Import Competition, Agency Problem and Aggregate Productivity: Theory and Evidence*

Cheng Chen†

Abstract. Evidence shows that import competition mitigates the agency problem inside the firm and incentivizes firms to improve management quality, as documented in Schmitz (2005) and Bloom, Draca, and Van Reenen (2016). In order to strengthen our understanding of this phenomenon, I propose a general equilibrium trade model with heterogeneous firms. When an economy opens up to trade, managers of unproductive surviving *non-exporters* are incentivized to exert more effort, leading to improved productivity within those firms. Importantly, this effect only applies to unproductive non-exporting firms that are *subject to the agency problem*. Using world management survey (WMS) data, I provide evidence to support the model's prediction on the relationship between firm size and the managerial effort, which is the key and unique empirical prediction of the model.

Keywords. import competition, firm productivity, agency problem, managerial effort

JEL Classification. D23, F10, F12, L22

*The author is grateful to Gene Grossman, Esteban Rossi-Hansberg, and Stephen Redding for invaluable guidance. The author also thanks Costas Arkolakis, Svetlana Demidova, Taiji Furusawa, Beata Javorcik, John Morrow, Peter Neary, Andrew Newman, Chang Sun, Zhihong Yu and seminar participants at ESWC, Hitotsubashi, Indiana, LSE, Nottingham, Oxford, Princeton, ULB for their valuable comments.

†School of Economics and Finance, The University of Hong Kong, Pokfulam Road, Hong Kong. E-mail: ccfour@hku.hk.

1 Introduction

Recent empirical research regarding the impact of import competition on firm productivity finds substantial productivity gains' coming from improvements within the firm. For instance, Brandt *et al.* (2017) document that surviving Chinese manufacturing firms increased productivity after China joined WTO and substantial reductions in output tariffs were made by the Chinese government. Echoing this finding, Bloom, Draca, and Van Reenen (2016) show that European firms increased productivity after imports from China surged or quotas imposed on Chinese imports were removed. Moreover, empirical studies also document that the pro-competitive effect of import competition is heterogeneous across firms and related to the firm's management quality. For example, Griffith (2001) documents that in the U.K., only establishments whose managerial control and ownership were separated improved productivity after the introduction of the European Union Single Market Program. In addition, Schmitz (2005), Bloom and Van Reenen (2010), and Bloom, Draca, and Van Reenen (2016) find that firms improve their managerial efficiency (or organizational methods) when facing tougher import competition. Why, therefore, do productivity and management quality of *some* firms increase when they face tougher import competition? At the firm level, how does the existence of the agency problem affect productivity gains after import competition becomes tougher? At the aggregate level, does it matter for gains in aggregate productivity after trade liberalization? This paper tries to answer these three questions.

Following the tradition dating back to Berle and Means (1932), I open the black box of the firm and treat the separation of ownership and control as the fundamental problem within the firm. Separation of ownership and control creates conflicts of interests, which exist not only in big corporations, but also in small partnership firms.[1] An investor (i.e., a firm owner) has enough financial resources to form a firm, but has no business idea and managerial ability to run the firm. Therefore, she needs to be matched with a manager who has the business idea and managerial ability to create a successful firm. After the firm owner is matched with the manager, a firm (i.e., a pair) is created. Then, the manager has to exert effort to develop the business idea. In the end, the overall quality of the business idea depends on two components: the initial quality of the idea the manager has and the effort exerted by the manager to implement this idea. This overall quality pins down the efficiency of production, which eventually determines firm productivity.

In this paper, I propose an industry equilibrium model based on Lucas (1978). The industry is populated by firms that produce differentiated products with a constant elasticity of substitution (CES) under conditions of monopolistic competition à la Dixit and Stiglitz (1977). There is a large pool of investors who have enough financial resources to form firms, and their outside option is normalized to zero. In addition to the investors, there are agents (with a fixed mass) who have business ideas to create firms. These agents differ in the quality of their busi-

[1]The only exception is probably the extremely small proprietorship firm run by family members.

ness ideas, which are random draws from an underlying distribution. The investors need to be matched with managers for the creation of firms, and the agent needs to choose between becoming a worker and becoming a manager before the match. Agents who choose to be workers earn wages as their payoff and constitute the (endogenous) supply of labor in the model. If the agent chooses to be a manager who is matched with an investor, ex ante transfer is made from the investor to the manager (to sustain the stable match) as managers are on the short side of the market. The agent who chooses to be a manager must exert effort to develop the business idea, which leads to a product blueprint with some overall quality. Next, the investor decides whether to pay a fixed cost to start production after observing the overall quality of the business idea. Then, if the production starts, the manager (or the owner) decides output and employment. Finally, firms compete in the market, and the investor and the manager receive their income from ex post operating profit. Following the incomplete contract approach to modeling the managerial compensation (i.e., Bolton and Scharfstein 1990; Hart and Moore 1994 and 1998), I assume that the manager and the owner obtain income via ex post bargaining.[2] Shares of the operating profit received by the two agents are assumed to be the solution to a generalized Nash bargaining game which sum up to one.

How do the manager and the firm owner make their decisions in autarky? At the fourth stage, the choice of output is to maximize the operating profit, since the manager and the owner bargain over the operating profit. At the third stage, the owner is willing to start production, if and only if the fraction of operating profit she receives at least covers the fixed production cost. The agent's occupational choice and effort choice at the first and second stages consist of three cases. If the initial quality of the business idea is low, the agent chooses to become a worker, as running the firm (and earning a fraction of the operating profit) would result in a lower payoff than the wage. If the initial quality of the idea is high, the agent chooses to be a manager and exerts effort to maximize his *own* objective function, which results in under-provision of the managerial effort (i.e., the second-best level) due to the profit sharing.[3] However, the investor is still willing to produce under the second-best level of effort, as the operating profit received by her is high enough to cover the fixed cost. When the initial quality of the idea does not belong to the above two cases, the agent still chooses to become a manager but exerts effort higher than the second-best level. In this case, the owner would not start production if the manager exerted effort at the second-best level, as the initial quality and the resulting operating profit are not too high. However, there is room for both the manager and the investor to achieve a Pareto improvement by making the production happen, since the second-best level of effort does not maximize the total payoff (of the two players) and the initial quality is not too low. In

[2]This approach assumes that complete contracts that base the managerial compensation on the manager's effort and performance measures (e.g., operating profits) are infeasible, since these measures are either non-verifiable or manipulatable.

[3]The second-best level of effort is defined as the one that maximizes the operating profit the manager receives from the ex post bargaining minus the cost of exerting effort *given* that the production is carried out. The first-best level of effort is defined as the one that maximizes the total operating profit minus the cost of exerting effort *given* that the production is carried out.

equilibrium, the manager exerts effort at the level that makes the investor break even (i.e., zero profit). As a result, the investor is willing to produce, and the manager earns a payoff higher than his outside option.[4] Finally, matching at the first stage consists of a set of investor and manager pairs. Within each pair, ex ante transfer is made from the investor to the manager to sustain the stable match. Every investor earns zero payoff (i.e., profit) in equilibrium, as they are on the long side of the matching market.

The model yields a unique prediction concerning how the managerial effort varies with the initial quality of the business idea. When the initial quality of the idea is far above the exit cutoff (of becoming a manager), the participation constraint of the investor (to start production) does not bind. Therefore, the manager exerts effort to maximize the fraction of operating profit (received by him), which increases with the initial quality of the idea. As there is a complementarity between the initial quality and the operating profit, the managerial effort increases with the initial quality of the idea. Conversely, the participation constraint of the investor binds when the initial quality of the idea is slightly above the exit cutoff. Therefore, the objective function of this type of manager is to make the investor break even. Naturally, it is easier for the investor to break even, when the initial quality draw is higher. Thus, the (required) managerial effort goes down with the initial quality draw when the initial quality is not too high. In total, the manager's effort decreases first and increases afterwards with the initial quality draw (i.e., "U"-shaped).

I extend the model described above into an international context à la Chaney (2008) and Monte (2011) to study how opening up to trade affects the manager's effort choice. Opening up to trade triggers within-industry resource reallocation, causing the least productive non-exporting firms to exit the market. Importantly, it also generates productivity gains for two types of firms. First, productivity of the least productive surviving non-exporters increases, even though their market size *shrinks*. After opening up to trade, the minimum productivity level under which the owner breaks even increases (due to tougher competition). When the manager earns substantial rents and his owner breaks even in autarky, he is willing to sacrifice a part of his rents and incentivize his owner to produce by exerting more effort to make his investor still break even in the open economy. Therefore, tougher import competition mitigates the agency problem and results in a disciplining effect on managers who work for *the least productive* surviving non-exporter. Second, productivity of the least productive exporters also increases after opening up to trade, for two reasons. First, the second-best level of effort increases, since the market size and the marginal return to exerting effort increase for exporters. Second, managers of the least productive exporters exert effort higher than the second-best level in order to incentivize their owners to export, while these managers exert effort at the second-best level in autarky. In total, managers whose firms' initial quality draws are close to the exit cutoff or the exporting cutoff exert more effort after opening up to trade. Importantly, the pro-competitive

[4] The purpose of deviating from the second-best level of effort is to induce the owner to produce. Thus, any further *upward* deviation from the effort level under which the owner breaks even is suboptimal for the manager.

effect of tougher import competition on firm productivity works among the least productive surviving non-exporting firms which is a unique prediction of this paper.

Next, although almost all firms are subject to the separation of ownership and control in reality, I consider an alternative world in which firms are not subject to the agency problem to highlight the importance of the agency problem in shaping productivity gains under tougher import competition.[5] In such a world, managers of *all* non-exporting firms exert less effort after opening up to trade, since market size shrinks and there are no conflicts of interest inside the firm. In short, the existence of the agency problem leads to productivity gains among the least productive surviving firms after tougher import competition, which is a new channel through which trade liberalization improves firm productivity.

Despite the new channel for productivity improvements after trade liberalization, gains in aggregate productivity *might* be lower in a world with the agency problem compared to a world without such a problem. Gains in aggregate productivity after trade liberalization come from two sources: the within-firm channel and the between-firm channel. In a world with the agency problem, productivity improvement in unproductive firms hinders resource reallocation toward productive firms following trade liberalization. This finding indicates a tension between the within-firm and the between-firm productivity gains after aggregate shocks such as the trade shock. Specifically, if there are many inefficient firms that improve productivity but still cannot reach productivity levels of efficient firms after the shock, this firm-level gain actually *dampens* gains in aggregate productivity due to the lack of resource reallocation. In sum, this insight indicates that the type of firm that improves productivity and the level of productivity improvements are the keys to evaluating changes in *aggregate productivity* after trade liberalization. A numerical example in Section 5 is used to validate the above argument.

The above insight on aggregate productivity gains also applies to the comparative statics of increasing the share of profit the manager receives, which can be viewed as a mitigation of the agency problem of the manager. In the closed economy, a bigger share of profit received by the manager leads to a higher zero profit cutoff for two reasons. First, managers exert more effort as a result of this bigger share, which makes competition tougher. Second, the firm owner's profit shrinks as a part of the total profit, which makes survival of the firm tougher. When I increase the share of profit the manager receives in the two trading economies, I find that they receive smaller gains in aggregate productivity. The key to understanding this is that the fraction of constrained non-exporters becomes larger when the share of profit received by the manager is bigger (and the share of profit that goes to the investor becomes smaller), as the room for achieving a Pareto improvement by making the investor earn zero profit increases. I.e., the severity of the incentive problem of starting production increases. Although these non-exporters increase productivity after trade, they hinder resource reallocation after opening up

[5] Extremely small proprietorship firms run by family members are probably the only firms that are not subject to the agency problem.

to trade. This leads to smaller gains in aggregate productivity from trade.[6]

Finally, using the data from world management survey (WMS), I provide evidence to support the unique and robust prediction of my model.[7] That is, the managerial effort (loosely speaking, management quality) is "U"-shaped with respect to the firm's initial quality draw among non-exporting (or small) firms. First, I use the average score on 18 management practices, documented in WMS, to measure the managerial effort. In addition, firm size (i.e., employment or sales) is used as a proxy for the initial quality draw. Then, I plot the average management score against firm size for non-exporting firms.[8] The empirical result supports the "U"-shaped prediction. That is, the average management score is the lowest for medium-sized non-exporting firms. In addition, the largest non-exporting firms have the highest average management score. To provide further evidence for this "U"-shaped relationship, I run a regression of the average management score on firm size (i.e., log employment or log sales) and the square term of it. Regression results show that the coefficient in front of the first-order term is negatively significant, while the coefficient in front of the second-order term is positively significant. The two findings together lend support to the theoretical prediction that the managerial effort is "U"-shaped with respect to the firm's initial quality draw. In addition, using another data set that has information on firm age (from WMS), I show that the "U"-shaped relationship survives even after controlling for firm age (which is a potential candidate for explaining management quality) in the regression. In total, empirical findings using data from WMS support my model's unique prediction.

