-Worker Wage Inequality

Table C.5: Robustness Results

robustness check:	*alternative dependent variable*				*firm fix effects*							
dependent variable:	*ln equity compensation*				*ln total compensation*				*ln (executive compensation / wage bill per employee)*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
	OLS	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*
task trade × ln EBIT	0.643***	1.517***			0.301***	0.293*			0.271*	0.429*		
	(0.244)	(0.417)			(0.105)	(0.173)			(0.139)	(0.254)		
task trade × ln mrkt cap			1.059***	2.175***			0.168**	0.264*				0.369*
			(0.223)	(0.341)			(0.0849)	(0.140)				(0.202)
task trade	-2.544	-7.973***	-7.553***	-16.97***	-0.876	-0.737	-0.866	-1.606	-1.292*	-2.908	-1.716*	-3.788**
	(1.554)	(2.905)	(1.680)	(2.948)	(0.616)	(1.262)	(0.617)	(1.183)	(0.754)	(1.799)	(0.913)	(1.638)
ln EBIT	0.0930***	0.0909***			0.0700***	0.0700***			0.0342***	0.0343***		
	(0.0167)	(0.0169)			(0.00644)	(0.00649)			(0.00919)	(0.00918)		
ln mrkt cap			0.299***	0.294***			0.172***	0.171***			0.0953***	0.0947***
			(0.0226)	(0.0230)			(0.00922)	(0.00933)			(0.0120)	(0.0121)
ln assets	-0.0624*	-0.0615*	-0.156***	-0.159***	0.0965***	0.0964***	0.0285**	0.0285**	0.106***	0.107***	0.0674***	0.0676***
	(0.0337)	(0.0336)	(0.0285)	(0.0284)	(0.0159)	(0.0159)	(0.0129)	(0.0129)	(0.0209)	(0.0209)	(0.0180)	(0.0179)
industry controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
type of fix effects	manager	manager	manager	manager	firm	firm	firm	firm	firm	firm	firm	firm
region x year f.e.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
observations	54,291	54,291	66,699	66,699	78,320	78,320	98,161	98,161	54,037	54,037	68,324	68,324
no. of managers	12,348	12,348	14,276	14,276								
no. of firms					4,338	4,338	4,798	4,798	2,830	2,830	3,243	3,243
R^2	0.038		0.039		0.084		0.078		0.049		0.041	
first stage:												
Kleibergen-Paap F-statistic		285.135		376.279		241.205		345.496		80.374		126.325
A-P F-statistic: task trade		288.11		285.86		251.41		277.40		103.39		151.03
A-P F-statistic: task trade× ln perf		335.67		282.92		262.85		227.22		141.44		113.69

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Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebene Anregungen sind als solche kenntlich gemacht.

Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht. Sofern ein Teil der Arbeit aus bereits veröffentlichten Papers besteht, habe ich dies ausdrücklich angegeben.

München, der 11. Dezember 2014

Jan Simon Schymik