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Does Globalization Create Superstars? A Simple Theory of Managerial Wages*

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Abstract

To examine the impact of globalization on managerial compensation, we consider a matching model where firms compete both in the product market and in the managerial market. We show that globalization, that is, the simultaneous integration of product markets and managerial pools, leads to an increase in the heterogeneity of managerial salaries. Typically, while the most able managers obtain a wage increase, less able managers are faced with a reduction in wages. Hence our model can explain the increasing heterogeneity of CEO compensation that has been observed in the last few decades.

JEL Classification: D43, F15, J31, L13

Key Words: Globalization, manager remuneration, superstars

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1 Introduction

The salaries of top managers have recently received considerable public attention. According to Murphy and Zabojnik (2004), the average base salaries and bonuses of Forbes 800 CEOs increased from 700,000 U.S. dollars in 1970 to more than 2.2 million dollars in 2002.¹ This effect is even larger when stock options are taken into account. The rapid rise in CEO pay over the last 30 years has been confirmed with more recent data by Frydman and Jenter (2010). Such figures cause particular concern when they are related to ordinary wages. The ratio between CEO cash compensation and average pay for production workers in the U.S. climbed from 25:1 in 1980 to 90:1 in 2000 (Murphy and Zabojnik, 2004). It is hardly surprising that this particular aspect of income redistribution has been highly controversial. Shareholders, labor unions, politicians and mass media have criticized both the level of managerial incomes and the tenuous connection between pay and performance. The discussion is by no means confined to the United States, as surveys in the Economist (Economist, 2007) and Llense (2010) testify. In the United Kingdom, the discussions have led to the introduction of transparency rules for managerial pay (Severin, 2003).

Given the amount of public attention and the substantial academic research in this area, it is surprising that the causes of the recent salary increases are still imperfectly understood. In line with popular opinion, Bebchuk and Fried (2004) attribute the developments to managerial power. Shareholders, so their argument goes, have limited control over the wage-setting process, and the board often gives in to the interests of CEOs.

Murphy and Zabojnik (2004) take issue with such explanations. Without necessarily denying the existence of managerial rent-seeking activities, they argue that an explanation for recent salary increases on this basis would also require an increase in managerial power, which they find unconvincing. Instead, they propose the idea that the changes reflect an increasing demand for general, rather than firm-specific, managerial skills, “perhaps as a result of the steady progress in economics, management

¹The figures are in 2002 dollars. The Forbes 800 list contains all companies ranked in the top 500 by assets, income, market capitalization or revenues. Typically, there are about 800 companies on the list.

science, accounting, finance and other disciplines which, if mastered by a CEO, can substantially improve his ability to manage a company” (Murphy and Zbojnik, 2004, p.193). This results in an increasing tendency for outside hiring and a resulting competition for managers that drives up wages. Gabaix and Laudier (2006) argue that the increase in managerial pay can be attributed to an increase in firm size.

In this paper, we provide an alternative explanation of recent trends that relates to informal arguments that are often advanced in popular accounts of the subject. Some observers regard increasing managerial wages as a by-product of globalization (see the discussion in Lense 2010, Frydman and Jenter 2010). We therefore examine the relation between globalization and managerial wages. In particular, we investigate how the simultaneous integration of product markets and managerial markets affects wages. We consider a matching model where a number of firms compete both in the product market and in the managerial market. In the product market, they interact as oligopolists. In the managerial labor market, they compete for the services of managers with heterogeneous abilities, where the heterogeneity is reflected in the different marginal cost levels of the firms they manage. Globalization thus refers to the simultaneous replacement of national markets with one integrated market with (i) higher demand, (ii) a larger number of firms and (iii) a larger pool of managers.

The effects of globalization on managerial remuneration are subtle, because channels (i)-(iii) can potentially have countervailing effects. Nevertheless, we obtain a robust prediction about the effects of globalization on the distribution of managerial wages: Globalization leads to an increase in the heterogeneity of managerial salaries. Typically, while the most able managers obtain a wage increase, less able managers are faced with a wage reduction. Hence our model can explain the increasing heterogeneity of CEO compensation that has been observed in the last few decades.

However, our model does not predict an increase in the average wage levels of managers without additional parameter restrictions. The reduction in wages for less competent managers may well offset the wage increases of the most competent managers. Nevertheless, our approach is consistent with the idea that globalization lies behind the increasing wages of *top* executives. Empirical results on *average* managerial salaries

typically refer to the averages within a fairly small group of top managers.² As our model predicts pay rises for the best-paid managers due to globalization, such averages should also be expected to rise.

It is crucial for our results that the equilibrium wage differences between more and less competent managers reflect the differences in profits between more and less efficient firms. Understanding the effects of globalization on managerial wages therefore boils down to understanding how efficiency differences translate into profit differences. Intuitively, the more intense competition induced by globalization increases the payoff for being more efficient in the sense that the profit ratio between the most efficient firm and its less efficient competitors necessarily increases.

While we believe we have uncovered the critical link between globalization and managerial wages, we do not claim to have a full theory of managerial compensation. For instance, we have chosen to abstract from asymmetric information between owners and managers because this allows us to identify the basic mechanism in the most transparent way: Globalization increases the payoff from being more efficient than competitors; this leads to competition for talent and therefore has a positive effect on wage spread. This effect does not require any asymmetric information, even though it would most likely survive in its presence.