The rest of this paper is organized as follows. Section 2 reviews the literature. Section 3 analyzes the model for a closed economy. Section 4 analyzes the model for an open economy. Section 5 investigates how the existence of the agency problem affects aggregate productivity gains from trade. Section 6 presents evidence to support the model's prediction. Section 7 concludes. Proofs of the main results are relegated to the appendices.

[6]There is a crucial difference between a world without the agency problem and an increase in the share of profit received by the manager in a world with the agency problem. In a world with the agency problem, we have two incentive problems: the manager's incentive problem of exerting effort and the investor's incentive problem of starting production. When we increase the share of profit received by the manager, the agency problem of the manager is mitigated while the incentive problem of the investor becomes more severe. However, in a world without the agency problem, both incentive problems disappear, as the manager both receives the full profit of production and decides whether to produce and to export (i.e., there is no role for the investor).

[7]For details about the data set, see `http://worldmanagementsurvey.org/`.

[8]Two points deserve attention here. First, in an open economy with multiple countries, there are multiple cutoffs for exporting. As a result, the model does not have a clear prediction on how the managerial effort varies with firm size among firms that export. Therefore, I focus on non-exporting firms (or small firms) to provide the empirical evidence. Second, most firms in WMS are subject to the agency problem, as average employment is high (around three hundred) in the data set.

2 Literature Review

This article aims to speak to the literature on the firm-level response to tougher import competition. A series of work has documented that within-firm productivity increases in industries where substantial reductions in output tariffs are observed (Pavnick 2002; Trefler 2004; Brandt *et al.* 2012; Bloom, Draca, and Van Reenen 2016). In addition, firm's heterogeneous responses to tougher import competition has been identified as well.[9] Furthermore, some recent work has linked the change in organizational/managerial efficiency to tougher import competition (Schmitz 2005; Bloom and Van Reenen 2010; Bloom, Draca, and Van Reenen 2016)). A recent paper by Bloom *et al.* (2016) studies how management quality affects firm's exporting performance and product quality. Complementary to this literature, this article proposes a new channel through which tougher import competition incentivizes some managers to improve managerial efficiency and provides evidence for the key prediction of the model.

The relationship between market competition and firm productivity is an old question in economics. A Schumpeterian view suggests that intensified competition destroys firms' profitability and, accordingly, their incentive to improve productivity.[10] However, this seems to stand at odds with a vast set of empirical findings and case studies showing that competitive pressure *does* make firms produce more efficiently and managers work harder. Therefore, economists have constructed various models in order to explain these findings.[11] However, none of them takes firm heterogeneity into account. Furthermore, most of these papers derive results from partial equilibrium analysis without worrying about *endogenous* changes in market competition.[12] This paper bridges the gap between the partial equilibrium analysis of the manager's effort choice and the general equilibrium analysis of market competition under firm heterogeneity.

This paper is related to literature arguing that internal firm organization matters for productivity gains from trade. Existing research has investigated how the delegation of decision making inside the firm (Marin and Verdier 2008, 2014), firm boundary (Conconi, Legros, and Newman 2012) and hierarchical structural of the firm (Chen 2017) affect productivity and welfare gains from trade liberalization. However, none of these papers has looked at how the separation of ownership and control inside the firm affects gains in productivity after trade liberalization. Furthermore, this problem is a dominant feature for most firms. My paper fills this gap in the literature.

[9] For example, Schor (2004) finds that only the least productive surviving firms had improved productivity after output tariffs were reduced in Brazil.

[10] Seminal papers in this literature include Grossman and Helpman 1991; Aghion and Howitt 1992 and others.

[11] Seminal papers include Hart (1983), Hermalin (1992), Aghion, Dewatripont, and Rey (1997), Schmidt (1997), Raith (2003), and Vives (2008). Aghion *et al.* (2005) show that the relationship between competition and innovation is non-monotonic.

[12] Wu (2011) is one exception. In that paper, he considers the role of manager in production explicitly and derives interesting results on changes in managerial remuneration schemes after trade liberalization. However, his paper does not focus on the impact of trade liberalization on firm productivity. Antoniades (2015) studies endogenous quality and markup choices of heterogeneous firms in general equilibrium.

Finally, this paper is also related to the study on how better market access affects within-firm productivity. Lileeva and Trefler (2010) document that new Canadian exporting firms experienced productivity gains after the enactment of the Canada-U.S. Free Trade Agreement. Bustos (2011) finds that Argentinean firms whose size is in the third quartile of the size distribution received productivity gained after MERCOSUR went into effect, and these firms were most likely to be the smallest exporters.[13] The above two findings are consistent with the prediction of my model. Importantly, the focus of my paper is on the disciplining effect of tougher import competition, which is different from the focus of this literature.[14]

3 The Closed Economy

In this section, I characterize the equilibrium in the closed economy. The key feature of the model is that the equilibrium effort of the manager is a *non-monotonic* function of the initial quality of the business idea.

3.1 Environment

There are three types of players in the economy: workers, managers, and investors. Workers and managers come from a common pool of agents with a fixed mass, L. The agents differ in the initial quality of their business ideas, which are realizations of random draws from an underlying distribution. Agents make their occupational choice based on realizations of the initial quality draw. As a result, agents with good draws choose to be managers in equilibrium. There is a large pool of investors who have financial resources to form firms, and their outside option is normalized to zero. For simplicity, I assume that the total amount of financial resources available is I, which is more than the (aggregate) ex ante payments for forming various firms.[15] As a result, investors are on the long side of the matching market when they get matched with the managers. And, they earn zero payoff which is their outside option in equilibrium.

There is one industry populated by firms that produce differentiated products under conditions of monopolistic competition à la Dixit and Stiglitz (1977). Each variety is indexed by ω, and Ω is the set of all varieties. Consumers derive utility from consuming these differentiated goods according to

$$U = \Big[\int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \Big]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

[13] Biesebroeck (2006), De Loecker (2007), and Fernandes (2007) document similar empirical findings.

[14] An alternative mechanism to mine is that opening up to trade reduces the cost of consumption (i.e., the ideal price index) and increases the benefit of working as real wage goes up. Therefore, agents choose to work harder after opening up to trade, which makes firms more productive under tough competition (Trindade 2008). However, this argument does not emphasize firm heterogeneity which is the key emphasis of the current paper.

[15] These payments include the (aggregate) ex ante transfers from the investors to the managers and and (aggregate) payments for fixed (production and exporting) costs.

where $q(\omega)$ is the consumption of variety ω, and σ is the constant elasticity of substitution (CES) between differentiated goods.

The timing of the game is described as follows. First, investors enter the industry and are matched with agents who chooses to be managers. After the match, ex ante transfer is made from the investor to the manager to ensure that every investor earns zero payoff in equilibrium, as investors are on the long side of the matching market. Agents who choose to be workers work for firms and constitute the labor supply. Next, the agent who chooses to be the manager exerts effort (denoted by ψ) to develop the quality of the business idea (denoted by ρ), which leads to a blueprint for a product with the overall quality of $\psi\rho$. Third, the investor decides whether or not to pay a fixed production cost, f, to start production. I assume that the investor observes the overall quality of the business idea, when deciding whether or not to start production. The overall quality of the implementable idea determines the labor productivity of the firm in the subsequent production.[16] Fourth, if the production starts, the manager (or the owner) decides the output level and employment. Then, firms compete in the market, and revenue and the operating profit are received.[17] Finally, the investor and the manager bargain over the operating profit to receive their payoffs. For simplicity, I assume that they play a generalized Nash bargaining game. As a result, the manager and the investor receive α and $1-\alpha$ fractions of the operating profit respectively.

Workers and managers are inputs to production. In order to produce q units output, a firm must employ $\frac{q}{\rho\psi(\rho)}$ units of workers. The manager's effort affects firm productivity and does not *literally* mean the amount of time he works. It represents the amount of time the manager works *for the interest of the firm*.[18] In order to exert effort, the manager must incur a cost (i.e., disutility) in terms of the numeraire of ψ^{θ_0}. Parameter θ_0 ($> \sigma - 1$) measure the cost of exerting effort.

3.2 Effort Provision and the Decision to Produce

I use backward induction to solve the equilibrium and highlight the interaction between the manager's effort choice and the investor's decision to start production. Based on the utility function defined in equation (1), the demand function for a firm charging price p is derived as

$$q(p) = \left(\frac{p}{P}\right)^{-\sigma} \frac{Y}{P}, \tag{2}$$

[16]Alternatively, I can assume that the overall quality of the implementable idea pins down the *quality* of the product. Qualitative results of the model are unchanged under this alternative specification.

[17]It is irrelevant who decides on the output and pricing level at this stage, since both parties' incentives are perfectly aligned to maximize operating profits at stage four (i.e., given the effort exerted by the manager).

[18]Bandiera *et al.* (2011) show that the amount of time a manager spends *inside* the firm is highly positively correlated with firm profitability.

where P is the ideal price index of the CES goods and defined as

$$P \equiv \Big[\int_{\omega(\rho)\in\Omega} p^{1-\sigma}(\rho) E dF(\rho)\Big]^{\frac{1}{1-\sigma}},$$

where $F(\rho)$ is the cumulative density function (c.d.f.) of the random draw, ρ, and E is the measure of varieties (or the measure of entering firms).

Since the manager's effort choice does not affect the fraction of operating profit he receives, the optimal price determined at the fourth stage is to maximize the operating profit. As a result, the optimal pricing rule is the same across firms and can be written as

$$p(\rho) = \frac{w}{\rho\psi(\rho)\lambda}, \tag{3}$$

where w is the worker's wage and $\lambda \equiv (\sigma - 1)/\sigma$ is the inverse of the markup. I choose the worker's wage w to be the numeraire in what follows. From equations (2) and (3), I derive the operating profit as

$$\pi(\rho, \psi) = \frac{1}{\sigma} R(\rho, \psi) = \frac{1}{\sigma}(\rho\psi\lambda P)^{\sigma-1} Y, \tag{4}$$

where $R(\rho, \psi)$ is the revenue, and Y is the total income earned by the managers, workers and the investors.

