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Saving Good Jobs under Global Competition by Rewarding Quality and Efforts*

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Saving Good Jobs under Global Competition

by Rewarding Quality and Efforts

By

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May 23, 2013

Abstract

This paper links firms' endogenous quality choice to worker effort and efficiency wages. The model generates two distinct features: effort is rewarded and quality is rewarded. Then firms with higher monitoring accuracy produce higher quality and pay higher wages. When trade is opened, while bad jobs with low wages and low rents are destroyed, good jobs are created. Nevertheless, unemployment can either rise or fall and wage polarization can arise, depending on the structure of monitoring cost and on the share of exporting firms. These results contrast sharply with the literature, and are consistent with empirical evidence.

Keywords: Trade liberalization; Unemployment; Efficiency wages; Quality choice

JEL Classification:

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1. Introduction

There is a recent revival of interest in how trade affects labor market outcomes. Although trade is believed to benefit the economy as a whole, popular conventional wisdom says that it might hurt workers by destroying their jobs, sometimes even good jobs with high wages. A provocative paper by Davis and Harrigan (2011) shows exactly that good jobs are destroyed by trade liberalization.

However, recent empirical literature suggests more efficient firms export more and employ more workers, given an identical wage (e.g., Bernard, Jensen and Lawrence, 1995; Eaton and Kortum, 2002; Melitz, 2003; Tybout, 2003). More importantly, bigger firms pay higher wages (e.g., Bernard, Jensen, Redding and Schott, 2007; Verhoogen, 2008; Gibson and Stillman, 2009), because workers there are more skilled, more disciplined, or simply more hard-working, etc.[1] Also, a great part of labor market reallocation occurs within industries rather than between industries, highlighting the substantial role firm heterogeneity plays in determining who gains and who loses.

Motivated by these observations, the present paper attempts to model the impact of trade on the labor market by incorporating heterogeneity in both wages and product quality. Specifically, we integrate efficiency wages (e.g., Akerlof, 1982, 1984; Shapiro and Stiglitz, 1984) with firms' endogenous quality choices, and show that bad jobs with the lowest wages are replaced by good ones with higher wages in the process of globalization. The basic mechanism is that higher effort is required to produce higher quality. Then firms better at monitoring produce higher qualities and earn higher profits, which enables them to offer higher wages.

One might think that trade liberalization simply strengthens this tendency.

[1] See The Washing Post, Nov. 28, 2012, "Bigger firms pay 50 percent higher wages than small business, study shows"; and also the World Development Report 2013.

However, we find that it depends on the structure of monitoring technology/cost. Trade induces the most talented firms in management/monitoring to upgrade product quality, if the scale effect of monitoring dominates the span of control effect. In this case, job rents in exporters rise but fall in non-exporting firms. However, the opposite can arise if the span of control effect dominates the scale effect. In particular, the model generates wage polarization similar to Costinot and Vogel (2010), but via a different mechanism.

The existing literature incorporates different aspects of labor market frictions into heterogeneous trade models, including search and matching frictions (Helpman and Itskhoki, 2010; Helpman, Itskhoki and Redding, 2010, 2011; Felbermayr, Prat and Schmerer, 2011 and Helpman, Itskhoki, Muendler and Redding, 2012) and fair wages (Grossman and Helpman, 2007; Egger and Kreickemeier, 2009; Amiti and Davis, 2011). The difference between our paper and the first strand literature is that, we allow heterogeneous firms to pay different wages to workers that are ex ante identical in terms of both observable and unobservable characteristics.[2] The second strand literature also has this feature, but stemming from fair-wage preference or rent sharing, while in our paper wage heterogeneity is due to monitoring of worker effort that determines quality heterogeneity.

The closest papers to ours are Davis and Harrigan (2011) and Verhoogen (2008), who also incorporate efficiency wages to investigate trade and quality via Melitz (2003). We depart from Davis and Harrigan in two crucial aspects. Firstly, we allow workers to choose effort and link it to product quality and firm performance, while they assume worker effort to be fixed at an exogenous level; Secondly, by incorporating monitoring cost, we allow firms to choose their own levels of

[2] In Helpman, Itskhoki and Redding (2010, 2011) and Helpman, Itskhoki, Muendler and Redding (2012), workers are homogeneous ex ante, but draw an unobservable ability when matched with a specific firm. Firms can invest in screening to obtain information about ability, thus generating wage differences across firms.

monitoring accuracy, and accordingly determine the optimal quality and wages, while they assume monitoring to be cost-free. Finally, Verhoogen (2008) uses a slightly different mechanism, by adopting the O-ring theory and assuming a linear wage-quality schedule without explicitly considering shirking and monitoring.

Due to these differences, the present paper generates conclusions and implications in stark contrast with the literature. First in Davis and Harrigan (2011), firms with higher monitoring accuracy pay lower wages since shirking is easier to detect in these firms, while in our paper these results are reversed, because higher monitoring accuracy leads to higher quality and higher profits, enabling the firm to pay higher wages to induce higher effort.

Second, while in Davis and Harrigan good jobs are destroyed from trade liberalization, in our paper, although trade forces the least able firms to exit and thus destroys low-wage jobs, it also creates better jobs in the exporting firms with higher wages. The impact of trade liberalization on the aggregate unemployment hinges critically on the structure of monitoring cost. In particular, if the scale effect dominates the span of control effect, unemployment rises.

Finally, while Verhoogen (2008) mainly tests the wage inequality between white-collar and blue-collar workers induced by exchange rate shocks, we focus on trade impacts on wages of workers who are ex ante identical. We also build solid micro foundations by directly modeling monitoring cost and linking quality to efforts, and thus generate his conclusion on quality upgrading as a special case of our model.

Our paper also complements the growing literature on quality-based heterogeneous firms and trade. For instance, in Baldwin and Harrigan (2009), Hallak and Sivadasan (2009), Kugler and Verhoogen (2010) and Dinopoulos and Unel (2013), firms draw their product quality from an exogenously distributed quality distribution, or invest in quality but with a pre-determined cost function, while in our paper, the cost function of quality upgrading is based on efficiency wages. More interestingly, trade liberalization could lead to quality upgrading for exporting firms and quality downgrading for domestic firms.

The remainder of the paper is organized as follows. Section 2 introduces the basic setup up. In section 3, we describe the general equilibrium in the closed economy. Section 4 introduces trade liberalization. The impacts of trade on monitoring and quality, and on labor market outcomes are examined in sections 5 and 6 respectively. Finally, section 7 concludes.

2. The basic setup

2.1 Consumers

Consumer preferences over goods are identical and homogeneous, with an instantaneous utility given by:

$$Q=\left\{\int[\lambda(i)q(i)]^{\frac{\sigma-1}{\sigma}}di\right\}^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where $q(i)$ is the quantity of variety i consumed, $\lambda(i)$ denotes the quality of good i, and σ is the elasticity of substitution between varieties of goods. Denoting the total expenditure as *E* and the price of variety i as $p(i)$, utility maximization gives the derived demand function for each variety as:

$$q(i)=\frac{E\lambda(i)^{(\sigma-1)}}{P^{1-\sigma}}p(i)^{-\sigma}, \quad P\equiv\left\{\int[p(i)/\lambda(i)]^{1-\sigma}di\right\}^{\frac{1}{1-\sigma}} \tag{2}$$

And the associated revenue for the producer of variety *i* is:

$$R(i)=E\left[P\lambda(i)\right]^{\sigma-1}p(i)^{1-\sigma} \tag{3}$$

2.2 Workers

We follow Davis and Harrigan (2011) by considering an economy with a fixed mass of workers denoted by *L*, each supplying one unit of labor. They are infinitely lived and risk neutral. Subject to the usual budget constraint, they maximize an expected discounted lifetime utility

$$\amalg[\int_0^\infty U\left(w_t, e_t\right)\exp\left(-\rho t\right)dt] \tag{4}$$

where $\amalg$ is the expectation operator, *e* is work effort exerted by the worker, ρ is the discount rate, $w\left(i\right)\equiv W\left(i\right)/P$ is his real wage, with $W\left(i\right)$ being the nominal wage at firm i and $P\equiv\left\{\int[p\left(i\right)/\lambda\left(i\right)]^{1-\sigma}di\right\}^{1/(1-\sigma)}$ being the aggregate price index. Observe that in (4), we have incorporated product quality into the price index *P*, with $\lambda\left(i\right)$ as the quality of good *i*, which is absent in Davis and Harrigan (2011).