Several existing papers (e.g. Schmidt, 1997 and Raith, 2003) deal with the effects of increasing competitive intensity on managerial compensation and efforts in the presence of asymmetric information. The mechanisms driving these papers differ from ours. Both papers focus on the role of competition on the contracts that managers receive and on the induced efforts. In Schmidt (1997) the positive effect of competition on equilibrium managerial efforts results because competition increases the threat of liquidation which is assumed to be costly to managers. Competition therefore makes it less costly for firm owners to induce managerial effort. Raith (2003) models increasing competition as a reduction in transportation costs on a Salop circle. As long as the number of firms is unaffected, there is no effect of competition on equilibrium efforts. However, lower transportation costs lead to exit of the firms, which makes innovations

²Compare footnote 1.

more profitable for the remaining firms who therefore incentivize their managers to increase efforts. In our model, exit of firms reinforces the results, but it is not decisive for the positive effect of competition on the wage spread.

The approach in our paper is complementary to Baranchuk, MacDonald and Yang (2008), who study an agency model with free entry of firms where managers differ in their ability. They show that an increase in the demand for the industry increases both the overall level and skewness of the cross-section distribution of managers' compensation. However while globalization typically entails an increase in per-firm demand; it is not equivalent to a simple demand shock. In addition, it has other, potentially countervailing effects on managerial compensation. For instance, it simultaneously reduces margins which, in itself turns out to work against increasing wage spreads. It is therefore not obvious that globalization has similar effects as a demand increase.

Our paper is also related to the literature on superstars initiated by Rosen (1981), who shows how quality differences between agents lead to more than proportional differences in wages, turning agents with a fairly small quality advantage into "superstars" earning substantially more than the others. Our arguments show that globalization moves the market for managers closer to such a market for superstars.³ In the context of globalization, such superstar effects have for instance been discussed by Manasse and Turrini (2001), who also argue that globalization increases wage heterogeneity. Their analysis differs from ours in several important respects. First, they consider the differences in wages between skilled and unskilled workers rather than necessarily managers. Second, the channel through which decreasing trade costs operate is totally different: The increasing wage heterogeneity comes from redistribution of income between exporting and non-exporting firms whose skill-intensity differs.

The paper is organized as follows. Section 2 introduces the model. In Section 3, we characterize the equilibrium. Section 4 analyzes the effects of globalization as a comparative-statics exercise. Section 5 presents some extensions of the model which demonstrate the robustness of the argument. Section 6 concludes.

³In addition, Baranchuk, MacDonald and Yang (2008) consider effort choices for managers in this framework and derive implied ability distributions for the managers which are highly right-skewed.

2 The Model

The model consists of a *wage-setting stage* followed by an *application stage* and a *product-market stage*. Firms $i = 1, \dots, I$ compete for managers $m = 1, \dots, M$ with $M \geq I$. Each firm has marginal costs c_0 , but can hire a manager to improve its operations. We model the effect of a manager by the level of marginal costs $c(m)$ that he can achieve in a firm. We index the managers by quality, that is,

$$c(1) \leq c(2) \leq \dots \leq c(M).$$

Manager 1 has the highest quality and can achieve the lowest marginal cost. Manager M has the lowest quality. As a normalization, we assume that he achieves no efficiency gains and thus produces with marginal costs c_0 . $\mathcal{M}^I \equiv \{1, \dots, I\}$ denotes the set of the best I managers.

At the *wage-setting stage*, all firms simultaneously make wage offers to all managers. We denote the offer of firm i to manager m as w_{im} .

In the *application stage*, after having observed the wage bids, managers decide which offer to accept. Outside options are normalized to zero. In the first round of the application stage, each manager accepts the highest non-negative offer.⁴ If several firms have offered the most attractive wage to a manager m , he will select the firm with the lowest index. We call this the first tie-breaking rule. If only one manager accepts an offer from firm i , he will be employed. If two or more managers accept the offer, the firm will select one of them. As a second tie-breaking rule, we assume that a firm chooses the most competent manager if it is indifferent among several managers.⁵ In the second round of the application stage, the procedure is repeated with the rejected managers and the firms who have not yet filled their vacancy. The application process continues until each manager is either employed by a firm or rejected by all firms. These tie-breaking rules create particularly simple matching patterns. We will discuss their significance and alternative tie-breaking rules in section 3.

⁴As a tie-breaking rule, we thus assume that all managers choose to be employed as long as wages are non-negative, that is, at least as high as the outside option.

⁵This second tie-breaking rule can be dispensed with by formulating that matching process as a dynamic game where firms approach managers in decreasing order of ability. Proposition 1 can still be derived in such a model with slightly more notational complexity.

In the *product-market stage*, the I firms engage in oligopolistic competition, with marginal costs c_i given by the outcome of the application stage. Though several of our results are more general, we often specialize to a case where firms are Cournot competitors producing homogeneous goods facing an inverse demand function $p = a - bx$, where x is aggregate output, p is the price, and a, b are two positive numbers.

For any manager of type m , we write \mathcal{M}_{-m}^I for the set of remaining managers among the best I managers. In many oligopoly models, if firm i employs manager m and the competitors employ the remaining managers in \mathcal{M}_{-m}^I , profits are independent of the exact matching between managers in \mathcal{M}_{-m}^I to competitors. Hence, gross profits Π_i of firm i if it employs a manager of type m and the other firms hire the remaining managers in \mathcal{M}_{-m}^I can be written as $\Pi_i(m, \mathcal{M}_{-m}^I)$, where we impose the symmetry assumption that the functional form Π_i is the same for each i . For simplicity, we will suppress \mathcal{M}_{-m}^I in the following and write $\Pi_i(m)$. Finally, net profits (or payoffs) of firm i are $\Pi_i(m) - w_{im}$.