At stage three, the investor is willing to start production, if and only if the fraction of operating profit he receives is larger than or equal to the fixed production cost. Formally, the participation constraint of the investor is

$$(1 - \alpha)\pi(\rho, \psi) - f = \frac{(1-\alpha)}{\sigma}(\rho\psi\lambda P)^{\sigma-1} Y - f \geq 0. \tag{5}$$

The manager's effort choice at stage two is more involved. I discuss it case by case. If the investor is willing to produce, the objective function of the manager (after transformation of variables) is

$$\max_{\beta} \quad \alpha\eta(P, Y)\phi\beta - \beta^{\theta}$$

$$s.t. \quad \alpha\eta(P, Y)\phi\beta - \beta^{\theta} \geq 1,$$

where $\theta \equiv \frac{\theta_0}{\sigma-1}$, and $\eta(P, Y) \equiv \frac{1}{\sigma}(\lambda P)^{\sigma-1} Y$ is the market size (i.e., total income Y) adjusted by the competitiveness of the market (i.e., the ideal price index P). Variables ϕ and β are rescaled initial quality and effort choice.[19] Note that the inequality inside the above optimization problem is the manager's participation constraint. The solution to this optimization problem is

$$\beta_s(\alpha, \eta, \phi) = \Big(\frac{\alpha\eta(P, Y)\phi}{\theta}\Big)^{\frac{1}{\theta-1}}, \tag{6}$$

which is defined as the second-best level of effort. Naturally, when ϕ is sufficiently small,

[19] Specifically, $\phi \equiv \rho^{\sigma-1}, \beta \equiv \psi^{\sigma-1}$.

the profit the investor receives from the ex post bargaining must be smaller than f under the second-best level of effort dictated by equation (6). Therefore, there is a cutoff, $\phi^{'}$, such that the manager cannot compensate his investor by exerting effort at the second-best level, if the initial quality is below this cutoff. Formally, the cutoff $\phi^{'}$ is calculated as

$$(1-\alpha)\pi(\phi^{'}\beta_s(\alpha,\eta,\phi^{'})) = f. \tag{7}$$

The manager with a business idea whose initial quality is $\phi^{'}$ chooses to be a worker if his payoff from running the firm is less than his outside option, or

$$\frac{\theta-1}{\theta}\alpha\pi(\phi^{'}\beta_s(\alpha,\eta,\phi^{'})) < 1.$$

If the above inequality is satisfied, we are in an uninteresting case in which managers of the zero-cutoff profit firm choose to be workers. In reality, it is probably true that when firms (i.e., investors) barely make a profit, their managers still receive high compensation (i.e., strictly positive payoffs) and stick to their jobs. The dataset I use in the empirical section illustrates this point. Among $11,806$ firm-year pairs that report return on capital (profit divided by the sum of equity and debt), roughly $1,653$ observations (14%) report negative or zero return on capital (i.e., profit). Thus, it is more likely that we are in the case in which managers in firms whose investors earn zero profit obtain payoffs that are strictly higher than their outside option. The following assumption guarantees the existence of such a case, and I adopt this assumption in the subsequent analysis.

Assumption 1

$$\alpha > \frac{1}{1+f(1-\frac{1}{\theta})}.$$

Note that the operating profit (a part of which is paid to the manager) is always strictly positive for all firms under the above assumption, while the final profit the investor receives is zero for some firms. Also note that zero final profit is the economic profit (i.e., not necessarily zero monetary profit).

How does the manager with an implementable idea whose initial quality is below $\phi^{'}$ make the effort choice? First, choosing an effort level lower than $\frac{\phi^{'}\beta_s(\alpha,\eta,\phi^{'})}{\phi}$ is suboptimal for him, since the investor would not start production. Second, choosing an effort level higher than $\frac{\phi^{'}\beta_s(\alpha,\eta,\phi^{'})}{\phi}$ is suboptimal for the manager as well. The investor is induced to start production if the effort level equals $\frac{\phi^{'}\beta_s(\alpha,\eta,\phi^{'})}{\phi}$. Any further upward deviation from this effort level reduces the manager's payoff, since this effort level is already above the optimal level of the effort (without considering the binding participation constraint of the investor). Finally, if the initial quality of the idea is too low, exerting effort at the level of $\frac{\phi^{'}\beta_s(\alpha,\eta,\phi^{'})}{\phi}$ gives the manager a payoff lower than his outside option which is one.[20] As a result, this type of manager chooses to become a

[20]As I will show later, this payoff includes both the ex post profit received by the manager and the ex ante

worker. In total, there is another cutoff (i.e., $\phi^*(<\phi')$) such that if the initial quality is above this cutoff but below ϕ', the manager chooses the effort level that makes the firm owner break even.

Now, I discuss the matching process at the first stage. A stable matching consists of a set of firms which is a collection of pairs of the manager and the investor. The (overall) surplus function of the manager and the investor is specified as $(\alpha\eta\phi\beta(\alpha,\eta,\phi) - \beta^{\theta}(\alpha,\eta,\phi), (1-\alpha)\eta\phi\beta(\alpha,\eta,\phi) - f)$ where the effort choice of the manager in equilibrium is denoted by $\beta(\alpha,\eta,\phi)$. The ex ante transfer from the investor to the manager is specified as $(\phi, t(\phi))$ which has to satisfy the following three conditions:

- Participation constraint: $(1-\alpha)\eta\phi\beta(\alpha,\eta,\phi) - f - t(\phi) \geq 0$ for the investor and $\alpha\eta\phi\beta(\alpha,\eta,\phi) - \beta^{\theta}(\alpha,\eta,\phi) + t(\phi) \geq 1$ for the manager.
- Stability of the match: For any $\phi_1 \geq \phi_2$, $t(\phi_1) \geq t(\phi_2)$.
- Equal treatment for the investors: $(1-\alpha)\eta\phi\beta(\alpha,\eta,\phi) - f - t(\phi) = 0$ for any θ.

The first condition above states that both players earn no less than their outside options from the match. The second condition is a monotonicity condition for the ex ante transfer. If it did not hold, there would exist two firm pairs such that $\phi_1 \geq \phi_2$, $t(\phi_1) < t(\phi_2)$. Then, the investor who is matched with the manager with ϕ_2 originally could offer $t(\phi_1) + \epsilon$ where $\epsilon < t(\phi_2) - t(\phi_1)$ to the manager with ϕ_1 and outbid the investor who is matched with the manager with ϕ_1 originally. As a result, her payoff strictly increases, as she is matched with a better manager and pay a smaller amount of ex ante transfer now. Therefore, this condition is a necessary condition for the matching to be stable. The last condition comes from the fact that the investors are homogeneous and on the long side of the matching market. As a result, every investor receives zero payoff in equilibrium. Based on the above conditions, I derive the ex ante transfer scheme as

$$t(\phi) = (1-\alpha)\eta\phi\beta(\alpha,\eta,\phi) - f. \tag{8}$$

Since the investor earns zero net profit ex post when $\phi \in [\phi^*, \phi']$, the above transfer is zero for $\phi \in [\phi^*, \phi']$ and strictly positive for $\phi > \phi'$. Essentially, the manager receives all the profit borne out of the production as managers are on the short side of the matching market. The following lemma summarizes the transfer scheme, the occupation choice of the manager, and the optimal managerial choice:

Lemma 1 *Agents make occupational choice based on the quality of the business ideas. Specifically, those whose quality draws are above ϕ' choose to be managers and are matched with investors who choose to start production. The cutoff, ϕ', is defined as*

$$\phi' \equiv \Big(\frac{f}{(1-\alpha)}\Big)^{\frac{\theta-1}{\theta}} \Big(\frac{\theta}{\alpha\eta(P,Y)^{\theta}}\Big)^{\frac{1}{\theta}}. \tag{9}$$

transfer from the investor.

For this type of manager, the effort choice is at the second-best level:

$$\beta(\alpha, \eta, \phi) = \beta_s(\alpha, \eta, \phi),$$

and the ex ante transfer from the investor is strictly positive:

$$t(\phi) = (1 - \alpha)\eta\phi\beta(\alpha, \eta, \phi) - f.$$

Agents whose quality draws between ϕ^* and ϕ' choose to be managers and are matched with investors who start production as well. The cutoff, ϕ^*, is determined by

$$\phi^* \equiv \frac{\phi' (\alpha f)^{\frac{1}{\theta}}}{\left(\theta[\alpha f - (1 - \alpha)]\right)^{\frac{1}{\theta}}} < \phi'. \tag{10}$$

For this type of manager, the effort choice is above the second-best level:

$$\beta(\alpha, \eta, \phi) = \frac{\beta_s(\alpha, \eta, \phi')\phi'}{\phi} > \beta_s(\alpha, \eta, \phi), \tag{11}$$

and the ex ante transfer from the investor is zero.

If the agent's initial quality draw is below ϕ^*, he chooses to become a worker and earn wage as the payoff.

Proof: See Appendix 9.1. QED.

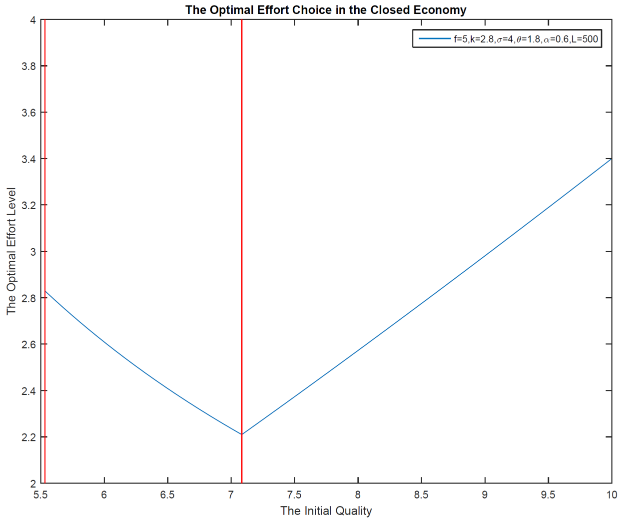
It is interesting that although the manager essentially receives all the profit from production, he still exerts effort lower than the first-best level. The reason is because the ex ante transfer has been made before the manager makes his effort choice. Although the investor decides the amount of transfer based on her ex post profit, the manager cannot promise the investor a higher level of effort in exchange for a higher ex ante transfer as it is not subgame-perfect.[21] Next, it is also interesting that although the agency problem exists inside the firm, the existence of the fixed cost mitigates this problem for some firms (i.e., unproductive firms). The fundamental friction here is that complete contracts are infeasible.[22] As Bolton and Scharfstein (1990) and Hart and Moore (1994, 1998) have forcefully argued, complete contracts that base the managerial compensation on the manager's effort or performance measures are usually infeasible, since these measures are either non-verifiable or manipulatable. Therefore, ex post bargain shapes both players' payoffs and creates an agency problem ex ante. However, the (credible) threat of not starting production by the investor can incentivize the manager whose quality draw is close to the exit cutoff to exert more effort.

The relationship between the initial quality of the idea and the manager's optimal effort

[21] I assume that the match is locked after the ex ante transfer is made.

[22] Otherwise, the investor could offer a contract that makes the manager receive the *full* operating profit and pay the investor a fixed fee after the operating profit is realized.

Figure 1: The Initial Quality and the Optimal Effort Choice



choice is non-monotonic as shown by Figure 1. When the initial quality is high, the optimal effort *increases* with it, as a higher initial quality increases the marginal return to exerting effort. I call firms whose quality draws are within this range "unconstrained firms", since their investors' participation constraint does not bind in equilibrium. However, when the initial quality of the idea is in the middle range, the optimal effort *decreases* with the initial quality, since a higher initial quality coupled with a lower effort level makes the investor break even. For this downward-sloping part, the fixed production cost acts as a disciplining device for the manager. I call firms whose quality draws are in this range "constrained firms", since their investors' participation constraint binds in equilibrium. In total, the relationship between the initial quality of the idea and the optimal effort level is "U" shaped.

For future use, I derive the manager's payoff ($V_m(\phi)$) from equations (6) and (11) as follows:

$$V_m(\phi) = \frac{\alpha f}{1-\alpha} - \left(\frac{\phi'}{\phi}\right)^{\theta} \frac{1}{\theta} \frac{\alpha f}{1-\alpha}, \tag{12}$$

when $\phi \in [\phi^*, \phi')$, and

$$V_m(\phi) = \frac{\alpha(\theta-1)}{\theta} \phi \beta_s(\alpha, \eta, \phi) \eta(P, Y), \tag{13}$$

when $\phi \geq \phi'$.

3.3 Aggregation in the Closed Economy

In this subsection, I analyze the industry equilibrium of the closed economy. In order to obtain analytical results, I assume that the initial quality of the idea is drawn from a Pareto distribution:

$$G(\phi) = 1 - \phi^{-k},$$

where the shape parameter k is negatively related to the variance of the distribution.[23]

There are three sets of equilibrium conditions. The first one is related to the cutoffs. The zero profit condition (ZPC) indicates that firms whose products' initial quality is ϕ' break even in equilibrium:

$$(1-\alpha)\phi'\beta(\alpha,\eta,\phi')\eta(P,Y) = f$$

or

$$\frac{f}{(1-\alpha)} = \left(\frac{\alpha}{\theta}\right)^{\frac{1}{\theta-1}} \phi'^{\frac{\theta}{\theta-1}} \left[\frac{1}{\sigma}(\lambda P)^{\sigma-1} Y\right]^{\frac{\theta}{\theta-1}}. \tag{14}$$

The cutoff for becoming a manager (i.e., the exit cutoff) is denoted by ϕ^* and pinned down by equation (10).