Depending on the effort level and employment of a worker, utility takes the following form, as in Davis and Harrigan (2011),

$$U\left(w,e\right)=\begin{cases} w & \text{if the worker shirks} \\ w/e & \text{if the worker exerts effort } e \\ 0 & \text{if the worker is unemployed} \end{cases} \tag{5}$$

Since quality generates utility as in (4), we must depart from Davis and Harrigan (2011). Specifically, we assume that product quality is effort dependent,[3]

$$e=\bar{e}\lambda\left(i\right)^\theta \tag{6}$$

where $\bar{e}>1$ is a constant parameter. Whereas in the absence of product quality ($\theta=0$), e is just an exogenous parameter as in Davis and Harrigan (2011). Our consideration is, to produce a higher quality, the worker must exert more effort, ceteris paribus, such as being more focused, following rules more precisely, using

[3] Verhoogen (2008) also assumes product quality depends on worker effort, by using a linear wage-quality schedule without explicitly considering monitoring and shirking.

more persistent efforts without ups and downs, etc. θ thus measures the intensity of effort associated with high quality goods. A bigger θ suggests higher efforts are required to produce higher quality, and $\partial\lambda(i)/\partial\theta<0$ for any given effort level.

Workers lose their jobs when they are caught shirking, or whenever a firm is hit by a bad shock with an exogenous rate δ. We assume no firm monitors effort perfectly, as in Shapiro and Stiglitz (1984) and Davis and Harrigan (2011). If workers at firm i were to shirk, they face a hazard rate $a(i)\in(0,1]$ of detection (i.e., the accuracy of firm monitoring). Observe that while in Davis and Harrigan (2011) the firm's monitoring accuracy is exogenously given, here we assume instead the firm's management talent $m(i)$ to be exogenous, specifically, drawn from a cumulative probability distribution $G(m)$ and density $g(m)$. Its monitoring accuracy, *a(i),* on the other hand, is endogenously determined through profit maximization and taking into account monitoring cost, as will be explained in detail soon.

Denote $V_N(i)$ and $V_S(i)$ the expected lifetime utility of a worker who exerts effort and a worker who shirks at firm i respectively. Let V_U be the expected lifetime utility of a worker being unemployed currently. Then the value equations for the non-shirkers and shirkers respectively are:

$$\rho V_N(i)=\frac{w(i)}{\bar{e}\lambda(i)^{\theta}}+\delta\left(V_U-V_N(i)\right) \tag{7a}$$

$$\rho V_S(i)=w(i)+\left(\delta+a(i)\right)\left(V_U-V_S(i)\right) \tag{7b}$$

These state that the life-time discounted utility consists of the flow real wage benefits, $\frac{w(i)}{\bar{e}\lambda(i)^{\theta}}$ for the non-shirker and $w(i)$ for the shirker respectively, plus an expected capital loss in case of a shift to unemployment due to a bad shock with probability δ, and shirkers face a higher likelihood of moving to unemployment due to monitoring.

For the worker to choose not to shirk, the firm must pay a sufficiently high wage so that $V_N(i) \geq V_S(i)$, which implies at the margin $V_N(i) = V_S(i) = V(i)$. From this condition we can solve the efficiency wage for equations (7a) and (7b) as:

$$\hat{w}(i) = \frac{\rho V_U \bar{e}\lambda(i)^\theta a(i)}{a(i) - \left(\bar{e}\lambda(i)^\theta - 1\right)(\rho + \delta)} \tag{8}$$

Differentiation gives $\partial\hat{w}(i)/\partial a(i) < 0$, implying that firms with higher monitoring accuracy pay lower wages, ceteris paribus. In addition, we also obtain $\partial\hat{w}(i)/\partial\lambda(i) > 0$, stating that firms producing higher quality pay higher wages, to induce greater effort.

Similarly, using the non-shirking condition $V_N(i) = V_S(i) = V(i)$, we get the utility reduction of job loss for a worker in firm i:

$$V(i) - V_U = \frac{w(i)}{a(i)} \frac{\bar{e}\lambda(i)^\theta - 1}{\bar{e}\lambda(i)^\theta} \tag{9}$$

Note that if θ is very small, the link between quality and effort becomes weak, and in the extreme if $\theta = 0$, expression $\frac{\bar{e}\lambda(i)^\theta - 1}{\bar{e}\lambda(i)^\theta}$ collapses to $\frac{\bar{e} - 1}{\bar{e}}$, then (9) becomes identical to equation (6) in Davis and Harrigan (2011).

Next, plugging the efficiency wage $\hat{w}(i)$ into equation (9) gives:

$$V(i) - V_U = \frac{\bar{e}\lambda(i)^\theta - 1}{a(i) - \left(\bar{e}\lambda(i)^\theta - 1\right)(\rho + \delta)} \rho V_U \tag{9'}$$

Straightforward differentiation gives $\partial[V(i) - V_U]/\partial\lambda(i) > 0$ and $\partial[V(i) - V_U]/\partial a(i) < 0$, stating that the surplus from having a job is increasing in the quality of goods but decreasing in the employer's monitoring accuracy.

The above derivations warrant a Proposition, summarizing the important features of the model---efforts and quality are rewarded from the worker's viewpoint. These features will be further used to derive additional results subsequently.

Proposition 1 (Rewarding effort): *Higher-quality producers pay higher wages to induce greater work effort, and the surplus from having a job is increasing in the product quality the worker produces.*

2.3 Firms

The timing for the firms is as follows. In the first stage, a mass of firms M_e enters, pays a fixed entry cost f_e, and then receives information about their management talent *m(i)*. In the second stage, after observing their types, each firm chooses the optimal monitoring accuracy *a*, which is a function of the firm's management talent *m*. In the third stage, they choose the quality of the varieties to produce, $\lambda(i)$. In the fourth stage, given the monitoring accuracy and quality chosen, firms decide the quantity for each variety to maximize profits, and consumption takes place afterwards. We solve this problem by backward induction.

In the last stage, profit maximization yields,

$$p(i)=\left(\frac{\sigma}{\sigma-1}\right)W(i) \tag{10}$$

Combined with equation (8) gives

$$p(i)=\left(\frac{\sigma}{\sigma-1}\right)\frac{\rho PV_U\overline{e}\lambda(i)^{\theta}a(i)}{a(i)-\left(\overline{e}\lambda(i)^{\theta}-1\right)(\rho+\delta)}. \tag{11}$$

The associated profit is then,

$$\pi(i)=\frac{E}{\sigma}\left[\left(\frac{\sigma-1}{\sigma}\right)P\lambda(i)\right]^{\sigma-1}W(i)^{1-\sigma}-F(i)-f \tag{12}$$

where $F(i)$ is the firm specific monitoring cost associated (see equation (29) for the detailed form), and is assumed to be exogenous at this stage, once the monitoring accuracy is determined.

Inserting (8) into (11) and using $w(i)\equiv W(i)/P$ give rise to

$$\pi(i)=\frac{E}{\sigma}\left[\left(\frac{\sigma-1}{\sigma}\right)\frac{\lambda(i)^{1-\theta}\left[a(i)+\rho+\delta\right]-(\rho+\delta)\overline{e}\lambda(i)}{\rho\overline{e}V_U a(i)}\right]^{\sigma-1}-F(i)-f \tag{13}$$

In the third stage, the firm's optimal quality choice is characterized by

$$\overline{e}\lambda(i)^{\theta}=(1-\theta)\left(\frac{a(i)}{\rho+\delta}+1\right) \text{ or } \lambda(i)=\left[\left(\frac{1-\theta}{\overline{e}}\right)\left(\frac{a(i)}{\rho+\delta}+1\right)\right]^{\frac{1}{\theta}} \tag{14}$$

From (5), *e > 1* must hold for the model to be interesting. Then in (14), $e=\overline{e}\lambda(i)^{\theta}>1$ holds only if $\theta<\frac{a(i)}{a(i)+\rho+\delta}$. Since $\frac{a(i)+\rho+\delta}{a(i)}$ is decreasing in *a*, to ensure $\lambda(i)>1$ for any $a(i)\in[\underline{a},\overline{a}]$, where $\underline{a}$ and $\overline{a}$ are the lower and upper bounds of monitoring accuracy. We restrict the parameters to $\theta<\frac{\underline{a}}{\underline{a}+\rho+\delta}$, so that equilibrium efforts are bigger than 1 and job rents are non-negative (See (9)).