3 Equilibria

We now provide a simple characterization of the symmetric equilibrium in pure strategies of the game that is not specific to the linear Cournot model we focus on later.

Proposition 1 *There always exist symmetric pure-strategy equilibria in which managers \mathcal{M}^I are employed and*

$$\begin{aligned}
 (i) \quad & w_{im}^* = \Pi_i(m) - \Pi_i(I) \text{ for } m < I \\
 (ii) \quad & w_{iI}^* = 0 \\
 (iii) \quad & w_{im}^* < 0 \text{ for } m > I. \\
 (iv) \quad & \text{All firms obtain net profits } \Pi_i(I).
 \end{aligned} \tag{1}$$

All symmetric equilibria must be of this type.

The proof of Proposition 1 is given in the Appendix.

According to (i), the wage differentials between managers $m < I$ reflect the additional gross profit that a firm achieves by replacing a less competent manager with a more competent manager at the expense of some competitor. Intuitively, with the proposed wage w_{im}^* increases in gross profits from hiring better managers would be exactly offset by corresponding wage increases. Conversely, lower wages would be offset by losses in gross profits resulting from lower efficiency. By (ii), the marginal manager receives his outside option.⁶ Proposition 1 reflects the two-sided competition in the markets for managers. Firms compete for managers which induces them to bid up wages to w_{im}^* . Managers compete by accepting the best offer they can obtain from the firms.

We have invoked particular tie-breaking rules to resolve indifferences. These particular rules have been chosen for convenience. There are two alternative approaches that lead to an equilibrium as described in Proposition 1. First, managers apply sequentially at all firms at which they are indifferent. The order in which they choose firm is not crucial. We have chosen one particular form in which managers start at firms with low indices and proceed to firms with higher indices. Second, managers coordinate on how they apply. For instance managers could always select the firm whose index is closest to their own index if they are indifferent among a set of firms. This would also yield the same unique equilibrium.⁷

4 The Impact of Globalization

We now consider the effects of different types of market integration. We always think of globalization as an integration of managerial and/or product markets corresponding to a suitable parameter shift in the Cournot model with heterogeneous firms. We therefore use Proposition 1 to derive a simple formula for the managerial wages.

⁶In the context of company worker training and technological spillovers it has been already observed that equilibrium wages of workers or R&D employees are given by their effects on firms profits (e.g., Gersbach and Schmutzler (2003)).

⁷The equilibrium does not exist if managers randomize among the set of firms at which they are indifferent. Then, a firm can for instance deviate from the candidate equilibrium by setting zero wages for all managers. Then within positive possibility the firm under consideration can employ a manager $m < I$ at zero wage as the manager $m = I$ may be employed in the first round by another firm. As a consequence, the expected payoff is larger than $\Pi_i(I)$.

4.1 Wages in the Cournot Model

The product market is characterized by a set of I active firms, inverse demand $p = a - bx$ ($b > 0$), and marginal costs (c_1, \dots, c_I) ; average costs are $\bar{c} = \frac{1}{I} \sum_{i=1}^I c_i$. We assume $a > \bar{c}$. The output of an individual firm i is denoted by x_i and $x = \sum_{i=1}^I x_i$ is the aggregate output. We assume that, for all $i \in \{1, 2, \dots, I\}$,

$$\frac{a + I\bar{c}}{I + 1} - c_i \geq 0. \quad (2)$$

Under this assumption, outputs in a Cournot oligopoly are

$$x_i = \frac{1}{b} \left(\frac{a + I\bar{c}}{I + 1} - c_i \right).$$

The price is

$$p = \frac{a + I\bar{c}}{I + 1}$$

Profits are

$$\pi_i = \pi(c_i, \bar{c}) = \frac{1}{b} \left(\frac{a + I\bar{c}}{I + 1} - c_i \right)^2. \quad (3)$$

According to Proposition 1, (3) implies that the equilibrium wage of manager m is given by

$$w_m = \frac{1}{b} \frac{(c_m - c_I) ((c_m + c_I)(1 + I) - 2a - 2\bar{c}I)}{I + 1}. \quad (4)$$

4.2 Integration

In the remainder of this section, we shall consider integration in such a way that the integrated economy results from the simultaneous addition of symmetric national demands, firms and manager pools. Also, all firms are assumed to be viable before and after integration. We shall refer to this type of integration as *market duplication*. However, in Section 5, we will address various alternatives.

First, it is instructive to isolate the effects of adding national demands, firms and managerial pools, respectively. This helps us to understand the source of our results for the model with simultaneous and symmetric integration, it is also useful to distinguish our contribution from others.

Specifically, we will consider the following three cases:

(i) A pure demand increase (reduction in b). This corresponds to a case with asymmetric managerial pools, where the country under consideration has the more competent managers, so that it takes over the production for the market of the other country.⁸

(ii) A pure increase in the number of firms. This corresponds to the case of asymmetric market access, where one country opens up to the exports of the other one without reciprocal market access.

(iii) Pure labor market integration, where product markets remain closed, but managers can move freely across country.

(i) and (ii) together summarize the effects of (symmetric) product market integration. One may argue that, even though product market integration is ubiquitous, except in some service industries and some industries with very high transportation costs, this is not necessarily the case for managerial labor markets. Even though increasing integration of managerial labor markets is clearly an important aspect of globalization,⁹ it is therefore worth analyzing this case separately and considering (i) and (ii) together.

The second important issue concerns the effects of integration on product market structure. In the short term, integration of product markets may well leave the total number of firms in the world economy unaffected, but in the long run, one would expect market exit. We shall deal with this possibility in Section 5.2.