The second set of equilibrium conditions is related to the effort choice. As Lemma 1 states, the optimal effort is determined by equation (6) when $\phi \geq \phi'$ and by equation (11) when $\phi \in [\phi^*, \phi')$.

The final set of equilibrium conditions is about market clearing. The supply of labor is simply $\left(1 - \frac{1}{\phi^{*k}}\right)L$. The demand for labor comes from two parts: labor used for the variable cost and that used for the fixed production cost. The first part is simply $\frac{\sigma-1}{\sigma}Y$, where Y is the total income as well as the total revenue of firms.[24] The second part can be derived as

$$\frac{(1-\alpha)}{1 + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\left(\frac{\alpha f}{\theta[\alpha f-(1-\alpha)]}\right)^{\frac{k}{\theta}}} \frac{Y}{\sigma},$$

where the first part of the above expression is the ratio of the aggregate fixed cost to the aggregate operating profit of the economy. In total, the labor-market-clearing condition is

$$Y = \left(1 - \frac{\left(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\right)^{\frac{k}{\theta}}}{\phi'^k}\right) \frac{L\sigma}{(\sigma-1) + \frac{(1-\alpha)}{1+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\left(\frac{\alpha f}{\theta[\alpha f-(1-\alpha)]}\right)^{\frac{k}{\theta}}}}. \tag{15}$$

This equilibrium condition pins down a positive relationship between Y and ϕ'. When more agents choose to become workers total income of the economy increases, as (wage) income of workers constitutes a fixed fraction of the total income. I omit the statement of the product market clearing condition due to Walras' law and set wage to one.

The general equilibrium of the economy is characterized by the zero profit cutoff, ϕ', the exit cutoff, ϕ^*, the effort choice, $\beta(\alpha,\eta,\phi)$, and the total income, Y. These variables are obtained by solving equations (6), (10), (11), (14) and (15).

I can reduce the equilibrium conditions into two equations (ZPC and the labor-market-clearing condition) and two unknowns (ϕ' and Y) after substituting the expression of the ideal

[23] In order to have a finite expected profit from entry, k has to be bigger than $\frac{\theta}{\theta-1}$.

[24] Notice that I have already used the product market clearing condition here (i.e., total income equals total sales).

price index into equation (14).[25] Specifically, ZPC now becomes:

$$\frac{f}{(1-\alpha)} = \frac{\phi'^{k} Y}{L\sigma\left[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \left(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\right)^{\frac{k}{\theta}}\right]}, \tag{16}$$

which pins down a negative relationship between Y and $\phi^{'}$. When the total income of the economy shrinks, survival becomes tougher, which results in an increase in the zero profit cutoff. Equations (15) and (16) together imply that

$$\phi^{'} = \left[(1+f)\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}} + \frac{f\Big[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}\Big]}{1-\alpha}(\sigma-1)\right]^{\frac{1}{k}}. \tag{17}$$

Obviously, it is required that $\phi^{'}$ derived above is bigger than or equal to the minimum possible draw of ϕ which is one:

$$(1+f)\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}} + \frac{f\Big[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}\Big]}{1-\alpha}(\sigma-1) \geq 1. \tag{18}$$

Under the above condition, the equilibrium (i.e., $\phi^{'}$ and Y) exists and is unique.[26] A quick check of equation (17) shows that when the fixed operation cost, f, goes up, the zero profit cutoff, $\phi^{'}$, increases. As a result, the exit cutoff, ϕ^{*}, also increases.[27] Therefore, equation (18) essentially imposes a lower bound on the fixed production cost, f. Having derived $\phi^{'}$, I can derive Y using equations (15) and (17). Other equilibrium variables such as the exit cutoff, ϕ^{*}, and the effort choices can be derived accordingly.

Finally, I derive a lower bound on I above which the amount of available financial resources is more than what is needed to form firms. Specifically, the investors need financial resources to make the ex ante transfers and payments of the fixed production cost in order to form firms and carry out production. The total amount of funds needed equals

$$L[1-G(\phi^{*})]f + \int_{\phi^{*}}^{\infty} t(\phi)g(\phi)Ld\phi = L[1-G(\phi^{*})]f + f\int_{\phi^{'}}^{\infty}\Big[\Big(\frac{\phi}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}} - 1\Big]g(\phi)Ld\phi.$$

Under the Pareto assumption, the above equation can be rewritten as

$$\frac{fL}{\phi'^{k}}\left[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \left(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\right)^{\frac{k}{\theta}}\right] \leq I.$$

[25]Details can be found in Appendix 9.2.

[26]As equations (15) and (16) pin down a positive and negative relationship between ϕ^{i} and Y, the equilibrium is unique as long as it exits.

[27]This is true, as $\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}$ increases with f.

Substituting the expression of ϕ' derived in equation (17) into the above equation, I derive the following result:

$$\bar{I} \equiv \frac{1}{\frac{1+f}{f\left[1+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\left(\frac{\alpha f}{\theta[\alpha f-(1-\alpha)]}\right)^{\frac{k}{\theta}}\right]}+\frac{\sigma-1}{1-\alpha}} \leq \frac{I}{L}. \tag{19}$$

If the financial resources eventually come from agents' savings, equation (19) states that there is a lower bound on the average savings of agents above which total available financial resources are more than enough to fund all firms in the economy.

4 The Open Economy

In this section, I analyze the properties of managerial effort and firm productivity in the open economy. My analysis explores the *differential* impact of the opening up to trade (and trade liberalization) on the equilibrium effort choice and firm productivity.

Similar to Melitz (2003), I assume there are two symmetric countries in the world: $\tau > 1$ is the iceberg (or variable) trade cost, and f_x is the fixed trade cost. The iceberg trade cost means that if τ units of output are shipped to the foreign market, only one unit of it arrives. The fixed trade cost means that the firm (i.e., the investor) must incur an additional fixed cost in order to export.[28]

4.1 The Optimal Effort Choice in the Open Economy

The analysis for the behavior of the manager and the investor is similar to what was discussed above. First, the optimal price decided by the manager at the fourth stage is still designed to maximize the expected profit. Second, the investor's participation constraint (i.e., the decision to start production at the third stage) is still governed by equation (5). Third, similar to the closed economy case, there are two types of firms among non-exporters in the open economy. For unproductive surviving non-exporters, their managers exert effort higher than the second-best level in order to induce their owner to produce. For productive non-exporters, their managers exert effort at the second-best level, and their owners make strictly positive profit.

A given level of effort brings more profit to the firm if the initial quality of its product is higher. Thus, there is an exporting cutoff ϕ_x^*, meaning that if the initial quality of the business idea is higher than this cutoff, the investor chooses to export. I consider the case in which there is selection into exporting among firms making a positive profit (i.e., the exporting cutoff, ϕ_x^*, is bigger than the zero profit cutoff, ϕ'), and a sufficiently large fixed trade cost ensures it is the case. Empirical evidence motivates this choice.[29]

[28] Similar to the timing assumed in the closed economy, I assume that the investor decides whether or not to export at stage three in the open economy.

[29] Data shows that only a small fraction of firms export, and exporting firms receive higher profit and revenue than non-exporting firms. For instance, only 18% of U.S. manufacturing firms exported in 2002 (Bernard, Jensen,

I analyze how the manager makes his effort choice at the second stage, case by case. The analysis in the closed economy applies to non-exporters in the open economy, since these firms do not have the access to the foreign market. Specifically, the zero profit cutoff and the exit cutoff are still governed by equations (9) and (10), except that P and Y are the ideal price index and the total income in the open economy. Next, the effort choice of managers with ϕ between ϕ^* and $\phi^{'}$ is still governed by equation (11). The analysis for a firm whose product's initial quality is much higher than $\phi^{'}$ is more involved, since its manager realizes that he can exert effort at a level higher than the one specified in equation (6) to induce his investor to not only produce but also export. I adopt the following assumption to ensure that there is selection into exporting among firms that make positive profit:

Assumption 2

$$\frac{f_x \tau^{\sigma-1}}{f} \geq (1 + \frac{1}{\tau^{\sigma-1}})^{\frac{1}{\theta-1}} \left[\theta - \frac{\theta - 1}{(1 + \frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}} \right]^{\frac{1}{\theta-1}}.$$

The following proposition summarizes the ex ante transfer scheme, the occupation choice of the manager, and the optimal managerial choice:

Proposition 1 *Agents make the effort choice based on the quality of their business ideas, and agents with better quality of business ideas choose to become managers.*

When the initial quality of the idea is good enough such that $\phi \geq \phi_x^{'}$, the agent chooses to be a manager and exerts effort at the level of

$$\beta(\alpha, \eta, \phi) = \beta_s(\alpha, \eta, \phi)\Big(1 + \frac{1}{\tau^{\sigma-1}}\Big)^{\frac{1}{\theta-1}}, \tag{20}$$

where

$$\phi_x^{'} \equiv \Big(\frac{(f_x \tau^{\sigma-1})^{\theta-1}\theta}{\alpha(1-\alpha)^{\theta-1}\eta(P, Y)^{\theta}(1 + \frac{1}{\tau^{\sigma-1}})}\Big)^{\frac{1}{\theta}}. \tag{21}$$

When the initial draw $\phi \in [\phi_x^*, \phi_x^{'})$, the agent become a manager and exerts effort according to

$$\beta(\alpha, \eta, \phi) = \frac{\beta_s(\alpha, \eta, \phi_x^{'})\Big(1 + \frac{1}{\tau^{\sigma-1}}\Big)^{\frac{1}{\theta-1}} \phi_x^{'}}{\phi}, \tag{22}$$

where

$$\phi_x^* \equiv \frac{\phi_x^{'}}{\left[\theta - \frac{\theta-1}{\big(1+\frac{1}{\tau^{\sigma-1}}\big)^{\frac{\theta}{\theta-1}}}\right]^{\frac{1}{\theta}}} \tag{23}$$

Variable ϕ_x^* is the exporting cutoff such that the investor decides to export, if her product's initial quality is higher than this threshold.

Redding, and Schott, 2007).

When the initial quality $\phi \in [\phi', \phi_x^*)$, the agent becomes a manager and exert effort at the level of

$$\beta(\alpha, \eta, \phi) = \Big(\frac{\alpha\eta(P, Y)\phi}{\theta}\Big)^{\frac{1}{\theta-1}}, \tag{24}$$

and his investor produces but does not export. When the initial quality draw $\phi \in [\phi^*, \phi')$, the agent chooses to be a manager and his effort is dictated by

$$\beta(\alpha, \eta, \phi) = \frac{\beta_s(\alpha, \eta, \phi')\phi'}{\phi} > \beta_s(\alpha, \eta, \phi), \tag{25}$$

and his investor produces but, again, does not export. When the initial quality draw, ϕ, is smaller than ϕ^*, the agent chooses to become a worker and earn wage income.

For non-exporting firms, the ex ante transfer scheme is zero for $\phi \in [\phi^*, \phi')$ and

$$(1 - \alpha)\eta\phi\beta(\alpha, \eta, \phi) - f$$

for $\phi \in [\phi', \phi_x^*)$. For exporting firms, the ex ante transfer is

$$(1 - \alpha)\eta\phi\beta(\alpha, \eta, \phi)\Big(1 + \frac{1}{\tau^{\sigma-1}}\Big) - f - f_x$$

for $\phi \geq \phi_x^*$.