To link the firm's optimal pricing to the quality of its product, from (14) we get the inverse of the quality function in terms of monitoring accuracy

$$a(i)=\left(\frac{1}{1-\theta}\overline{e}\lambda(i)^{\theta}-1\right)(\rho+\delta) \tag{15}$$

which can be combined with (11) to give

$$p(i)=\frac{\sigma}{\sigma-1}\frac{1-\theta}{\theta}\left(\frac{1}{1-\theta}\overline{e}\lambda(i)^{\theta}-1\right)\rho PV_U \tag{16}$$

Then, $\partial p(i)/\partial\lambda(i)>0$; that is, *better quality sells for higher prices*.

Using (2) and (16), we also have

$$q(i)=\frac{E}{P(\rho V_U)^{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{\theta}{1-\theta}\right)^{\sigma}\lambda(i)^{(\sigma-1)}\left(\frac{1}{1-\theta}\bar{e}\lambda(i)^{\theta}-1\right)^{-\sigma} \tag{17}$$

Differentiating (17) gives $\partial q(i)/\partial\lambda(i)>0$ if and only if $\frac{1}{\theta}\frac{(\sigma-1)}{\sigma}>\frac{(a(i)+\rho+\delta)}{a(i)}$.

Thus $\partial q(i)/\partial\lambda(i)>0$ holds for any $a(i)$, if quality production is sufficiently cheap, or elasticity of substitution between goods is high enough.

Inserting (16) into (3) then gives

$$\pi(i)=\frac{E}{\sigma}\left[\left(\frac{\sigma-1}{\sigma}\right)\frac{1}{\rho V_U}\frac{\lambda(i)}{(1/\theta-1)\bar{e}\lambda(i)^{\theta}+1}\right]^{\sigma-1}-F(i)-f \tag{18}$$

Since $\theta<1$, it immediately follows that $\partial\pi(i)/\partial\lambda(i)>0$.

We can summarize the above results as

Proposition 2 (Rewarding quality): *Firms that produce higher quality charge higher prices, earn bigger revenue and make more profits; and they also sell larger quantities if* $\theta<\frac{\sigma-1}{\sigma}\frac{\underline{a}}{\underline{a}+\rho+\delta}$, *i.e., quality production is sufficiently cheap, or elasticity of substitution between goods is sufficiently high.*

Proposition 2 implies "quality is rewarded" from the firm's point of view. Note also that differentiation of (14) gives rise to $\partial\lambda(i)/\partial a(i)>0$ and $\partial\lambda(i)/\partial\theta<0$, implying that firms with higher monitoring accuracy produce goods of higher quality and product quality is decreasing in the disutility of effort.

Next, equations (8) and (14) lead to $\frac{w(i)}{e(i)}=\frac{1}{\theta}\frac{\rho V_U a(i)}{a(i)+\rho+\delta}$. Substituting into (14) again yields the real wage

$$w(i) = \rho V_U \left(\frac{1-\theta}{\theta}\right)\frac{a(i)}{\rho+\delta} \tag{19}$$

Observe that differentiation of (19) gives $\partial w(i)/\partial\theta < 0$, i.e., worse technology for quality decreases wages. More importantly, $\partial w(i)/\partial a(i) > 0$, which can be combined with Proposition 2 to immediately yield:

Proposition 3 (Rewarding monitoring): *Firms with higher monitoring accuracy not only produce higher qualities and earn higher profits, but also pay higher wages.*

Proposition 3 is in stark contrast with the literature. Conventional wisdom suggests that monitoring accuracy and wages are substitute instruments for motivating workers: poorly monitored workers must be well paid in order not to shirk. Then monitoring intensity and wages are negatively correlated. Therefore to match the empirical regularity that bigger firms pay higher wages,[4] Davis and Harrigan (2011) have to impose the counter-intuitive assumption that firms more proficient in monitoring are less efficient in production.

In contrast, Proposition 3 states that wages and monitoring accuracy can be complementary on the aggregate level, if effort and quality are rewarded as in Propositions 1 and 2, essentially because monitoring increases quality, leading to higher profits. The present paper thus endogenously generates the size-wage positive correlation as observed in the empirical literature (see footnotes 1 and 3), without resorting to an exogenously assumed negative relationship between monitoring accuracy and production efficiency.

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[4] The size-wage correlation is supported by several empirical studies; see footnote 1, and also, Blanchflower et al. (1996), Hildreth and Oswald (1997), and Bayard and Troske (1999).

2.4 Unemployment

For any two firms i and j, with monitoring accuracy of $a(i)$ and $a(j)$ respectively, the ratio of the real wages is given by:

$$\frac{w(i)}{w(j)}=\frac{W(i)}{W(j)}=\frac{a(i)}{a(j)} \tag{20}$$

That is, the firm-specific real and nominal wages are in a constant ratio that depends positively on the firm-level relative monitoring accuracy.

This result again contrasts with Davis and Harrigan (2011), in which firm-specific real and nominal wage ratios are negatively related with firm-level relative monitoring accuracy, and the last equality in (20) would not hold. The key mechanism that generates the above difference lies in the fact that quality and accordingly the worker's effort are endogenously chosen in the present paper, so that firms with higher monitoring accuracy produce higher-quality varieties. Since higher-quality varieties require higher efforts, higher wages must be paid. Dittrich and Kocher (2011) present an experimental test of a shirking model where effort is a continuous variable, and find evidence for the complementarities between wages and monitoring intensity. While in this paper, we explicitly model the firm's quality choice and link product quality with worker effort.

Let the wage paid at the firm with the best available management talent be the numeraire, i.e., being equal to 1. Using (20), we have a wage schedule

$$W(i)=a(i) \tag{21}$$

Substituting into equations (10) and (2) gives

$$p(i)=(\frac{\sigma}{\sigma-1})a(i) \quad \text{and} \quad q(i)=\frac{E}{P^{1-\sigma}}\{(\frac{1-\theta}{\bar{e}})[\frac{a(i)}{\rho+\delta}+1]\}^{\frac{\sigma-1}{\theta}}[\frac{\sigma-1}{\sigma a(i)}]^{\sigma} \tag{22}$$

The next step is to connect wages to unemployment. Plugging equations (14) and

(21) into equation (9), we have

$$V(i)=\frac{A}{P}+V_U,\quad A\equiv\frac{a(i)-\theta[a(i)+\rho+\delta]}{(1-\theta)[a(i)+\rho+\delta]} \tag{23}$$

where A is the nominal job surplus. Taking derivatives straightforwardly gives $\partial V(i)/\partial a(i)>0$, i.e., the surplus from having a job is increasing in the firm's monitoring accuracy. Thus, to meet the non-shirking condition, higher quality requires bigger job surplus. In addition, $\partial V(i)/\partial\theta<0$, $\partial V(i)/\partial\delta<0$ and $\partial V(i)/\partial\rho<0$, implying that job surplus is increasing in production technology ($1/\theta$), while decreasing in the firm's death rate (δ) and the worker's impatience (ρ).

The fundamental asset equation for an unemployed worker is:

$$\rho V_U=b\coprod\left[V(i)-V_U\right]=\frac{b}{P}\coprod[A] \tag{24}$$

where b is the instantaneous probability of re-employment, and $\coprod$ is the expectation operator as before.

Let U be the total number of unemployed workers. In equilibrium, separation occurs at the exogenous shock rate δ. Then the steady state requires,

$$bU=\left(L-U\right)\delta,\quad \text{or equivalently}\quad b=\left(\frac{1-u}{u}\right)\delta \tag{25}$$

where $u\equiv U/L$ is the unemployment rate. The value of unemployment is increasing in the death rate of jobs, the average monitoring accuracy of the active firms, and is decreasing in the quality preference.