4.3 Market duplication

We now present the benchmark model of market duplication. We assume two countries of equal size and with an equal pool of managers integrate. Hence, after integration, instead of two markets with $I = J$ firms and inverse demand $p = a - B \cdot x$ ($B > 0$), we have only one product market with $I = 2J$ firms, aggregate demand $p = a - \frac{B}{2} \cdot x$ and two managers of each quality $c(m)$.¹⁰ Equilibrium profits and wages under integration are denoted as Π_m^G and w_m^G , respectively, where m varies between 1 and J and each m stands for two firms that have the same marginal costs c_m .

⁸This is equivalent to a pure demand increase as analyzed by Baranchuk et al. (2008)

⁹See e.g. Fioole, van Driel and van Baalen (2007).

¹⁰The demand function results from horizontal addition of the two identical autarky demand functions.

We want condition (2) to hold for $I = J$ and $I = 2J$, so that profits of all firms are positive before and after integration. Because $\frac{a+J\bar{c}}{I+1} - c_i$ is decreasing in I , condition (2) is easier to satisfy for $I = J$ than for $I = 2J$; survival under autarky is easier than under globalization. Intuitively, while integration increases competition, it also increases demand, but the first effect dominates. Thus, as long as (2) holds for $I = 2J$, profits and wages under autarky and globalization are given by (3) and (4), respectively, with $I = J$ and $I = 2J$.

After simple rearrangements, the effect of integration on wages of manager m can be seen to be

$$\delta = -\frac{1}{B} \frac{(c_J - c_m)(c_J - 2a + c_m + 3Jc_J + 3Jc_m - 4J^2\bar{c} + 2J^2c_J + 2J^2c_m - 6J\bar{c})}{2J^2 + 3J + 1}. \quad (5)$$

This expression can be used to derive several results on the effects of globalization.

Proposition 2 *For each parameter constellation, there exists a critical cost level $c^* \in [c_1, c_I]$ so that integration increases wages if and only if $c_i < c^*$.*

Proof: See Appendix.

In addition, several simple observations can be derived.

Fact 1 *When the cost differences between the firms are sufficiently small, the effect of market duplication is positive for all firms except for those with marginal costs c_J .*

To see this, note that the second term in brackets in the numerator of (5) approaches $2\bar{c} - 2a < 0$ as c_m , c_J and \bar{c} become sufficiently similar. Continuity implies the claimed result.

Fact 2 *c^* is increasing in market size a and the average cost level \bar{c} , and it is decreasing in the number of firms in each country, J , and the cost level c_J of the least efficient firm.*

Proof: See Appendix.

The result implies that, for a given cost distribution of firms, a greater fraction of managers will benefit as the initial market size a increases. The remaining three results concern changes in the cost distribution. For instance, an increase in the average costs \bar{c} for unchanged costs of the least efficient firm essentially means that firms become more similar. Consistent with Fact 1, this increasing similarity means that more managers benefit from wage increases. The effect of an increase in the cost level of the least efficient firm, c_J , has a converse interpretation. Finally, an increase in the number of firms J for given levels of average and maximal costs can be interpreted as an increase in competition under autarky. Thus, if the market is initially more competitive, it will require lower marginal costs for a firm to benefit from market duplication.

To understand the economic forces underlying the results more generally, it is important to note that

$$w_{im} = \int_{c_I}^{c_m} \frac{\partial \pi}{\partial c_i} (c_i, \bar{c}) . \quad (6)$$

Thus, understanding the effects of globalization on wages boils down to understanding the effect on $\left| \frac{\partial \pi}{\partial c_i} \right|$, the marginal incentive to reduce own costs and at the same time increase the average industry costs by poaching the manager of a competitor.

Fact 3 *The effect of market duplication on $\left| \frac{\partial \pi_i}{\partial c_i} \right|$ is positive for firms that have lower than average marginal costs. Also, if it is positive for any firm, then this holds for all firms that have lower marginal costs.*

Proof: See Appendix.

Thus, mirroring the effect of integration on wages (Proposition 2), integration does not have a clear-cut effect on $\left| \frac{\partial \pi_i}{\partial c_i} \right|$, but it tends to have a positive effect on high-quality managers and a negative effect on low-quality managers. To repeat, $\left| \frac{\partial \pi_i}{\partial c_i} \right|$, contains not only the effect of lower own costs, but also the raising rival's cost effect from poaching.

To understand the effect of globalization on $\left| \frac{\partial \pi_i}{\partial c_i} \right|$, let $Q(c_i, \bar{c})$ stand for equilibrium outputs and $M(c_i, \bar{c})$ for equilibrium margins. From $\pi(c_i, \bar{c}) = Q(c_i, \bar{c}) \cdot M(c_i, \bar{c})$ we obtain:

$$\left| \frac{\partial \pi}{\partial c_i} \right| = M \cdot \left| \frac{\partial Q}{\partial c_i} \right| + Q \left| \frac{\partial M}{\partial c_i} \right| . \quad (7)$$

Thus, the value of having lower marginal costs (while simultaneously increasing the costs of a competitor) consists of a positive effect on outputs evaluated by the margin and a positive effect on margins evaluated by the output level. Globalization affects three of the four components in (7). It reduces profit margins M , which makes it less attractive to increase the own equilibrium output by having a more able manager. However, it also increases the equilibrium output Q of each firm (except possibly very bad firms), which makes it more important to have the higher margins associated with a better manager. Globalization also increases the impact of lower costs on the equilibrium output ($\left|\frac{\partial Q}{\partial c_i}\right|$). These last two effects work in favor of a positive relation between globalization and wages.¹¹ Because of these countervailing effects, the effect of integration on wages is ambiguous in general. Decomposition (7) also shows why the effect tends to be positive for good managers, but not necessarily for bad managers: The fact that globalization increases the effect of lower costs on output, $\left|\frac{\partial Q}{\partial c_i}\right|$, is particularly valuable when margins M are high, that is, for good managers.