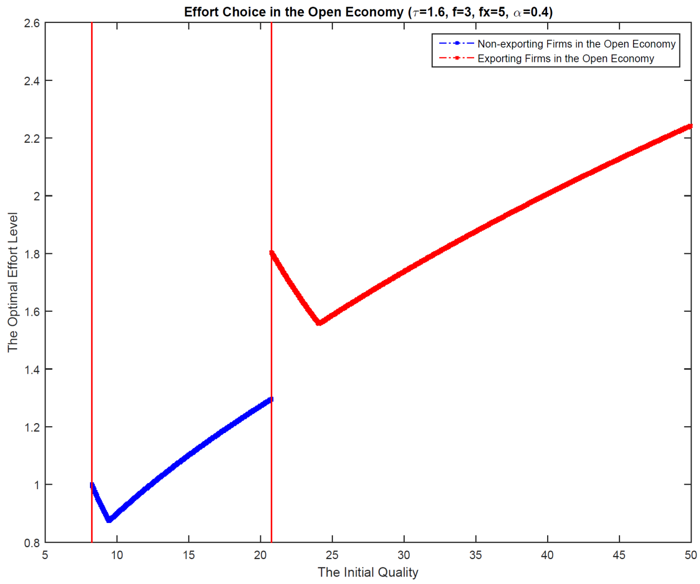
Proof: See Appendix 9.4. QED.

Figure 2 illustrates how the optimal effort varies with the initial quality of the idea in the open economy. It contains two "U"-shaped curves. For firms whose initial quality draws are between ϕ^* and ϕ' (i.e., the constrained non-exporters), the managers exert effort higher than the second-best level to induce their investors to produce. Similarly, for firms whose initial quality draws are between ϕ_x^* and ϕ_x' (i.e., constrained exporters), the managers choose effort levels higher than the second-best level, since they want to induce their investors to export. For the unconstrained non-exporters (i.e., $\phi \in [\phi^*, \phi']$) and exporters (i.e., $\phi \geq \phi_x'$), the change in the managerial effort is purely driven by the change in market size. Thus, managers of unconstrained non-exporters (and exporters) lower (and raise) their effort levels respectively. In total, the fixed costs (i.e., f and f_x) act as disciplining devices for managers in *the least productive* non-exporting *and* exporting firms. Assumption 2 ensures that the exporting cutoff, ϕ_x^*, is bigger than the zero profit cutoff, ϕ'. Vast empirical evidence suggests that exporters are rare and most of them make positive profit, which motivates this assumption.

4.2 Aggregation in the Open Economy

Like the closed economy, the open economy has three sets of equilibrium conditions as well. The first set is still related to the cutoffs. First, the zero profit cutoff, ϕ', and the exit cutoff, ϕ^*, are still governed by equations (14) and (10). Second, the exporting cutoffs, ϕ_x^* and ϕ_x', are

Figure 2: The Optimal Effort Choice in the Open Economy



determined by equations (23) and (21).

The second set of equilibrium conditions is related to the manager's effort choice. Equations (20), (22), (24), and (25) pin down the manager's effort choice in equilibrium. The third set is the labor-market-clearing condition. Specifically, I can derive a condition similar to equation (15) here:

$$Y = \left(1 - \frac{1}{\phi^{*k}}\right) \frac{L\sigma}{(\sigma - 1) + A(\alpha, \theta, k, \sigma, f, \lambda)}, \tag{26}$$

where $A(.)$ is a term pinned down by six parameters. The general equilibrium of the open economy is characterized by the zero profit cutoff, $\phi^{'}$, the exit cutoff, ϕ^{*}, the exporting cutoffs, ϕ_x^{*} and $\phi_x^{'}$, the effort choices, $\beta(\phi)$, and the total income, Y. These variables are obtained by solving equations (10), (14), (20), (21), (22), (23), (24), (25) and (26). Similar to the closed economy analysis, I can reduce the equilibrium conditions into two equations (ZPC and the labor-market-clearing condition) and two unknowns ($\phi^{'}$ and Y). For further discussion about the equilibrium conditions and the existence of the equilibrium in the open economy, see Appendix 9.3.

4.3 Opening Up to Trade and Firm Productivity

In this subsection, I discuss how opening up to trade affects the optimal effort choice as well as firm productivity. The key economic insight is that intensified competition due to the introduction of international trade acts as a disciplining device for managers in the least productive surviving non-exporting and exporting firms. The following proposition summarizes the main result of the paper.

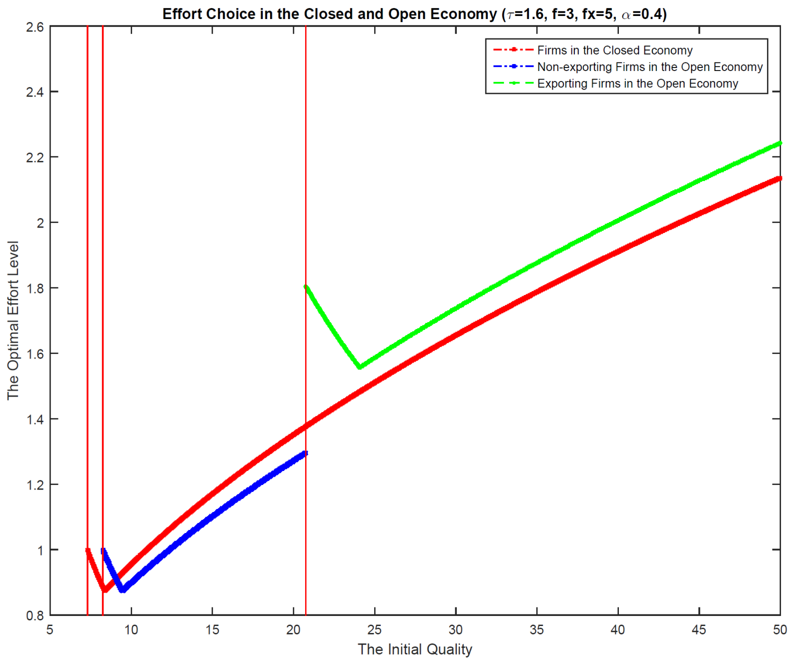
Proposition 2 *After opening up to trade, the exit cutoff (ϕ^*) and the zero profit cutoff (ϕ') both increase, as market size faced by non-exporting firms shrink. Productivities of the least productive exporters and the equilibrium effort level of managers working in these firms are higher in the open economy than in the closed economy. When trade costs are not too small in the open economy, there exists a cutoff on the initial quality draw, $\phi'' \in (\phi^*, \phi')$, such that, for surviving non-exporters with $\phi \leq \phi''$, the equilibrium effort level and firm productivity are higher in the open economy than in the closed economy. I.e., the least productive surviving firms increase productivity after opening up to trade. For surviving non-exporters with $\phi > \phi''$, the equilibrium effort level and firm productivity are lower in the open economy than in the closed economy.*

Proof: See Appendix 9.5. QED.

Figure 3 shows how the optimal effort changes after the economy opens up to trade. Managers of the least productive surviving non-exporters and exporters increase their effort levels, when the economy moves from autarky to an open economy. This is mainly due to the disciplining effect. In order to incentivize their investors to produce and continue to receive rents in the open economy, managers of the least productive surviving non-exporters exert more effort. The introduction of international trade reduces rents earned by managers working in these firms and mitigates the agency problem. Managers of the least productive exporting firms exert more effort for two reasons. First, enlarged market size increases the marginal return to exerting effort at the second-best level. Second, the disciplining effect works for them as well. I.e., managers in these firms exert effort higher than the second-best level to induce their investors to export. Since changes in the manager's effort level directly translate into changes in firm productivity, productivities of the least productive surviving non-exporters and exporters increase after opening up to trade.

Different from Melitz (2003) which is an endogenous entry model, the current paper uses a model of exogenous firm entry (i.e., the mass of potential entrants is fixed at L), which is similar to Chaney (2008) and Monte (2011). Some implications are true in both the current model and in Melitz (2003). In both models, market size shrinks and the exit cutoff increases after opening up to trade. In both models, exporting firms expand and demand more labor after opening up to trade as well. The key difference between the two models is labor supply. In the endogenous entry model, real wage has to increase to make labor demand equal labor supply after opening up to trade, although labor supply itself is unchanged by assumption. In the current model, as labor supply is endogenous, increasing labor demand (from exporting firms) leads to both an increase in real wage (i.e., a reduction in the ideal price index) and an increase in labor supply, which is possible only when the cutoff for becoming the manager (and entering the market) increases. Therefore, the current model not only generates tougher selection into the market (by non-exporting firms) after opening up to trade, but also yields tougher selection into the occupation of managers after opening up to trade. In total, the exogenous entry model serves

Figure 3: Impact of Trade on Managerial Effort



the purpose of this article well, as this paper focuses both on endogenous competition between firms and on endogenous occupational choice and effort choice of agents.

Why does the validity of the above proposition require the condition that trade costs are not too small? The key observation is that if the reduction in trade costs is not too big, some managers would be constrained in both the closed economy and the open economy.[30] It is exactly this type of manager who exert more effort when the economy moves from autarky to the open economy. However, if the reduction in trade costs is too large, the model predicts that managers working in *all* non-exporters exert less effort when the economy opens up to trade. Despite this result, the percentage decrease in productivity is still smaller for unproductive surviving non-exporters than for productive surviving non-exporters, which is summarized in the following proposition.

Proposition 3 *After opening up to trade, the exit cutoff (ϕ^*) and the zero profit cutoff (ϕ') both strictly increase. When trade costs are sufficiently small in the open economy, productivity of all non-exporters decrease. However, the percentage decrease in productivity is smaller for less productive surviving non-exporters than for more productive surviving non-exporters.*

Proof: See Appendix 9.6. QED.

The main difference of the above proposition compared with Proposition 2 concerns the least productive surviving non-exporters. When the reduction in trade costs is small, managers

[30] These managers are constrained in the sense that second-best level of effort could not induce their investors to produce.

working in the least productive surviving non-exporters exert effort at the level that makes their investors break even both before and after the opening up to trade (see Figure 3). In this case, *only* the disciplining effect plays a role. When the reduction in trade costs is in the middle range, managers of this type of firm exert effort at the second-best level in autarky and at the level that makes their investors break even after opening up to trade. Although shrinking market size pushes down the second-best level of effort, the disciplining effect incentivizes the managers to exert effort higher than the second-best level in the open economy. In the end, the disciplining effect dominates the market size effect, and managers of this type of firm exert more effort (see Figure 8). Finally, the market size effect dominates the disciplining effect when the reduction in trade costs is sufficiently large. This results in reduced effort provision for managers of the least productive surviving non-exporters (see Figure 9), which is summarized by Proposition 3. In total, a robust prediction of the model is the differential impact of opening up to trade on firm productivity. That is, the percentage decrease in firm productivity is always smaller for the least productive surviving non-exporters than for the most productive surviving non-exporters.

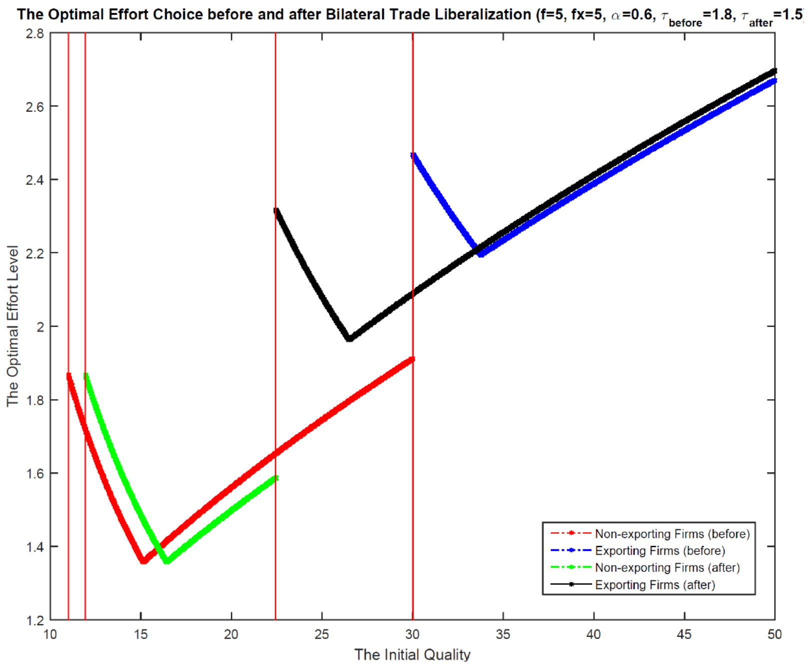
4.4 Bilateral Trade Liberalization

In previous subsection, I discussed how opening up to trade affects firm productivity. Bilateral trade liberalization between two symmetric countries yields similar empirical predictions to opening up to trade, except that I now introduce a new type of firm: the continuing exporter. Among this type of exporting firm, the least productive ones actually *decrease* their managerial effort and productivity, as it is easier for the managers to incentivize their investors to export now. Specifically, managers of these firms are incentivized to choose effort levels higher than the second-best level in order to induce their investors to export before the liberalization. However, they induce their investors to export by exerting effort at the second-best level after the liberalization, since the variable (or the fixed) trade cost goes down. This explains why managers of these firms exert less effort after bilateral trade liberalization. In short, the model does *not* predict that all continuing exporters improve productivity after bilateral trade liberalization. This theoretical result is consistent with the empirical finding from Bustos (2011) that there is no evidence that continuing exporters of Argentina improved productivity after the enactment of MERCOSUR. Figure 4 illustrates how bilateral trade liberalization affects managerial effort choice of different types of firms.