Substituting equation (25) into equation (24) yields

$$\rho V_U=\left(\frac{1-u}{u}\right)\delta\frac{b}{P}\coprod[A] \tag{26}$$

Intuitively, a rise in the job rent requires a rise in unemployment to prevent shirking for given values of ρV_U, leading to a negative relationship between the employment rate $(1-u)$ and the average job rent.

From (19), it is clear that the wage moves positively and proportionally with the firm's monitoring accuracy. Using (21), equation (19) can be re-expressed as

$$\rho V_U = \frac{\rho+\delta}{P}\frac{\theta}{(1-\theta)} \tag{27}$$

that is, the flow benefit of the unemployed worker is a constant in equilibrium. Also, equations (26) and (27) together yield

$$u=\frac{\delta(1-\theta)\coprod[A]}{(\rho+\delta)\theta+\delta(1-\theta)\coprod[A]}, \quad \text{and } \ u\in(0,1) \tag{28}$$

For a given value of $\coprod[A]$, we find $du/d\delta>0$: u is increasing in the shock rate δ; and $\partial u/\partial\coprod[A]>0$: the unemployment rate is increasing in the average job surplus. The latter arises because $\partial\coprod[A]/\partial a(i)>0$, $\partial\coprod[A]/\partial\theta<0$ and $\partial\coprod[A]/\partial\rho<0$, which imply $du/da(i)>0$, $dA/d\theta<0$ and $dA/d\rho<0$, i.e., u is increasing in the average monitoring accuracy of the active firms and the quality-production technology, but is decreasing in the discount rate.

2.5 Optimal monitoring accuracy

In the second stage, firms choose the optimal monitoring accuracy. Similar to Mehta (1998), suppose that monitoring cost is increasing both in the *accuracy (*or *intensity)* of monitoring, $a(m)$, and the number of workers supervised (i.e., the *extensity* of monitoring).

To obtain clear-cut results, we assume a monitoring cost of

$$F(a(m),m)=\frac{1}{m}\{\eta[z(a(m))]^{\gamma}+(1-\eta)[a(m)l_v(a(m))]^2\} \tag{29}$$

where $[z(a(m))]^{\gamma}$ indicates the fixed component of the monitoring cost, $l_v(a(m))$

is labor used for a firm with management talent m, then $[a(m)l_v(a(m))]^2$ is the variable component, and $\eta \in [0,1]$ captures the relative importance of the fixed component in total monitoring costs.

From this subsection on, we use the management talent *m* as the firm identifier. Substituting (14) and (19) into equation (11) gives

$$\pi(m) = \frac{r(m)}{\sigma} - F(a(m), m) - f \tag{30}$$

where $r(m) = Bz(a(m))^{\sigma-1}$, $z(a) \equiv (\frac{1-\theta}{\bar{e}})^{\frac{1}{\theta}}(\frac{1}{\rho+\delta}a^{1-\theta} + a^{-\theta})^{\frac{1}{\theta}}$, and $B = E[\frac{\sigma-1}{\sigma}P]^{\sigma-1}$. Note that to ensure $\bar{e}\lambda^{\theta} \geq 1$, we have imposed the assumption of $\theta \leq \frac{a}{a+\rho+\delta}$, which in turn gives $z'(a) \geq 0$. In addition, *B* is the revenue shifter depending on trade liberalization and the firm's export status as follows. In autarky, *B* is identical for all active firms, and is increasing in the total expenditure and the price index; Under trade liberalization, foreign competition drives *B* down in each market, and that for domestic firms is driven down more than for exporting firms.

Equation (30) indicates that firm performance is completely determined by its monitoring accuracy *m*. Using the firm's pricing rule, (30) can be rewritten as

$$\pi(m) = \frac{B}{\sigma}z(a(m))^{\sigma-1} - \frac{1}{m}[\eta z(a(m))^{\gamma} + (1-\eta)(\frac{\sigma-1}{\sigma}Bz(a(m))^{\sigma-1})^2] - f \tag{31}$$

Then the first order condition and the implicit function theorem give $\frac{\partial z(a(m))}{\partial m} > 0$, i.e., firms with better management talent choose higher monitoring accuracy.

Next, regarding the function $\bar{B}(m)$, we get

Lemma 1: $\frac{\partial z(a(m))}{\partial B} > 0$ *if and only if* $B < \bar{B}(m)$, *where*

$$\bar{B}(m) = \frac{\sigma}{(\sigma-1)}\sqrt{\frac{\sigma\gamma\eta}{2(1-\eta)}}z(a(m))^{\frac{\gamma-2(\sigma-1)}{2}}.$$

Lemma 1 is important for later use, so we explain it here by two cases. (i). If $\gamma > 2(\sigma-1)$, the fixed portion of the monitoring cost plays a bigger role than the variable portion, then the marginal revenue increases in the monitoring cost, which gives rise to higher monitoring accuracy, and we call it the *scale (economy) effect*; (ii). If $\gamma < 2(\sigma-1)$, the variable portion becomes more dominant in that a manager must supervise more workers in bigger firms, in turn higher revenue requires higher monitoring cost, which gives rise to lower monitoring accuracy, and we call it the *span (of control) effect*. Whether higher revenue leads to higher monitoring accuracy or not depends on the relative size of the two effects.

We can illustrate the above comparison with two diagrams. If $\gamma > 2(\sigma-1)$, the *scale effect* dominates, then function $\bar{B}(m)$ is increasing in management talent *m*, as depicted in Figure 1a.

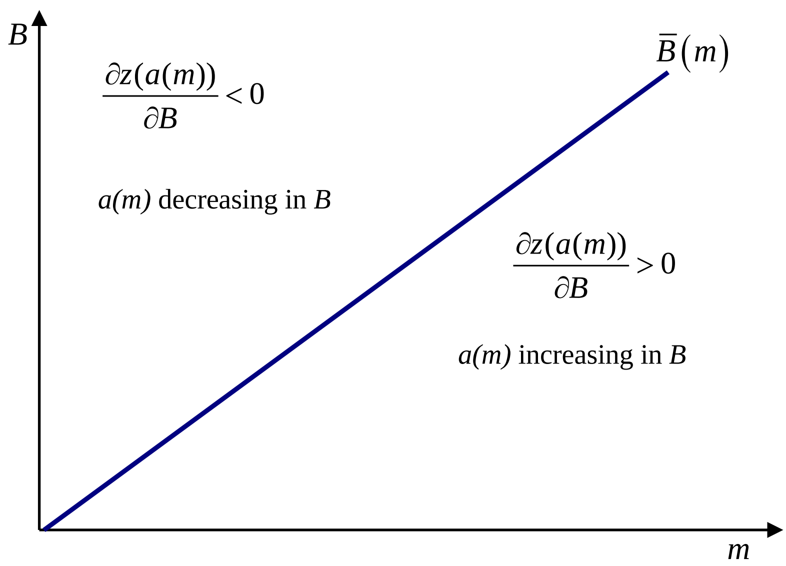

Figure 1a: The optimal monitoring accuracy with $\gamma > 2(\sigma-1)$

On the other hand, if $\gamma < 2(\sigma - 1)$, the *span effect* dominates, and function $\bar{B}(m)$ is decreasing in management talent *m*, as depicted in Figure 1b.