4.4 An Example

We now introduce a specific example. This example shows that it is not only possible that some managers lose from globalization, but that the total wage sum falls. It also introduces some additional comparative statics.

As an example, we focus on the simple case of constant ability differences:

$$c_m = c_I - (I - m)\Delta, \quad m = 1, \dots, I, \quad \text{for some } \Delta > 0. \quad (8)$$

The following result specifies the critical managerial quality above which integration increases wages, the existence of which is guaranteed by Proposition 2.

Proposition 3 *Assume that c_m is defined as in (8). Then*

$$w_m^G > w_m^A \text{ if and only if } m < m^{crit} \equiv \frac{2(a - c_I) + 2\Delta I(I + 2)}{(2I + 1)\Delta(I + 1)}.$$

The proof of Proposition 3 can be found in the Appendix.

¹¹The effect of lower marginal cost on margins $\left|\frac{\partial M}{\partial c_i}\right|$ turns out to be independent of globalization.

When the heterogeneity between managers is small, the critical value m^{crit} is degenerate, so that integration will benefit all managers. This is captured in the following corollary:

Corollary 1

$$(i) \quad \frac{\partial m^{crit}}{\partial \Delta} < 0$$

$$(ii) \quad \lim_{\Delta \rightarrow 0} m^{crit} = \infty$$

Moreover, we obtain:

Corollary 2

$$(i) \quad \frac{\partial m^{crit}}{\partial a} > 0$$

$$(ii) \quad \frac{\partial m^{crit}}{\partial I} < 0 \quad \forall I \geq 2$$

The proof of Corollary 2 is tedious but straightforward and therefore omitted.

The result says that, as the demand captured by the parameter a increases under autarky, more managers will benefit from integration, whereas the converse statement holds for increases in the number of firms under autarky.

4.4.1 Numerical Specification

We have analyzed the example for several parameter values (see Table 1). The calculations suggest a number of insights beyond those already captured by the above results.

	Scenarios					Results						
	I	Δ	a	b	c_I	$\frac{\Pi^A}{\Pi_2^A}$	$\frac{\Pi^G}{\Pi_2^G}$	$\sum_{i=1}^M \Pi_i^A$	$\sum_{i=1}^M \Pi_i^G$	$\sum_{i=1}^M w_i^A$	$\sum_{i=1}^M w_i^G$	m^{crit}
1.	5	10	300	1	100	1.47	1.78	7722	6000	6333	6000	1.66
2.	5	10	600	1	100	1.22	1.38	38556	24347	16333	16909	2.58
3.	5	10	1000	1	100	1.13	1.22	118556	71950	29667	31455	3.79
4.	5	10	1500	1	100	1.08	1.15	281056	168645	46333	49636	5.30

Table 1: Numerical results for $c_m = c_I - (I - m)\Delta$

First, the ratio between the profit of the most efficient firm and the profit of the second-best firm is higher under integration (Π_1^G/Π_2^G) than under autarky (Π_1^A/Π_2^A). Similar results also can be shown to hold for the ratio of the leader's profit and those of all other firms. Thus, integration increases competition in the sense proposed by Boone (2000).

Second, total profits under integration ($\sum \Pi_i^G$) are lower than under autarky ($\sum \Pi_i^A$). Again, this reflects increasing competition. Third, and most importantly, total managerial wages are not necessarily higher under integration ($\sum w_i^G$) than under autarky ($\sum w_i^A$). The perception that globalization benefits all managers may therefore be misleading. In view of our earlier results, it seems more likely that globalization generates an increasing spread of managerial wages, with increasing top salaries but decreasing salaries for less efficient managers. However, as shown in Corollaries 1 and 2, for scenarios with a small number of firms and small cost differences (small heterogeneity), integration raises the wages of all managers, which is illustrated in the fourth scenario in Table 1.

We illustrate the impact of integration on the level and distribution of wages of managers for the four scenarios in Table 1 in Figures 1 - 4. These figures plot the equilibrium wages under autarky and integration, respectively. The figures illustrate how globalization increases the wage spread. They also show how an increase in market demand shifts the critical level in m^{crit} to the right, eventually leading to a situation where all managers benefit from globalization.

Figure 1:

I	Δ	a	b	c_I
5	10	300	1	100

Figure 2:

I	Δ	a	b	c_I
5	10	600	1	100

Figure 3:

I	Δ	a	b	c_I
5	10	1000	1	100

Figure 4:

I	Δ	a	b	c_I
5	10	1500	1	100

5 Extensions and Robustness

To illustrate the impact of globalization on managerial compensation in the most transparent way, we focused on the simple case of market duplication so far. We now consider alternative approaches.

5.1 Partial integration

The total effect of integration in the market duplication model can be decomposed into three components, each of which corresponds to a specific notion of partial integration, which may be adequate in particular markets.

First, one can consider the integration of two product markets without changes in the number of firms and without effect on the managerial pool, that is, a *ceteris paribus* reduction in the demand parameter b . Intuitively, this corresponds to the case where the demand in the two countries is added up and the firms from one country serve the entire world (for instance, because the other country does not allow market access, or because their managers are so much less competent that the firms immediately disappear). As the increased demand on the product market translates into an increased demand for managers, this kind of integration has unambiguously positive effects on managerial wages (See formula 4). Moreover, while wage inequality increases in absolute terms, the relative wages remain the same.