5 Within-Firm and Between-Firm Productivity Gains

In this section, I explore how the existence of the agency problem affects changes in firm productivity after trade liberalization. I also show how a shift in the bargaining power from the investor to the manager impacts market competition and aggregate gains in productivity after opening up to trade.

Figure 4: Trade Liberalization and Managerial Effort



5.1 A World Without the Agency Problem

In this subsection, I consider a world without the agency problem in order to highlight the importance of the agency problem for shaping up aggregate gains in productivity from trade. As there is no separation of ownership and control inside firms in this alternative world, the manager (i.e., the owner) chooses the effort to maximize the total profit and decides whether to start production. Since the analysis is straightforward, I use the following proposition to summarize how firm productivity changes after the economy opens up to trade (see Figure 7 for a graphical representation).

Proposition 4 *Consider a world without the agency problem. After the economy opens up to trade,* all *non-exporters decrease productivity, while all exporters increase productivity.*

Proof: See Appendix 9.7. QED.

The change in market size is the only factor that affects the manager's effort choice in a world without the agency problem. Since the market size shrinks for non-exporters, their managers exert less effort. Meanwhile, managers of exporters increase their effort provision, as their market size increases, resulting in a productivity loss for non-exporters and a productivity gain for exporters. Importantly, there is no heterogeneous impact on non-exporters' productivity change in a world without the agency problem, which differs from the prediction derived in a world with such a problem. In total, the new channel through which tougher import competition improves firm productivity hinges on the existence of the agency problem.

Despite of the new channel for productivity improvements discussed above, gains in aggregate productivity from trade *can* be smaller in a world with the agency problem (compared to a world without). Gains in aggregate productivity come from two sources: the within-firm channel and the between-firm channel. In a world with the agency problem, productivity improvement of the least productive firms (i.e., the constrained non-exporters) dampens resource reallocation toward the most productive firms (i.e., exporters) after opening up to trade. Specifically, productivity levels of the constrained non-exporters do not increase that much and still cannot reach the levels of efficient firms (i.e., unconstrained non-exporters and exporters) after opening up to trade. Moreover, if there are *many* such inefficient firms, the share of exporting firms will be small in the open economy, as a substantial fraction of resource (i.e., labor) is trapped in these unproductive firms in the open economy. The above two forces together reduce gains in aggregate productivity after opening up to trade in the agency world.

I use the following numerical example to illustrate the above insight. Parameter values for this example are reported in Table 1, and I consider a scenario in which the two symmetric economies move from autarky to a costly trade regime (i.e., $f_x = 10$ and $\tau = 2$). It is clear from Table 2 that although there are *many more* firms' increasing productivity in the agency world, the increase in both simple and weighted average of firm productivity is *smaller* in the agency world.[31] Due to the existence of too many constrained non-exporters in the economy (58.28%), resource reallocation after opening up to trade is dampened in a world with the agency problem. As a result, the increase in the exit cutoff and the share of exporters are smaller in such a world, when the economies move from autarky to open economies.

Table 1: Parameter Values

σ	k	θ	α	f	f_x	τ	L
4	3.1	3.5	0.3	10	10	2	300

Table 2: Simulation Result

	Agency	No Agency
Share of firms improving productivity	> 58.93%	2.75%
Increase in average productivity	1.04%	1.48%
Increase in weighted average of productivity	13.96%	14.74%
Share of constrained non-exporters	58.28%	Not applicable
Increase in exit cutoff (selection)	0.53%	0.80%
Share of exporting firms	1.34%	2.75%
Overall welfare gains	0.16%	0.27%
Welfare gains for workers	0.17%	0.27%

The above finding points out a tension between within-firm and between-firm productivity gains after aggregate shocks such as the trade shock. Specifically, if there are many inefficient

[31] I use the share of revenue as the weight when calculating the weighted average of firm productivity.

firms that improve productivity but still cannot reach the levels of efficient firms after an aggregate shock, this firm-level gain actually dampens aggregate gains in productivity. In sum, the type of firm that gains in productivity is the key to evaluating *aggregate gains* in productivity after trade liberalization. Moreover, it warns us that government policies that incentivize small and inefficient firms to improve productivity might reduce gains in aggregate productivity.[32]

Different from the previous numerical example, the following numerical example illustrates that the existence of the agency problem might be able to amplify aggregate-level productivity gains from opening up to trade. Specifically, I reset parameter values as follows:

Table 3: Parameter Values

σ	k	θ	α	f	f_x	τ	L
4	3.1	5	0.2	5	10	1.2	300

Note that under this set of parameter values, Assumption 1 holds with an equality. I.e., there are exactly zero constrained non-exporters in equilibrium. However, as the iceberg trade costs are low (i.e., $\tau = 1.2$), there is a substantial amount of constrained exporters in the open economy now.

Table 4: Simulation Result

	Agency	No Agency
Share of firms improving productivity	13.37%	14.71%
Increase in average productivity	13.30%	11.47%
Increase in weighted average of productivity	46.96%	44.70%
Share of constrained non-exporters	0%	Not applicable
Increase in exit cutoff (selection)	7.73%	7.33%
Share of exporting firms	13.37%	14.71%
Share of constrained exporters	6.21%	Not applicable
Overall welfare gains	2.08%	2.39%
Welfare gains for workers	2.41%	2.39%

Different from the result in Table 2, Table 4 illustrates that gains in both simple and weighted average of firm productivity are larger in a world with the agency problem than in a world without such a problem for two reasons. First, as there are zero constrained non-exporting firms in the open economy now, resource reallocation after opening up to trade is not hindered by the existence of the agency problem inside non-exporting firms. Second and importantly, separation of ownership and control incentivizes managers of the least productive exporting firms (i.e., constrained exporting firms) to exert an extra effort in order to make their owners start to export. As a result, these firms' productivity goes up substantially compared to all other firms. Since the constrained exporting firms are highly productive and there is a reasonably large fraction of them in the open economy (i.e., 6.21%), the selection effect of trade is stronger

[32]Subsidies to small firms and size-dependent policies are examples of such policies.

in a world with the agency problem. This triggers larger gains in aggregate productivity after opening up to trade.

The lesson we draw from the above two numerical examples is that firm-level gains in productivity do not necessarily translate into aggregate-level gains in productivity. While the agency problem inside (the least productive) non-exporting firms generates firm-level gains in productivity after opening up to trade, it hinders resource reallocation and therefore dampens aggregate productivity gains. To the contrary, the agency problem inside (the least productive) exporting firms generates firm-level gains in productivity. Moreover, it helps resource reallocation and aggregate gains in productivity after opening up to trade.

5.2 Severity of the Agency Problem of the Manager

One crude measure for the severity of the principal-agent problem is parameter α. If the manager's bargaining power increases, α increases, which implies that the manager receives a larger fraction of the operating profit. As a result, the firm suffers from a less severe agency problem of *the manager*.[33] A quick check of equation (17) shows that a bigger α leads to a higher zero profit cutoff, as it is tougher for the investors to break even and start production when α goes up (as the share of profit she receives decreases). In short, in a world with the less severe agency problem of the manager, market competition is tougher and it is harder for firms to survive.[34]

Now, I study how the severity of the agency problem of the manager affects productivity and welfare gains from opening up to trade. Following the numerical exercise done before, I keep all parameters other than α unchanged from Table 1 in the following exercise. Specifically, I reduce the value of α from 0.3 to 0.2 and compare two equilibria with different values of α. Table 5 shows the two calculated equilibria for the comparison.

Table 5: Simulation Result

	$\alpha = 0.3$	$\alpha = 0.2$
Increase in average productivity	1.04%	1.21%
Increase in weighted average of productivity	13.96%	14.36%
Share of constrained non-exporters	58.28%	48.17%
Increase in exit cutoff (selection)	0.53%	0.61%
Share of exporting firms	1.34%	1.67%
Overall welfare gains	0.16%	0.21%
Welfare gains for workers	0.17%	0.21%

The simulation result reported in Table 5 suggests that a larger share of profit received by the manager is associated with a smaller gain in both aggregate productivity and welfare.

[33] Note that a bigger α also implies that it is tougher for the firm to survive, as the investor receives a smaller fraction of the operating profit.

[34] Note that it is not clear how α affects the cutoff for becoming a manager, ϕ^*, as the room for achieving a Pareto improvement by making the investors earn zero profit increases with α. As a result, a bigger α leads to a larger share of constrained firms (i.e., $\frac{\phi'}{\phi^*}$ increases with α).

A change in α generates two effects on two agency problems in my model, as both decision makers (i.e., the manager who exerts effort and the investor who decides whether to produce) do not receive the full profit of production. First, the incentive power faced by the manager increases when α goes up, which mitigates the agency problem of the manager. As a result, both the manager himself and his competitors work harder and compete more fiercely in the market. Conversely, the incentive power faced by the investor is reduced when α increases, as she compares a smaller fraction of the operating profit with the fixed production cost when deciding whether to produce. As a result, the incentive problem of starting production becomes more severe, which leads to tougher selection, a higher exit cutoff and a higher zero profit cutoff in equilibrium. In short, both opening up to trade and an increase in the share of profit the manager receives generate tougher selection.[35]

Opening up to trade interacts with the severity of the agency problem (of the manager) through resource reallocation as well. Table 5 shows that the fraction of constrained non-exporters is larger when α is bigger, as the room for achieving a Pareto improvement by making the investor earn zero profit increases. I.e., the severity of the incentive problem of starting production increases. Although these non-exporters increase productivity after opening up to trade, they hinder resource reallocation. This is verified by a smaller increase in the exit cutoff and a smaller share of exporting firms in the open economy when α is bigger in Table 5. Therefore, aggregate gains in productivity and welfare are smaller when α is bigger, as within-firm gains in productivity go against the between-firm gains in productivity. Again, it is the interaction between the two types of productivity gains that triggers the interaction between the severity of the agency problem of the manager and the impact of opening up to trade on productivity.

There is a crucial difference between a world without the agency problem studied in Section 5.1 and an increase in α in a world with the agency problem. In a world with the agency problem, we have two incentive problems as discussed above. However, in a world without the agency problem, both agency problems disappear, as the manager both receives the full profit of production and decides whether to produce. The common lesson we learn from the two comparative statics is that aggregate gains in productivity are smaller, if there are too many (or more) constrained non-exporting firms in the open economy. This is because the existence of these firms hinders resource reallocation, which is verified by the simulation result presented in both Table 2 and Table 5. In total, this paper highlights the tension between within-firm productivity gains and between-firm productivity gains. In addition, it also highlights the importance of the two-sided incentive problems in shaping productivity and welfare gains from trade.

[35] Although I cannot solve the model of two countries' having difference values of α in the open economy, I conjecture that the country with the less severe agency problem (i.e., a bigger α) still has a higher zero profit cutoff and disproportionately more constrained non-exporting firms in the open economy. Therefore, the "U"-shaped pattern should be more pronounced in economies with the less severe agency problem, and market competition is tougher in these economies as well.

6 Evidence

In this section, I present evidence to support the model's key and unique prediction on the relationship between the managerial effort and firm size. This prediction is also a robust prediction of the model, as it does not depend on the level of change in trade costs. The model predicts that among non-exporting firms, the managerial effort is "U"-shaped with respect to the initial quality draw of the firm.[36] Using the data from WMS, I show that the average management score (i.e., a proxy for the managerial effort) of non-exporting (or small) firms is indeed "U'-shaped with respect to firm size (i.e., a proxy for the initial quality draw). Of course, the caveat here is that all the empirical findings in this section are not causal evidence for my model's prediction.