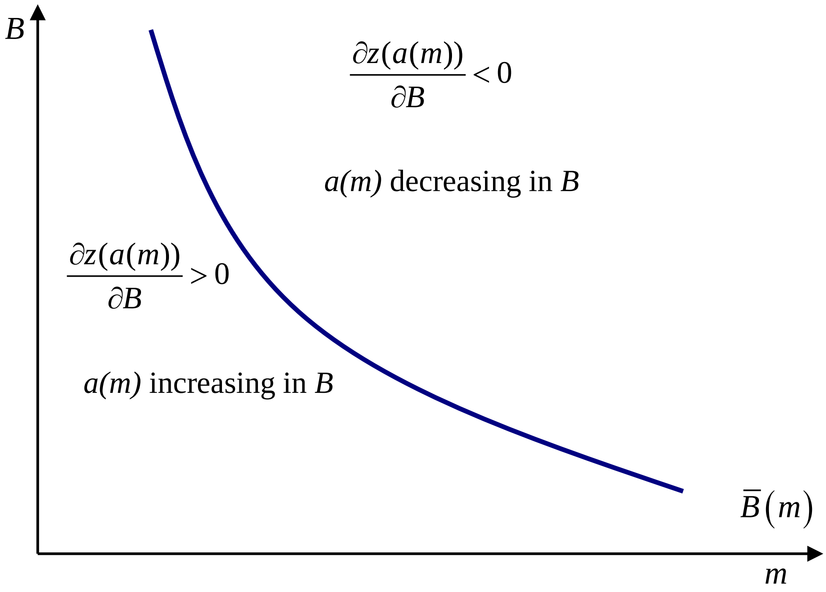

Figure 1b: The optimal monitoring accuracy with $\gamma < 2(\sigma - 1)$

In both diagrams, as *B* increases, the fixed component of the monitoring cost becomes less important, which gives rise to higher (lower) monitoring accuracy for smaller (larger) *B*. It then follows that there is a threshold *B*, namely $\bar{B}(m)$. The optimal monitoring accuracy is first increasing in *B*, for $B < \bar{B}(m)$, and then decreasing, for $B > \bar{B}(m)$.

2.6 Firm entry and exit

A firm's value function is given by $V(m) = \max\{0, \pi(m)/(\rho+\delta)\}$. The full equilibrium features a cutoff level m^*, such that firms with $m < m^*$ exit immediately upon learning of their draw. Thus, given the cumulative distribution $G(m)$ and density function $g(m)$, the equilibrium density of m, $\mu(m)$, is conditional on a successful draw $(m > m^*)$:

$$\mu(m)=\frac{g(m)}{p_{in}}, \quad m \in \left[m^*,1\right) \tag{32}$$

where $p_{in}=1-G\left(m^*\right)$ is the probability of a successful draw. This allows us to define the aggregate productivity analogous to Melitz (2003).

$$\tilde{z}(a(m^*)) \equiv \left[\frac{1}{p_{in}}\int_{m^*}^{1} z\left(a\left(m\right)\right)^{\sigma-1} g\left(m\right) dm\right]^{\frac{1}{\sigma-1}} \tag{33}$$

The aggregate price index is $P=\frac{\sigma}{\sigma-1}M^{\frac{1}{1-\sigma}}[\tilde{z}(a(m^*))]^{-1}$. As in Melitz, the lowest level of m^* is given by the zero-cutoff profit (ZCP) condition:

$$\pi(m^*)=\frac{r(m^*)}{\sigma}-f=\frac{E}{\sigma M}\left[\frac{z\left(a(m^*)\right)}{\tilde{z}\left(a(m^*)\right)}\right]^{\sigma-1}-f=0 \tag{34}$$

Using (34), the average operating profit (ZCP in $\left(\tilde{\pi}, m\right)$ space) can be written as

$$\tilde{\pi}=fk(m^*), \; k(m^*) \equiv [\frac{\tilde{z}(a(m^*))}{z(a(m^*))}]^{\sigma-1}-1 \tag{35}$$

A firm enters the market if the present-discounted value of average operating profit, conditional on successful entry, is at least as high as the entry cost f_e. This leads to the free entry condition (FE):

$$\tilde{\pi}=\frac{\left(\rho+\delta\right) f_e}{p_{in}} \tag{36}$$

The intersection of the ZCP and FE curves determines the equilibrium marginal entrant m^*. Further, (35) is decreasing but (36) is increasing in $\left(\tilde{\pi}, m\right)$ space, so equilibrium exists and is unique under the same conditions as in Melitz (2003).

3. Closed-Economy General Equilibrium

The equilibrium level of monitoring m^* completely determines the structure of the economy, including output, revenue, employment, and profit for each firm. Also, we can recover the unemployment rate and mass of firms in equilibrium.

We first need to calculate $\amalg[A]$. Denoting employment in a firm with talent m as $l(m) = f + q(a(m))$, then

$$\amalg[A] = \amalg\left[\frac{a(m) - \theta(a(m)+\rho+\delta)}{(1-\theta)(a(m)+\rho+\delta)}\right]$$
$$= \frac{\int_{m^*}^{1}\left(\frac{a(m)}{a(m)+\rho+\delta} - \theta\right) l(m)\, g(m)\, dm}{(1-\theta)\int_{m^*}^{1} l(m)\, g(m)\, dm} \equiv \psi(m^*) \tag{37}$$

$\psi'(m^*) > 0$ if $\int_{m^*}^{1}\left(\frac{a(m)}{a(m)+\rho+\delta} - \frac{a(m^*)}{a(m^*)+\rho+\delta}\right) l(m)\, g(m)\, dm > 0$, a sufficient condition for it is $a'(m) > 0$, which holds by assumption.

Then it follows from equation (28) that

$$u = \frac{\delta(1-\theta)\psi(m^*)}{(\rho+\delta)\theta + \delta(1-\theta)\psi(m^*)} \tag{38}$$

It is straightforward to show that $u'(m^*)$ has the same sign as $\psi'(m^*)$. Thus, given $a'(m) > 0$, a rise in m^* causes unemployment.

Having determined u, we now examine the mass of firms M and the mass of entrants M_e. In stationary equilibrium, the mass of successful entrants, $p_{in}M_e$, must be equal to the mass δM of firms hit by bad shocks: $M_e = \delta M / p_{in}$. The equilibrium is determined by setting aggregate employment to total labor demand,

$$(1-u)L = M_e f_e + M\int_{m^*}^{1} l(m)\, \mu(m)\, dm = \frac{M}{p_{in}}\left[\delta f_e + \int_{m^*}^{1} l(m)\, g(m)\, dm\right] \tag{39}$$

4. Trade Liberalization

In this section we examine how trade liberalization affects workers and firms, in terms of wages, employment and profits. As usual, a beachhead fixed cost f_x is required per period in order to export, and the standard iceberg trade cost exists, whereby $\tau > 1$ units of a good must be shipped in order for 1 unit to arrive at destination. The world is comprised of $n+1 \geq 2$ symmetric countries. Symmetry ensures that workers in firms with the same management talent across all countries earn the same wage.

4.1 Product market

Each firm's pricing rule in its domestic market is given, as before, by $p_d(m) = a(m)/\rho$. But exporting firms charge higher prices in foreign markets due to the iceberg trade cost, $p_x(m) = \tau p_d(m)$.

The revenues from domestic sales and export sales to any given country are, $r_d(m) = E[\frac{\sigma - 1}{\sigma} Pz(a(m))]^{\sigma - 1}$ and $r_x(m) = \tau^{1-\sigma} r_d(m)$, respectively, where E and P denote the aggregate expenditure and price index. And a firm's operating profits come from two parts:

$$\pi_d(m) = r_d(m)/\sigma - f \quad \text{and} \quad \pi_x(m) = r_x(m)/\sigma - f_x \qquad (40)$$

In a stationary equilibrium, an incumbent firm with management talent m earns profits $\pi_x(m)$ in every period from its export sales to any given country. Since the export cost is assumed equal across countries, a firm will either export to all countries in every period or never export. Each firm's combined profits can then be written as: $\pi(m) = \pi_d(m) + \max\{0, n\pi_x(m)\}$.

Prior to entry, firms face the same ex-ante distribution of management talent $g(m)$ and probability δ of bad shocks. For a firm to stay alive in the domestic market, its management talent must be at least as high as m^*, defined by $\pi_d(m^*) = 0$.

A firm exports to all n countries if its management talent is at least as high as m_x^*, defined by $\pi_x\left(m_x^*\right)=0$, where $m_x^*>m^*$ if and only if $\tau^{\sigma-1}f_x>f$, i.e., the trade cost relative to domestic overhead cost must be high enough. We hence assume $\tau^{\sigma-1}f_x>f$, thereby partitioning firms according to their export status. Firms with $m\in\left[m^*, m_x^*\right)$ serve the domestic market only, while those with $m\in\left[m_x^*, \overline{m}\right]$ serve both the domestic and foreign markets.