Second, one can isolate the effect of increasing the number of firms I in the market without changes in the demand parameters or the managerial labor pool. Intuitively, this corresponds to a unilateral trade liberalization where firms in one country are exposed to the exports from the other country, but obtain no market access themselves. Formula 4 immediately implies that the wage effect is negative for all managers. Increasing competition from other firms reduces not only the overall profits of a firm, but also the incremental effect of a better manager on profits.

Finally, consider the effect of pure labor market integration, which corresponds to an integration of managerial pools without a change in the remaining parameters of the model. Thus, in each country, firms can now make wage offers to all managers in the two countries. Using the logic of Proposition 1, it is straightforward to see that the wages after labor market integration are determined by the profit differential that a manager generates relative to the marginal manager I . As product markets are unaffected by pure labor market integration, there are no wage effects of pure labor market integration.¹²

To sum up, the total effect of market duplication on managerial wages is the net effect of the demand increase and the increasing competition from other firms, with the integration of labor markets playing no crucial role. The increase in demand tends to increase managerial wages, the increase in competition reduces it.

Figure 5 illustrates the roles of the two individual effects. Rather than considering only duplications of the number of firms and of overall demand, we consider multiplications with arbitrary factors k and m , respectively, allowing in particular for biased changes. Specifically, reconsider the examples in Table 1, and consider an average manager, corresponding to marginal costs of 80. Figure 2 gives those values of k and m for which the manager experiences a wage increase for different values of a . In line with the previous consideration, a pure increase of demand (m) leads to higher wages, whereas a pure increase of k leads to a reduction in wages; thus points in the upper left of the figure tend to correspond to wage increases. As a increases, smaller increases of m are sufficient to generate a positive wage effect of globalization. Similar results hold for non-average managers. Finally, note that the points on the dashed line correspond to unbiased integration, and, in particular, $(2, 2)$ corresponds to market duplication.

5.2 Entry and Exit

We considered the number of firms as exogenous, not allowing for entry or exit. As in the monopolistic competition framework of Melitz (2003), globalization is likely to

¹²Note, however, that this argument relies to some extent on the symmetric manager pools in the two countries.

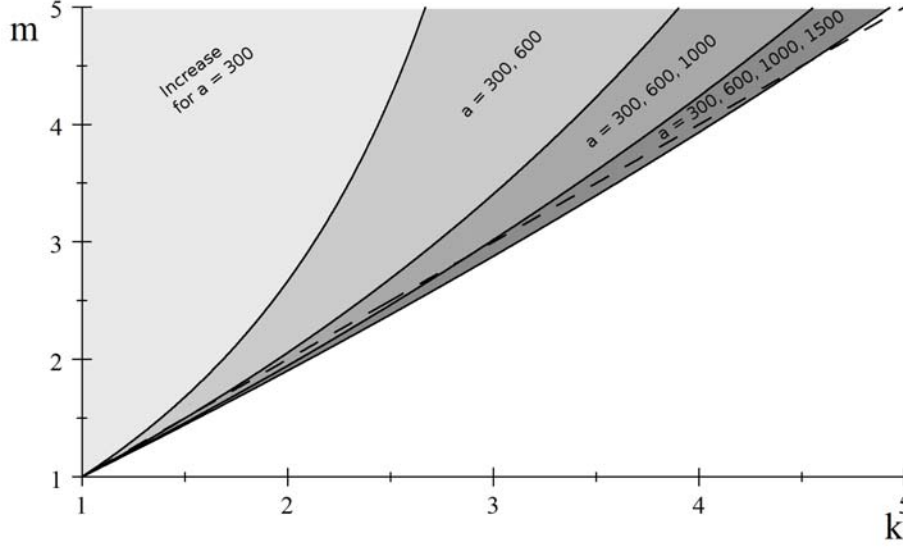


Figure 5: Wage Increase with Biased Integration

lead to the exit of inefficient firms in our model at least when there are positive fixed costs. We shall now demonstrate that our results are reinforced if we allow for this possibility.

To this end, we modify the model by assuming that there is a pool of potential firms that is so large that, at least the firms with relatively inefficient managers would optimally set outputs equal to zero. We then add an initial stage where firms decide whether they want to be in the market. After that, the game proceeds as before. We suppose that there are small, but positive fixed costs of being in the market.

The equilibrium structure will then be as follows. Under autarky, the number I of firms is determined so that the marginal firm earns non-negative profits, whereas any additional firm would earn negative profits if it entered the market. After integration there cannot be net entry since, as discussed in section 4.3, the competition effect dominates the positive impact of higher demand on firms' profits. If condition (2) holds for I , but not for $2I$, there will be net exit until the marginal firm has profits slightly above zero, so that the number of firms in the market will be smaller than $2I$. Compared to the benchmark case without exit, that is, with $2I$ firms, the remaining non-marginal firms benefit from the exit of the competitors, so that their profits are

higher than in the benchmark case. This observation is consistent with Figure 2: If $k < m$, the wage effect is more likely to be positive than for $k = m$. As a consequence, the profit differential between the best firm and the marginal firm increases, which immediately translates into an increase in the wage differential. Summing up, therefore, the increase in wage heterogeneity discussed in Section 4 is reinforced.