The two data sets I am using are downloaded from WMS website, and they are the same as the ones used in Bloom and Van Reenen (2010). The first data set includes the overall management score as well as individual score on each of the 18 management practices defined by Bloom and Van Reenen (2010).[37] It also has some additional information such as whether the firm is a multinational enterprise (MNE)[38] and the ownership structure of the firm. Note that the first data set only contains cross-sectional information on management quality, as the management survey had been conducted only once for each firm. The second (panel) data set has production and financial information (e.g., employment, sales, value of tangible assets etc.) for each firm surveyed in the first data set and covers the period of 2003-2008. Using a common firm identifier, I merge the two data sets to obtain the data set that is used in the following empirical analysis. For details of the merging and summary statistics of the merged data set, see Appendix 9.9.

I construct variables as follows. First, I use the average score on 18 management practices (the same as the overall management score) to measure the level of managerial effort. Quality of many management practices surveyed by WMS directly measures the level of managerial effort. For instance, good monitoring requires high levels of the managerial effort. In addition, managers have to exert enough effort in order to design appropriate targets for the firm and an efficient system of rewarding (and punishing) good (and bad) performers. Second, as the initial quality draw is unobservable, I use firm size to proxy for the quality draw.[39] Strictly

[36]In an open economy with multiple countries, which is the case in the data, there are multiple cutoffs for exporting. As a result, the model *does not* have a clear prediction on how the managerial effort varies with firm size among firms that export to multiple countries. Therefore, I focus on non-exporting (or small) firms to implement the empirical analysis.

[37]The link to WMS is `http://worldmanagementsurvey.org/`. For detailed discussion of the survey and variables constructed in the data set, see Bloom and Van Reenen (2007, 2010).

[38]The theory presented in this paper does not analyze how MNE status affects the managerial effort. However, if we think MNEs have better initial quality draws and are far away from the exit cutoff, the logic of the model would predict that these firms have higher managerial effort and better management quality than non-MNEs.

[39]In this model, managerial effort is a part of firm productivity and should be taken into account, when we estimate productivity. Therefore, it is hard to estimate the initial productivity or quality draw separately, (i.e., a firm-level productivity measure that excludes the endogenous managerial effort), given that this paper is not a paper that focuses on structural estimations of productivity. Instead, I choose to use a more transparent variable

speaking, the model predicts that there is a cluster of small firms with exactly the same size (i.e., sales and employment) at the exit cutoff. As a result, the managerial effort varies even among these equal-sized firms. However, in a slightly extended version of the model, I can generate the prediction that firm size increases with the initial quality draw even among the constrained non-exporters. In addition, all the other predictions of the original model are unchanged (e.g., the manager's effort choice and productivity change after trade liberalization). As a result, the managerial effort is indeed "U"-shaped with respect to firm size overall in this slightly extended model.[40] This validates the empirical analysis in this section. Third, in order to avoid a substantial loss of observations, I treat the average management score of each firm unchanged overtime and use all observations (across different years) to implement the empirical analysis. The empirical findings I am going to show are qualitatively unchanged, when I use a (smaller) sample of observations whose accounting year and interviewing year (for management practices) coincide.

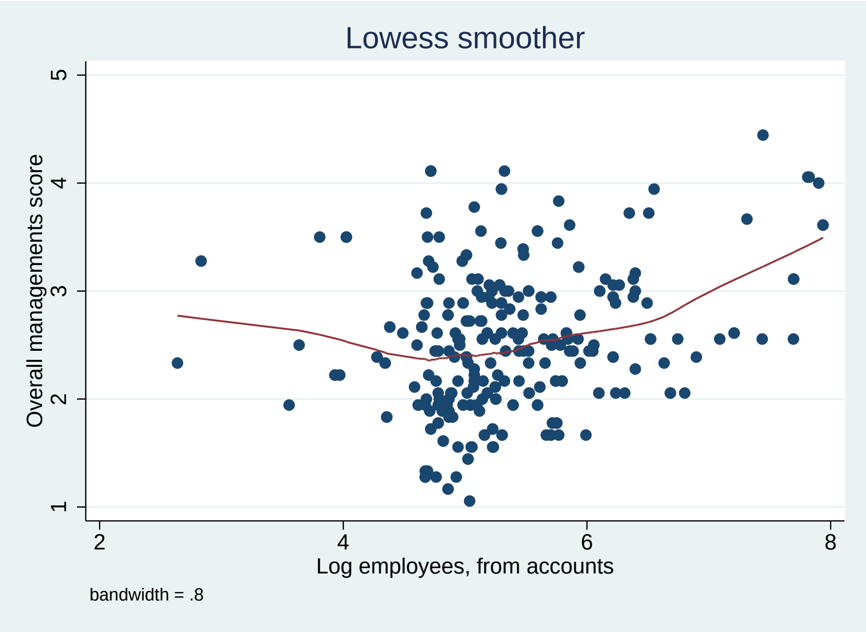
As the first step, I plot average management score against firm size for non-exporting firms that are subject to the agency problem. WMS provides information on the ownership of the firm. In the benchmark plot, I assume all firms are subject to the agency problem. In the robustness check, I exclude family firms that have family CEOs and firms that are owned by managers from the analysis, as these firms might not be subject to the agency problem (i.e., compared with firms that are held by diversified shareholders).[41] Unfortunately, Brazil is the only country where there are enough observations that report their exporting value is zero in WMS. Therefore, I do the plot for Brazilian non-exporting firms only. Figures 5 and 6 clearly show that the managerial effort is "U"-shaped with respect to employment for all firms and for firms that are more likely to be subject to the agency problem. Specifically, the average management score is the lowest for medium-sized non-exporting firms. In addition, the largest non-exporting firms have the highest average management score. In total, this evidence supports my model's prediction concerning the relationship between the managerial effort and the initial quality draw.

(i.e., firm size) which is easy to measure and not subject to estimation biases to run the regressions. Note that the theory has a clear prediction on how the managerial effort or management quality varies with firm size, which validates the empirical analysis using firm size as the dependent variable.

[40]For details, see Appendix 9.8.

[41]The agency firms in the robustness check include firms that have more than five shareholders and family firms that hire outside CEOs. Firms owned by the government or private equity or founders or private individuals are also classified as the agency firms.

Figure 5: Management Score and Firm Size of Brazilian Non-exporters (All firms)



6.1 Regressions

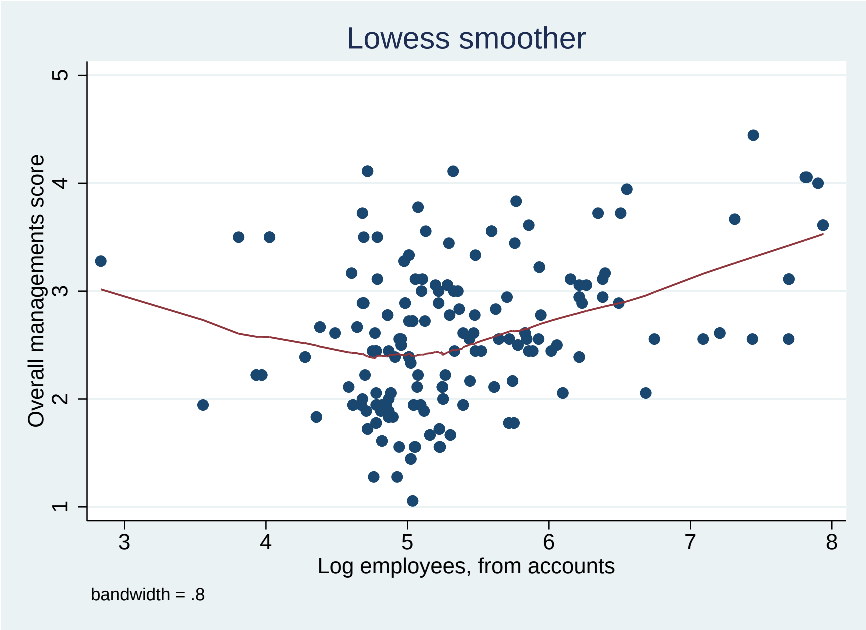
To provide further evidence for the existence of the "U"-shaped curve, I run a regression of the average management score on firm size and the square term of it as follows:

$$\begin{aligned} MS_i &= v_0 + v_1 \ln(employment)_{i,t} + v_2 \ln(employment)^2_{i,t} + Control_{i,t} \\ &+ Non - MNE_{i,t} + Domestic\ MNE_{i,t} + sic_j + country_c + year_t + \epsilon_{i,t}, \end{aligned} \quad (27)$$

where i indicates the firm; t denotes the year; c indicates the country where the firm is located; j denotes the firm's three-digit ISIC industry. Variable MS_i is the average management score on 18 management practices. Variables sic_j, $country_c$, $year_t$ are industry, country and year fixed effects. In some of the regressions, I use country-industry fixed effects and country-year fixed effects in order to control for country-specific differences across industries and time-varying differences across countries. Since existing research (Bloom and Van Reenen 2007, 2010) documents that MNEs have better management quality than non-MNEs, I add two dummy variables related to MNEs. The dummy variable, $Domestic\ MNE_{i,t}$, equals one, if the firm is a domestic firm that has affiliates(s) in a foreign country, while $Non - MNE_{i,t}$ equals one if the firm is not an MNE. Thus, the group of foreign MNEs that have affiliates in the domestic market is the omitted group in the regression. Since firm age[42] and asset holding can potentially affect

[42]It is possible that small firms used in the regressions represent a mixture of truly unproductive old firms and new entrants, whose size will grow fast with time but is currently small due to market experimentation. This means that the new entrants could have high-effort managers despite their small size, which, together with old firms with not so efficient managers, generates the "U" shape observed. This is an alternative hypothesis for the empirical pattern predicted by my model. Therefore, it is crucial to control for firm age in the regressions.

Figure 6: Management Score and Firm Size of Brazilian Non-exporters (Excluding Two Types of Firms)



management quality of the firm, I control for the two variables in our regressions. Specifically, firm-level control variables, $Control_{i,t}$, include the log of tangible assets per employee and the log of tenure of the manager interviewed (in the firm) which is used to proxy for firm age.[43]

As only 4.6% observations report zero exports, I would lose too many observations by only using observations with zero exports. In order to deal with this issue, I use firm size (i.e., log employment) to proxy for firm's exporting status. It is a stylized fact that big firms are more likely to be exporters than small firms. Therefore, I only include small-sized firms (i.e., firms whose employment is below a certain threshold of the employment distribution) into the regressions. Since the "U"-shaped curve exists only when I look at *all* the agency non-exporters, I need to choose a high enough threshold to include most non-exporting firms into the regressions. Among observations that report export value in the data set, one third of them report zero.[44] As employment and exporting status is not perfectly correlated, I set the threshold to the 50*th*. percentile of the employment distribution of firms that belong to the same country-industry pair (in WMS) in the benchmark case. Setting the cutoff to either the 40*th*. percentile or the 60*th*. percentile yields the same empirical results.

Regression results reported in Table 6 support the "U"-shaped prediction yielded by the model. Specifically, the estimated coefficients, v_1 and v_2, are indeed negatively and positively significant. These findings together imply that the managerial effort is "U"-shaped with respect

[43] Although the data set has a variable called "firm age", most observations have missing value for this variable. Thus, I use the manager's tenure in the firm as a proxy for firm age, although I admit that this is a noisy measure for firm age.

[44] Only 13.5% observations report their export value in the data.

to firm size. In addition, the estimates of *Domestic MNE* and *Non-MNE* suggest that foreign MNEs have the highest management quality and non-MNEs have the lowest management quality. Since MNEs probably have better initial quality draws and are far away from the exit cutoff, the theory presented in this paper would predict that these firms have higher managerial effort and better management quality, which is consistent with the regression results. As foreign MNEs are probably a more selected group than domestic MNEs, their management quality is shown to be the highest among all firms. Admittedly, the estimated coefficient of $\ln(tenure)_{ma}$ is quantitatively small and statistically insignificant, which seems to suggest that firm age does not play a role in determining management quality. However, it should also be noted that the measure I use is not an ideal measure for firm age, and I will address this issue in Appendix 9.10.