Similarly to the closed-economy case, firm value is given by $v\left(m\right)=\max\left\{0, \pi\left(m\right)/(\rho+\delta)\right\}$, and the probability of successful entry is $1-G(m^*)$. The equilibrium distribution of management talent for incumbent firms is then $\mu(m)=g(m)/[1-G(m^*)]$, $\forall m\in\left[m^*,1\right)$, and the ex ante probability that a successful entrant will export is $p_x=\left[1-G\left(m_x^*\right)\right]/\left[1-G\left(m^*\right)\right]$, which is also the fraction of firms that exports. Let M, as before, denote the equilibrium mass of incumbent firms in any country, then, $M_x=p_xM$ represents the mass of exporting firms, while $M_t=M+nM_x=M\left(1+np_x\right)$ represents the mass of varieties available to consumers (i.e., the mass of firms competing) in any country.

4.2 Open-economy general equilibrium

Analogous to (31), we define the aggregate productivity in the open economy as

$$\tilde{z}_t \equiv \left\{\frac{1}{M_t}\left[M\tilde{z}\left(a(m^*)\right)^{\sigma-1}+nM_x\tau^{1-\sigma}\tilde{z}\left(a(m_x^*)\right)^{\sigma-1}\right]\right\}^{\frac{1}{\sigma-1}} \qquad (41)$$

where $\tilde{z}\left(a(m^*)\right)$ and $\tilde{z}\left(a(m_x^*)\right)$ are functions of m^* and m_x^* respectively, defined in (23). The aggregate price index is then $P=\left(\frac{\sigma}{\sigma-1}\right)M_t^{\frac{1}{1-\sigma}}\left(\tilde{z}_t\right)^{-1}$.

By the same reasoning as in Melitz (2003), the lowest levels of management talent for domestic and export sales, m^* and m_x^*, are given by the ZCP conditions:

$$\pi_d\left(m^*\right)=\frac{E}{\sigma M_t}[\frac{z(a(m^*))}{\tilde{z}_t}]^{\sigma-1}-f=0\,; \qquad \pi_x\left(m_x^*\right)=\frac{E}{\sigma M_t}[\frac{z(a(m_x^*))}{\tau\tilde{z}_t}]^{\sigma-1}-f_x=0\,, \tag{42}$$

which can be linked as follows:

$$z\left(a(m_x^*)\right)=\tau\left(f_x/f\right)^{\frac{1}{\sigma-1}}z\left(a(m^*)\right). \tag{43}$$

Define $\tilde{\pi}_d\left(m^*\right)$ and $\tilde{\pi}_x\left(m_x^*\right)$ as respectively the average profit from domestic sales and exporting to any given country. Then the overall profit, $\tilde{\pi}=\tilde{\pi}_d\left(m^*\right)+p_x n\tilde{\pi}_x\left(m_x^*\right)$, which is also the ZCP in the open economy, is given by

$$\tilde{\pi}=fk\left(m^*\right)+\frac{1-G\left(m_x^*\right)}{1-G\left(m^*\right)}nf_x k\left(m_x^*\right) \tag{44}$$

where $k\left(m^*\right)\equiv[\tilde{z}(a(m^*))/z(a(m^*))]^{\sigma-1}-1$ and $k\left(m_x^*\right)\equiv[\tilde{z}(a(m_x^*))/z(a(m_x^*))]^{\sigma-1}-1$. The FE condition is then

$$\tilde{\pi}=\frac{(\rho+\delta)f_e}{1-G\left(m^*\right)}. \tag{45}$$

The unemployment rate in the open economy has the same functional form as in the closed economy given by (36) and (37). Using u, we can determine the mass of entrants M. The labor demand for a firm is comprised of three parts: the entry cost f_e, the fixed cost for domestic sales f and export f_x, the variable labor used for domestic sales $l_d\left(m\right)=f+q_d\left(m\right)$ and for export $l_x\left(m\right)=f_x+\tau q_x\left(m\right)=f_x+\tau^{1-\sigma}q_d\left(m\right)$. The equilibrium is again determined by setting total employment to labor demand,

$$(1-u)L=M\left(\frac{\delta l_e}{p_{in}}+\int_{m^*}^{1}l_d\left(m\right)\mu\left(m\right)dm+p_x\int_{m_x^*}^{1}l_x\left(m\right)\mu_x\left(m\right)dm\right) \tag{46}$$

where, $\mu(m)=\frac{g(m)}{1-G(m^*)}$ and $\mu_x(m)=\frac{g(m)}{1-G(m_x^*)}$ are the conditional probability distribution for domestic and foreign firms respectively.

5. Trade Impacts on Quality Choice

The first step is to examine how the cutoff is affected by moving from autarky to trade. Let m_a^* denote the cutoff management talent in autarky. Since the existence of a trading equilibrium requires $m_x^*<1$, comparing (33) and (34) with (44) and (45), it is straightforward that trade liberalization only shifts upwards the ZCP condition, while leaving the FE condition unchanged, thus raising the cutoff management talent from autarky, yielding $m^*>m_a^*$. Further, since $k'(m^*)<0$, $\tilde{\pi}_d(m^*)$ must decrease, indicating that all firms incur a loss in domestic sales, due to foreign competition in the open economy. Therefore, firms that do not export incur revenue and profit losses, while the export revenues of the exporting firms increase, more than making up for their losses in domestic sales.

The above derivations can be summarized as:

Lemma 2: *Opening to trade increases the average sales and profits of all active firms, by raising the total sales and profits of the exporters while reducing those of the firms only serving the domestic market, with the former dominating the latter.*

Lemma 2 basically parallels the results in Melitz (2003), as expected.

We next look at the impact of trade opening on the firms' quality choice. From equations (13) and (14), the optimal quality choice is only determined by the firm's monitoring accuracy, which in turn depends on both the firm's management talent and the revenue shifter B. Let B_a denote the revenue shifter in autarky, and B_d and

B_x be the counterparts for the non-exporting and exporting firms respectively in the open economy. Then from Lemma 1 one sees that, starting from autarky when $B = B_a$, with trade *B* increases for exporters but declines for non-exporters, giving $B_d < B_a < B_x$. Define $m_k = \overline{B}^{-1}\left(B_k\right)$, where $k = \{d, a, x\}$.

5.1 Case of $\gamma > 2(\sigma - 1)$

We obtain several contrasting cases. First, recall that if $\gamma > 2(\sigma - 1)$, the scale effect dominates the span effect and $\overline{B}\left(m\right)$ is increasing in *m*, which yields $m_d < m_a < m_x$ in Figure 2. The product quality rises after trade for exporters with management talent m_x but declines for those with management talent m_a. Further, since $\frac{\partial z\left(a(m_x)\right)}{\partial B} > 0$ and $\frac{\partial z\left(a(m_a)\right)}{\partial B} < 0$, the monitoring accuracy rises (falls) for exporters with management talent above m_x (below m_a). Then by *the mid-value theorem*, it is straightforward that there exists an $\tilde{m}_x \in (m_a, m_x)$, such that $\frac{\partial z\left(a(\tilde{m}_x)\right)}{\partial B} = 0$. For exporters with $m > \tilde{m}_x$, trade opening causes them to upgrade their product quality and increase their monitoring accuracy, while for exporters with $m < \tilde{m}_x$, the opposite arises.

On the other hand for domestic firm, we get a threshold $\tilde{m}_d \in (m_d, m_a)$ such that trade liberalization leads to quality and monitoring upgrading (increases in accuracy) for those with talent $m < \tilde{m}_d$, but downgrading for others (see Figure 2).