Essentially, the effect of endogenous market structure can be understood as a reduction of the number of firms following the duplication. Thus we examine how the wage reacts to changes in the number of firms:

Fact 4

$$\frac{\partial w_m}{\partial I} < 0 \quad (9)$$

Hence, a reduction of the number of firms increases wages. More importantly, as shown in the proof of the fact, the absolute value of the effect of the number of firms on wages, i.e. the term $\frac{4}{B} \frac{c_I - c_m}{(I+1)^2} (a - \bar{c})$, declines with c_m . Hence, endogenous exit reinforces our main result.

5.3 General Managerial Abilities

Another special aspect of our model is that managerial abilities are specific to one product market. Clearly, however, managerial talents are often more general. We will therefore show that our results are not affected when firms from different industries compete on the managerial labor market.

The simplest way to do so is to suppose that there is a finite number of copies of the product market described in Section 2 in each country, with firms from all industries competing for the same pool of managers. Thus, we go to the opposite extreme where managerial talent is fully general rather than specific to a particular industry. Globalization then corresponds to the simultaneous integration of all product markets and the managerial labor market. The equilibrium analysis parallels Section 3. In equilibrium, firms from all industries make wage offers to all managers. Wages are determined according to Propositions 1; with the obvious difference being that \mathcal{M}_{-i}^I now corresponds only to the subset of managers employed by the other firms in the same industry. As

a result, the effects of globalization can be calculated in exactly the same way as in Section 4.

6 Conclusion

In this paper, we have examined how globalization affects the distribution of managerial wages. Our key insight is that globalization increases the heterogeneity of managerial salaries, but not necessarily the overall wage level. Numerous issues deserve further scrutiny. For instance, incorporating asymmetric information and agency costs, or increasing demand for general rather than firm-specific managerial skills into our model suggests further insights into the structure of managerial compensation. Our paper constitutes a benchmark model for such research.

7 Appendix A: Proofs

7.1 Proof of Proposition 1

Necessary Conditions

We use m_i to denote the index of the manager hired by firm i in equilibrium. We first establish a necessary condition that wages for managers have to satisfy in equilibrium. Consider the best-response conditions. Firm j does not want to undercut the offer w_{im_i} if

$$\Pi_j(m_j) - w_{jm_j} \geq \Pi_i(m_i) - w_{im_i}$$

Firm i will not want to offer a higher wage to manager m_j if

$$\Pi_i(m_i) - w_{im_i} \geq \Pi_j(m_j) - w_{jm_j}.$$

Together, both inequalities imply $\Pi_i(m_i) - \Pi_j(m_j) = w_{im_i} - w_{jm_j}$. In particular, therefore, using the symmetry condition that $\Pi_i(m_I) = \Pi_I(m_I)$

$$\Pi_i(m_i) - \Pi_i(m_I) = w_{im_i} - w_{Im_I} \tag{A.1}$$

Existence

Next we show that the proposed wages actually constitute an equilibrium. We note that in the proposed equilibrium $w_{im_i} = \Pi_i(m_i) - \Pi_i(I)$. Given wage offers w_{im}^* , managers are indifferent among all firms and apply first at firm 1 who will select the most competent manager according to the first and second tie-breaking rule. The procedure is repeated at the other firms until all managers are employed. Firm i will employ manager i , i.e. $m_i = i$.

The only reason for a firm to deviate by offering a higher wage to some manager would be to employ some more efficient manager $m < I$. However, by construction of w_{im}^* the required wage increase would exceed the increase in gross profits.

Now consider downward deviations of firm i . Suppose the wages for some subset S of managers ($I \notin S$) are reduced but remain non-negative. All of the managers will

apply at all of the other firms. Denote the lowest index of the managers in S by m_s . If $m_s > i$, firm i will obtain the application of manager $m = i$ as this manager has not been hired by firms $1, \dots, i - 1$. Hence, firm i will employ manager $m = i$ and payoffs remain unchanged. Hence, the deviation is not profitable.

If $m_s \leq i$, then all manager in S will apply at all other firms. As $I \notin S$, manager I will not be chosen by any other $I - 1$ firms as he is the least able and our second tie-breaking rule applies. Conversely, all managers with $m < I$ will be employed at a firm $j \neq i$ as they apply at all of these firms and will be employed at one firm. Hence, at the end of the process firm i will end up with manager I who receives a wage of 0, so that deviation profits are $\Pi_I(m_I)$. Thus, the deviation is not profitable.

Finally, a downward deviation where w_{iI}^* is reduced is not possible, because $w_{iI}^* = 0$ is the outside option. Thus, there are no profitable deviations for firm i .

Uniqueness

For uniqueness, it suffices to show that there can be no equilibrium with $w_{iI} > 0$. Suppose that an equilibrium with $w_{iI} > 0$ exists. By A.1, the candidate equilibrium wages satisfy

$$w_{im_i}^* = \Pi_i(m_i) - \Pi_i(I) + w_{iI} \text{ for } m < I$$

Wages in this candidate equilibrium are given by

$$\Pi_i(I) - w_{iI}$$

Thus, a firm j could offer the wages $w_{jm} = 0$ for all m . According to our matching procedure and the tie-breaking rule that managers accept non-negative wages, firm j would hire manager I and would obtain profits $\Pi_i(I)$. Hence, the deviation is profitable, so that there can be no equilibrium with $w_{iI} > 0$.