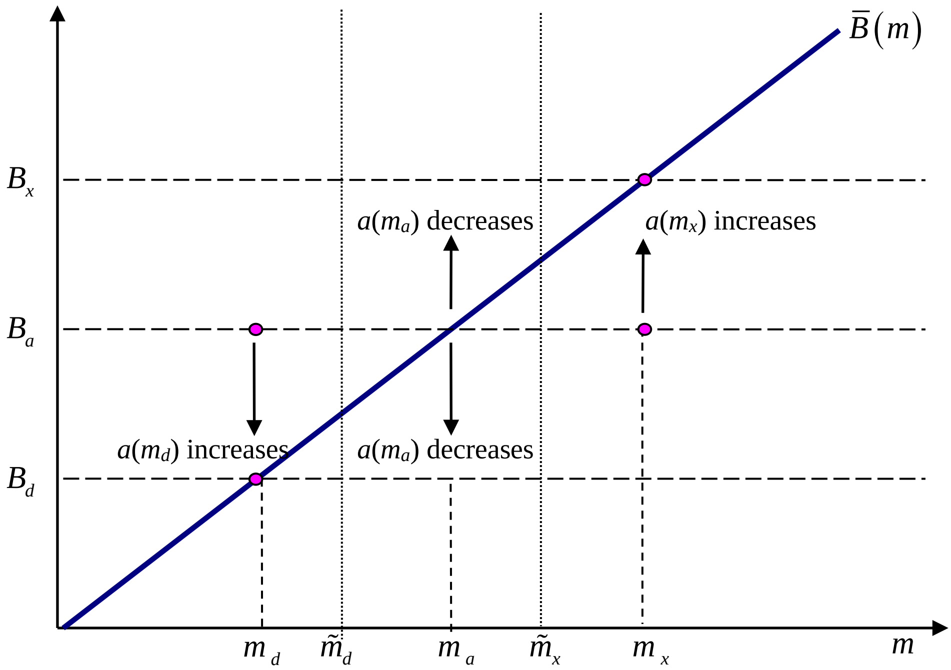

Figure 2: Trade impact on monitoring with $\gamma > 2(\sigma - 1)$

Note two special cases if $\eta \to 0$ ($\eta \to 1$), i.e., the scale effect disappearing (dominating), both $\tilde{m}_d$ and $\tilde{m}_x$ converge to infinity (zero). Then trade opening brings exactly opposite effects: quality and monitoring *downgrading for exporters* but *upgrading for domestic firms* for $\eta \to 0$ as illustrated in Figure 3a, and exactly the opposite for $\eta \to 1$ as depicted in Figure 3b. These contrasting results demonstrate the importance of the structure of the monitoring cost, in having both a fixed and a variable component.

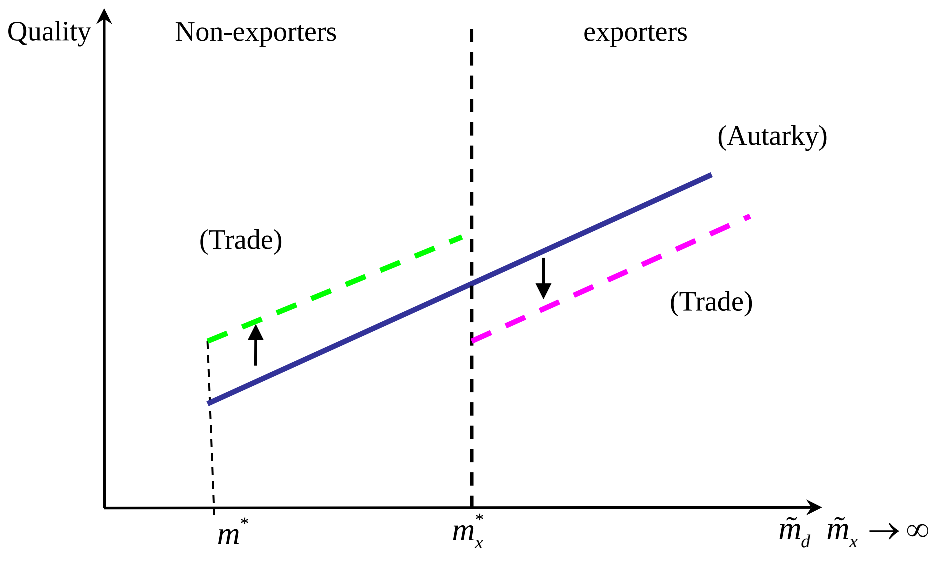

Figure 3a: Trade impacts on quality for $\eta \to 0$ (without fixed monitoring cost)

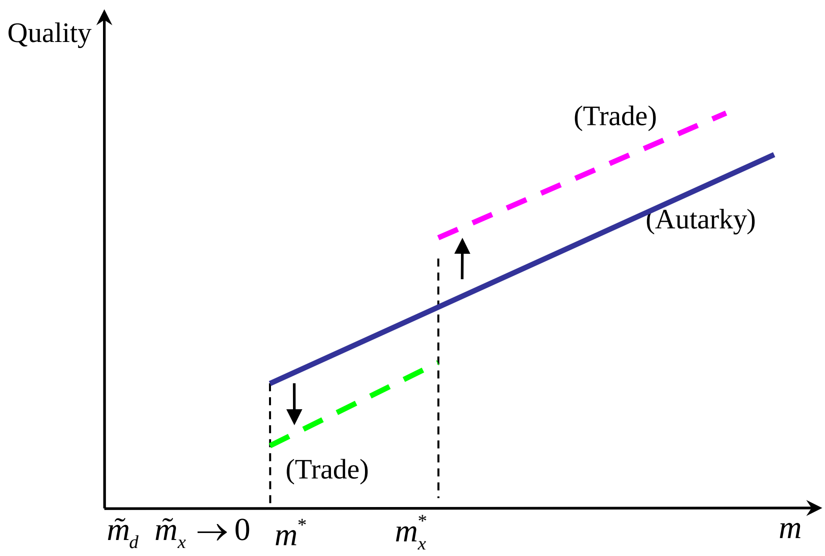

Figure 3b: Trade impacts on quality for $\eta \to 1$ (without variable monitoring cost)

In the more general case of $\eta \in (0,1)$, we should expect that trade opening leads to quality and monitoring upgrading for the most and least talented active firms, while downgrading for firms lying in-between. This case is illustrated in Figure 3c.

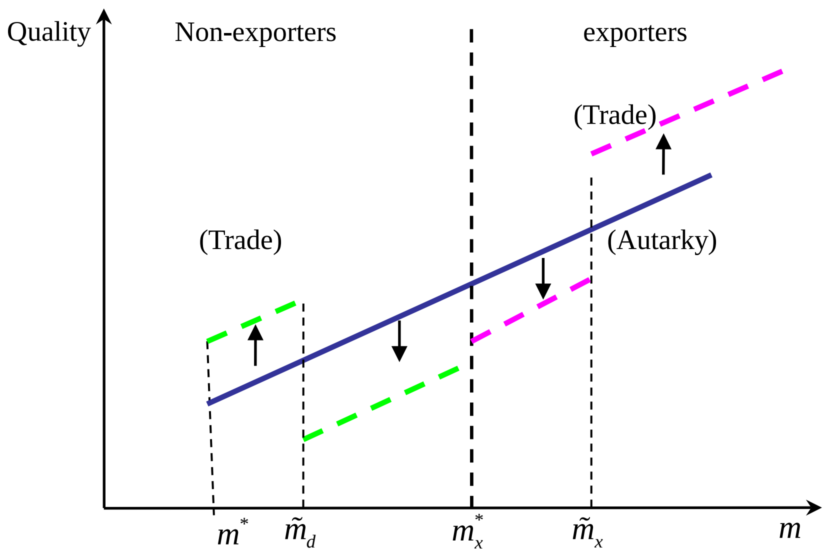

Figure 3c: Trade impacts on quality for $\eta \in (0,1)$ with $\gamma > 2(\sigma - 1)$

5.2 Case of $\gamma < 2(\sigma - 1)$

If $\gamma < 2(\sigma - 1)$, the span effect dominates and $\bar{B}(m)$ is decreasing in *m*, giving $m_x < m_a < m_d$. We still get the two threshold management talent, $\tilde{m}_x \in (m_x, m_a)$ for exporters and $\tilde{m}_d \in (m_a, m_d)$ for domestic firms (See Figure 4); If $\eta \to 0$ or $\eta \to 1$, it does not matter whether $\gamma < 2(\sigma - 1)$ or not, and therefore we focus on the intermediate case where $\eta \in (0,1)$, which is illustrated in Figure 5.

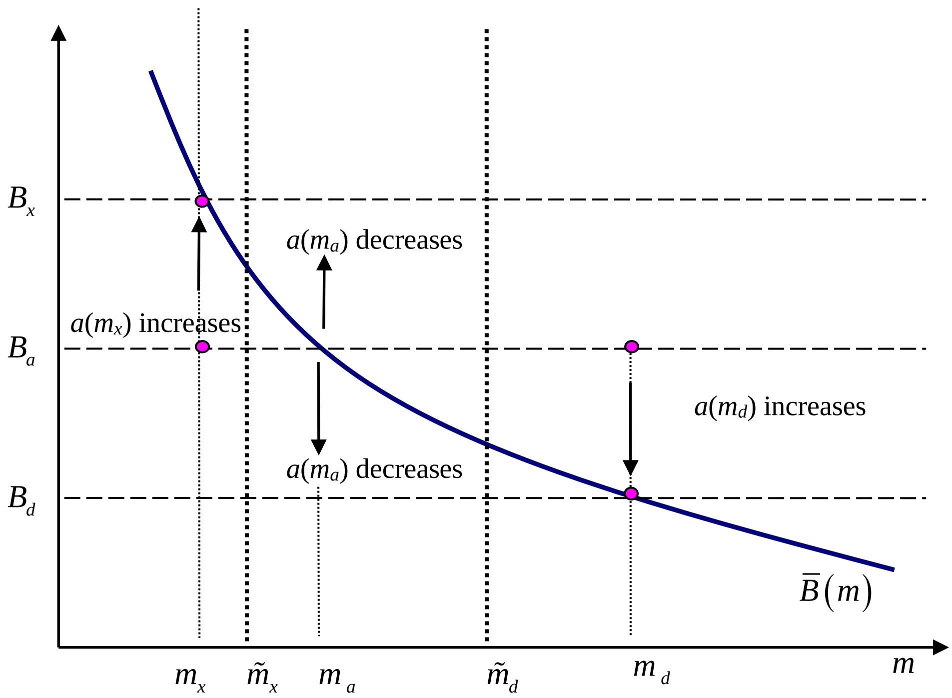

Figure 4: Trade impact on monitoring with $\gamma < 2(\sigma - 1)$

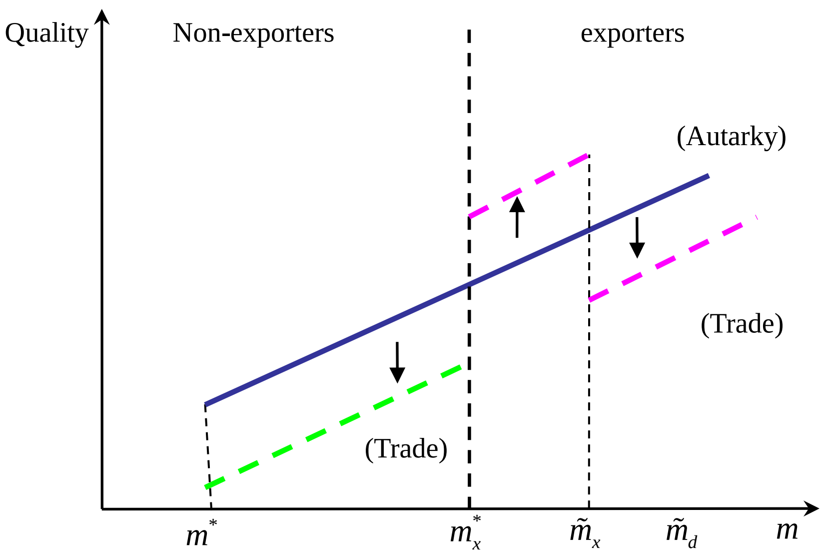

Figure 5: Trade impacts on quality for $\eta \in (0,1)$ with $\gamma < 2(\sigma - 1)$

We now summarize the above contrasting results.

Proposition 4 (Quality impact): *Opening to trade forces the firms producing the* *lowest product quality with management talent* $m \in \left[m_a^*, m^*\right)$ *to exit. But the quality impact on the active firms can be divided into three cases: (i) If monitoring incurs only a variable cost, the span effect dominates, then trade opening leads to quality upgrading for the domestic firms and quality downgrading for the exporters; (ii) If monitoring incurs only a fixed cost, the scale effect dominates, then trade opening leads to quality upgrading for the exporters and quality downgrading for the domestic firm; (iii) In the more general case when both types of costs are incurred, trade opening leads to quality upgrading for the most talented and least talented active firms, while downgrading for the firms lying in-between, if* $\gamma > 2(\sigma - 1)$*. However, if* $\gamma < 2(\sigma - 1)$*, then exactly the opposite arises.*

Proposition 4 clearly states that trade liberalization induces quality adjustments at the "intensive margin" for the active firms, in addition to forcing the low quality firms to exit (i.e., changes at the extensive margin), while in the literature (for instances, Baldwin and Harrigan, 2009; Kugler and Verhoogen, 2010 and Dinopoulos and Unel, 2013), only the latter effect can be found. More interestingly, while product quality is positively correlated with export status in the literature, Proposition 6 implies that in our model, the product quality of exporters is not necessarily higher than that of non-exporters, due to the *span (of control)* effect.

6. Trade Impacts on Labor Market Outcomes

The impact of trade opening on job surplus can also be divided into three cases.

(i). $\eta \to 0$: On the extensive margin, workers in the least talented firms lose their jobs and on the intensive margin, job surplus in the exporting firms declines, however, job surplus in the domestic firms increases. Thus the impact of trade liberalization on the average job surplus and unemployment rate is generally ambiguous. If the share of exporters is relatively large, we would expect to see decreases in both the average job surplus and unemployment rate; But if the share of domestic firms is relatively large, then both the average job surplus and the unemployment rate increase.

(ii). $\eta \to 1$: On the extensive margin, workers in the least talented firms lose their jobs as before, and on the intensive margin, job surplus increases in the exporting firms but decreases in the domestic firms. Thus, the impact of trade liberalization on the average job surplus and unemployment rate increases if the share of exporting firms is relatively large, and vice versa.

(iii). $\eta \in (0,1)$: on the extensive margin, workers in the least talented firms lose their jobs as before; On the intensive margin, workers in the most talented and least talented active firms now earn more job surplus, while workers in the firms with intermediate management talent earn less, if $\gamma > 2(\sigma - 1)$, and the opposite arises if $\gamma < 2(\sigma - 1)$. Therefore, the impact of trade liberalization on the average job surplus and unemployment rate becomes ambiguous.

Summarizing the above, we have:

Proposition 5 (Good & bad jobs): *Firms with monitoring accuracy* $m \in \left[m_a^*, m^* \right)$ *exit after trade liberalization and hence the "worst jobs" that carry low rents are destroyed; New jobs are created, which can be either good or bad jobs, however. Specifically, (i) If monitoring incurs only a variable cost, job rents rise in domestic firms but fall in exporting firms. (ii) If monitoring incurs only a fixed cost, then job rents rise in exporting firms but fall in domestic firms. (iii) In the general case where both types of costs are incurred, job rents in the most talented and least talented active firms rise but fall in firms with intermediate management talent, if*

$\gamma > 2(\sigma - 1)$*; however, if* $\gamma < 2(\sigma - 1)$*, then exactly the opposite occurs.*

Proposition 5 states that the worst jobs with lowest rents are destroyed by trade liberation, while in Davis and Harrigan (2011) the best jobs are destroyed. Also, in our setting the job rents in the active firms are changed by trade opening, since firms can choose the optimal levels of monitoring accuracy and product quality.

7. Conclusions

We have examined the trade impacts on labor market outcomes, in a model incorporating efficiency wages and endogenous product quality choices, where wages and product quality depend on firms' management talent and monitoring accuracy. We find that firms more efficient in monitoring pay produce higher quality, earn higher profits and thus pay higher wages. Trade liberalization can lead to quality upgrading and higher wages, with bad jobs being replaced by good ones. Unemployment rises if the scale effect of monitoring technology dominates the span of control effect. In addition, wage polarization can also arise. These results contrast sharply with some recent theoretical works but match well with several empirical findings mentioned in the introduction of the paper.

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