7.2 Proof of Proposition 2

Proof: Using (5), there are exactly two cost levels, for which integration has no effect on wages, namely $c_m = c_J$ and

$$c_m = c^* \equiv -\frac{-2a + c_J + 3Jc_J - 4J^2\bar{c} + 2J^2c_J - 6J\bar{c}}{3J + 2J^2 + 1}.$$

Next, note that (5) is positive if and only if

$$c_J - 2a + c_m + 3Jc_J + 3Jc_m - 4J^2\bar{c} + 2J^2c_J + 2J^2c_m - 6J\bar{c} < 0. \quad (\text{A.2})$$

As

$$\begin{aligned} \frac{\partial}{\partial c_m} (c_J - 2a + c_m + 3Jc_J + 3Jc_m - 4J^2\bar{c} + 2J^2c_J + 2J^2c_m - 6J\bar{c}) &= \\ 2J^2 + 3J + 1 &> 0, \end{aligned}$$

holds if and only if $c_m < c^*$. The statement of the proposition follows.

7.3 Proof of Fact 2

The critical value below which firms benefit from market duplication is given by

$$c^* = -\frac{-2a + c_J + 3Jc_J - 4J^2\bar{c} + 2J^2c_J - 6J\bar{c}}{3J + 2J^2 + 1}.$$

Differentiation of this expression with respect to a , \bar{c} , J and c_J yields

$$\begin{aligned} \frac{\partial c^*}{\partial a} &= \frac{2}{2J^2 + 3J + 1} > 0, \\ \frac{\partial c^*}{\partial \bar{c}} &= 2J \frac{2J + 3}{2J^2 + 3J + 1} > 0 \\ \frac{\partial c^*}{\partial J} &= -2(4J + 3) \frac{a - \bar{c}}{(2J^2 + 3J + 1)^2} < 0 \\ \frac{\partial c^*}{\partial c_J} &= -1 < 0 \end{aligned}$$

7.4 Proof of Fact 3

The marginal effect of poaching on profits after globalization is given by

$$\left| \frac{\partial \pi_i}{\partial c_i} \right|^G = \left| \frac{\partial}{\partial c_i} \left(\frac{2}{B} \left(\frac{a + 2J\bar{c}}{2J + 1} - c_i \right)^2 \right) \right| = \frac{4a - 4c_i + 8J\bar{c} - 8Jc_i}{B + 2BJ},$$

while before globalization the marginal effect of poaching on profits is

$$\left| \frac{\partial \pi_i}{\partial c_i} \right|^A = \left| \frac{\partial}{\partial c_i} \left(\frac{1}{B} \left(\frac{a + J\bar{c}}{J+1} - c_i \right)^2 \right) \right| = \frac{2(a - c_i + \bar{c}J - Jc_i)}{B(J+1)}.$$

We obtain the effect of integration on the marginal effect as the difference of the two expressions above which yields

$$\left| \frac{\partial \pi_i}{\partial c_i} \right|^G - \left| \frac{\partial \pi_i}{\partial c_i} \right|^A = \frac{2(a - c_i - 3Jc_i + 2J^2\bar{c} - 2J^2c_i + 3J\bar{c})}{B(2J^2 + 3J + 1)}.$$

Hence $\left| \frac{\partial \pi_i}{\partial c_i} \right|^G - \left| \frac{\partial \pi_i}{\partial c_i} \right|^A > 0$ if and only if

$$c_i < \frac{a + 2J^2\bar{c} + 3J\bar{c}}{3J + 2J^2 + 1}. \quad (\text{A.3})$$

As the right-hand side of (A.3) is greater than \bar{c} , this condition holds for $c_i < \bar{c}$.

7.5 Proof of Proposition 3

With $c_m - c_I = -(I - m)\Delta$, we obtain

$$\begin{aligned} c_I - c_m &= (I - m)\Delta \\ c_I + c_m &= 2c_I - (I - m)\Delta \\ \sum_{j \neq m, j \neq I} c_j &= (I - 2)c_I - \frac{\Delta}{2}(I^2 - 3I + 2m) \\ \bar{c} &= \frac{1}{I} \sum_{i=1}^I c_i \end{aligned}$$

We note that \bar{c} is the same for the countries under autarky and after market duplication.

Hence,

$$w_m^A = \frac{\Delta(I - m)}{b(I + 1)} \left(2(a - c_I) + \Delta(2I - m(I + 1)) \right)$$

and

$$w_m^G = \frac{2\Delta(I - m)}{b(2I + 1)} \left(2(a - c_I) + \Delta(3I - m(2I + 1)) \right).$$

To compare w_m^A and w_m^G , we calculate the difference $w_m^G - w_m^A$:

$$w_m^G - w_m^A = \underbrace{\frac{\Delta(I - m)}{b(I + 1)(2I + 1)}}_{(*)} \left(2(a - c_I) + \Delta(2I + 1)(I - mI) + \Delta(3I - m(2I + 1)) \right)$$

Since $(*) > 0$, $w_m^G - w_m^A > 0$ if and only if

$$2(a - c_I) + \Delta(2I + 1)(I - mI) + \Delta(3I - m(2I + 1)) > 0,$$

which is equivalent to

$$m < \frac{2(a - c_I) + 2\Delta I(I + 2)}{\Delta(2I + 1)(I + 1)} \equiv m^{crit}.$$

7.6 Proof of Fact 4

The wage of manager m is given by

$$w_m = \frac{2}{B} \frac{c_m - c_I}{I + 1} (c_m - 2a + c_I - 2\bar{c}I + Ic_m + Ic_I). \quad (\text{A.4})$$

We differentiate (A.4) with respect to I and obtain:

$$\frac{\partial w_m}{\partial I} = \frac{4}{B} \frac{c_m - c_I}{(I + 1)^2} (a - \bar{c}) < 0. \quad (\text{A.5})$$

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