To provide robustness checks for Table 6, I implement several additional regressions. First, I exclude the two types of firms that might not be subject to the agency problem (as discussed above) and rerun the regression in equation (27), and the results are reported in the first three columns of Table 7.[45] Next, I use a (smaller) sample of observations whose accounting year and interviewing year (for management practices) are the same to rerun the regression, as one might worry that management quality of some firms changes from year to year. The results are reported in the last three columns of Table 7. Finally, instead of using log employment, I use log sales as the proxy for firm size and rerun the regression, The results are reported in Table 8. As both tables show, the coefficient in front of the first-order term is negatively and statistically significant, while the coefficient in front of the second-order term is positively and statistically significant. In total, empirical findings using the data from WMS support my model's prediction on the relationship between the managerial effort and the quality draw of the firm.

Interestingly, the "U"-shaped relationship does not hold when I use all the observations which include both non-exporters and exporters to run the regression, as shown by Table 9. When I use log employment as the measure for firm size, both ν_1 and ν_2 become insignificant. When I use log sales as the measure for firm size, only ν_2 becomes positively significant. Therefore, the "U"-shaped relationship only holds for small firms which are likely to operate in only one market (i.e., the domestic market). When the firm is big and can export, it faces multiple markets. The existence of multiple fixed entry costs dis-enables the theory to predict an "U"-shaped relationship among all firms. In summary, the empirical evidence is not only consistent with what the theory predicts, but also consistent with what the theory does not predict.

[45] I do believe that almost all firms that appear in WMS are subject to the agency problem.

Table 6: Managerial Effort and Firm Employment: An "U"-shaped Curve

	Management Score					
$\ln(empl)$	-0.146***	-0.122**	-0.151***	-0.141***	-0.107**	-0.126*
	(-2.84)	(-2.29)	(-2.89)	(-2.63)	(-2.24)	(-1.91)
$\ln(empl)^2$	0.0253***	0.0224***	0.0250***	0.0255***	0.0210***	0.0223**
	(4.51)	(4.08)	(4.20)	(3.71)	(3.76)	(2.54)
$\ln(tenure)_{ma}$	-0.000855	0.00213	0.00254	0.00909	0.00760	0.00716
	(-0.07)	(0.18)	(0.20)	(0.52)	(0.50)	(0.37)
$Domestic\ MNE$	-0.207***	-0.198***	-0.202***	-0.172***	-0.180***	-0.162***
	(-5.61)	(-5.75)	(-5.09)	(-3.45)	(-4.04)	(-2.74)
$Non-MNE$	-0.387***	-0.389***	-0.378***	-0.323***	-0.339***	-0.289***
	(-11.06)	(-11.68)	(-10.39)	(-6.41)	(-7.44)	(-5.04)
Cutoff Percentile	50%*th.*	60%*th.*	40%*th.*	50%*th.*	60%*th.*	40%*th.*
MNE FEs	yes	yes	yes	yes	yes	yes
Country FEs	yes	yes	yes	-	-	-
Year FEs	yes	yes	yes	-	-	-
Industry FEs	yes	yes	yes	-	-	-
Country-Year FEs	-	-	-	yes	yes	yes
Country-Industry FEs	-	-	-	yes	yes	yes
N	7588	9099	6383	7588	9099	6383
R^2	0.266	0.259	0.273	0.530	0.498	0.560
adj. R^2	0.248	0.244	0.252	0.446	0.425	0.463

Standard errors are clustered at country-industry level. t statistics in parentheses.

Management score: constant for a firm across years. Years covered: 2003-2008.

$\ln(empl)$: log employment; $\ln(tenure)_{ma}$: log of tenure of the manager.

$Domestic\ MNE$ equals one if the firm is a domestic MNE; $Non-MNE$ equals one if the firm is not an MNE.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Managerial Effort and Firm Employment: Robustness Checks

	Management Score					
$\ln(empl)$	-0.178***	-0.150***	-0.173***	-0.163**	-0.0889	-0.158*
	(-3.08)	(-2.59)	(-2.95)	(-2.08)	(-1.12)	(-1.91)
$\ln(empl)^2$	0.0272***	0.0242***	0.0256***	0.0297***	0.0197**	0.0275***
	(4.37)	(4.10)	(3.84)	(3.44)	(2.42)	(2.85)
$\ln(tenure)_{ma}$	0.000757	-0.00000444	0.00402	0.0112	0.0122	0.0217
	(0.05)	(-0.00)	(0.26)	(0.71)	(0.79)	(1.24)
$Domestic\ MNE$	-0.185***	-0.174***	-0.176***	-0.167***	-0.200***	-0.147***
	(-4.63)	(-4.79)	(-4.05)	(-3.64)	(-4.65)	(-2.85)
$Non-MNE$	-0.379***	-0.390***	-0.359***	-0.346***	-0.374***	-0.354***
	(-9.63)	(-10.78)	(-8.62)	(-7.31)	(-8.55)	(-6.92)
Cutoff Percentile	$50\%th.$	$60\%th.$	$40\%th.$	$50\%th.$	$60\%th.$	$40\%th.$
Only agency firms?	Yes	Yes	Yes	No	No	No
One-firm-one-observation?	No	No	No	Yes	Yes	Yes
MNE FEs	yes	yes	yes	yes	yes	yes
Country FEs	yes	yes	yes	yes	yes	yes
Year FEs	yes	yes	yes	yes	yes	yes
Industry FEs	yes	yes	yes	yes	yes	yes
N	5742	6896	4879	1300	1568	1105
R^2	0.282	0.284	0.285	0.300	0.285	0.317
adj. R^2	0.259	0.264	0.258	0.218	0.215	0.221

Standard errors are clustered at country-industry level. t statistics in parentheses.

Management score: constant for a firm across years. Years covered: 2003-2008.

$\ln(empl)$: log employment; $\ln(tenure)_{ma}$: log of tenure of the manager.

$Domestic\ MNE$ equals one if the firm is a domestic MNE; $Non-MNE$ equals one if the firm is not an MNE.

Columns 1-3: Family firms that have family CEOs and firms that are owned by managers are excluded.

Columns 4-6: Only observations whose accounting year and interviewing year coincide are included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Managerial Effort and Firm Sales: An "U"-shaped Curve

	Management Score					
$\ln(sales)$	-0.0968**	-0.0910**	-0.114***	-0.136***	-0.144***	-0.133***
	(-2.20)	(-2.11)	(-2.58)	(-3.15)	(-3.37)	(-2.77)
$\ln(sales)^2$	0.0103***	0.0104***	0.0110***	0.0113***	0.0128***	0.0105***
	(4.31)	(4.55)	(4.51)	(4.00)	(5.07)	(3.16)
$\ln(tenure)_{ma}$	0.00420	0.00370	0.00745	0.00924	0.0119	0.00943
	(0.33)	(0.32)	(0.55)	(0.54)	(0.79)	(0.48)
Domestic MNE	-0.195***	-0.181***	-0.199***	-0.169***	-0.150***	-0.167***
	(-5.02)	(-5.12)	(-4.56)	(-3.30)	(-3.26)	(-2.65)
$Non-MNE$	-0.317***	-0.313***	-0.314***	-0.280***	-0.274***	-0.263***
	(-8.57)	(-9.48)	(-8.04)	(-5.44)	(-6.19)	(-4.55)
Cutoff Percentile	50%*th.*	60%*th.*	40%*th.*	50%*th.*	60%*th.*	40%*th.*
MNE FEs	yes	yes	yes	yes	yes	yes
Country FEs	yes	yes	yes	-	-	-
Year FEs	yes	yes	yes	-	-	-
Industry FEs	yes	yes	yes	-	-	-
Country-Year FEs	-	-	-	yes	yes	yes
Country-Industry FEs	-	-	-	yes	yes	yes
N	7637	9249	6308	7637	9249	6308
R^2	0.255	0.256	0.262	0.523	0.494	0.559
adj. R^2	0.237	0.241	0.240	0.441	0.424	0.464

Standard errors are clustered at country-industry level. t statistics in parentheses.

Management score: constant for a firm across years. Years covered: 2003-2008.

$\ln(sales)$: log sales; $\ln(tenure)_{ma}$: log of tenure of the manager.

Domestic MNE equals one if the firm is a domestic MNE; $Non-MNE$ equals one if the firm is not an MNE.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Managerial Effort and Firm Size: Not an "U"-shaped Curve Overall

	Management Score			
ln(*empl*)	0.0318	0.0640		
	(0.58)	(1.14)		
$\ln(empl)^2$	0.00683	0.00383		
	(1.46)	(0.79)		
ln(*sales*)			-0.0169	-0.0389
			(-0.39)	(-0.83)
$\ln(sales)^2$			0.00617^{***}	0.00704^{***}
			(2.96)	(3.03)
$\ln(tenure)_{ma}$	-0.00643	0.00417	-0.00645	0.00466
	(-0.60)	(0.33)	(-0.63)	(0.39)
Domestic MNE	-0.212^{***}	-0.206^{***}	-0.203^{***}	-0.189^{***}
	(-7.48)	(-6.27)	(-7.26)	(-5.74)
$Non-MNE$	-0.365^{***}	-0.337^{***}	-0.312^{***}	-0.295^{***}
	(-14.20)	(-11.02)	(-12.00)	(-9.45)
MNE FEs	yes	yes	yes	yes
Country FEs	yes	-	yes	-
Year FEs	yes	-	yes	-
Industry FEs	yes	-	yes	-
Country-Year FEs	-	yes	-	yes
Country-Industry FEs	-	yes	-	yes
N	13850	13850	14682	14682
R^2	0.254	0.448	0.258	0.453
adj. R^2	0.244	0.398	0.249	0.408

Standard errors are clustered at country-industry level. t statistics in parentheses.

Management score: constant efor a firm across years. Years covered: 2003-2008.

ln(*sales*): log sales; ln(*empl*): log employment; $\ln(tenure)_{ma}$: log of tenure of the manager.

Domestic MNE equals one if the firm is a domestic MNE.

$Non-MNE$ equals one if the firm is not an MNE.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Alternative Hypothesis

An important alternative hypothesis for the observed "U"-shaped relationship is that small firms which are young on average might have higher productivity and better management quality. The reason why they are small is that they are learning the demand or accumulating customer capital (i.e., Foster, Haltiwanger, and Syverson 2016). I deal with this issue by using another data set from WMS which has information on firm age. Specifically, I use the data set that is used in Bloom and Van Reenen (2007) to replicate the regression run before. Since this is a data set which is different from the data set used in the paper, I relegate all the discussions into Appendix 9.10. This additional empirical analysis further confirms our empirical results established in the paper. In particular, I show that the "U"-shaped relationship still holds among small firms even after firm age's having been controlled for in the regression.

7 Concluding Remarks

This paper presents a model that highlights the agency problem inside the firm in order to explain why *some* of the agency firms improve productivity after trade liberalization. The main prediction of the model is that the least productive surviving agency non-exporters increase productivity after trade liberalization, since managers of these firms are incentivized to exert more effort in order to induce their owners to produce. Furthermore, this disciplining effect *does not* apply to firms that are not subject to the agency problem. However, this new channel for productivity improvement does not *necessarily* lead to larger gains in aggregate productivity from trade. The reason is that resource reallocation toward the most productive firms is hindered due to the non-exits of these least productive firms after trade liberalization.

Using WMS data, I provide evidence to support the model's key prediction on the relationship between the managerial effort and firm size. In the data, firms that receive the lowest average management scores are indeed the medium-sized firms. In addition, the biggest firms have the highest average management scores. All these findings are consistent with the model's predictions.

Nevertheless, much remains to be done, and there are at least two issues that can be investigated further. First, this model has the potential to explain changes in managerial effort in the context of *gradual* trade liberalization. It is clear that, although the least productive firms exit the market eventually, they improve productivity before exiting in the process of gradual trade liberalization. Second, using the current model to study how other types of economic reforms (e.g., industry deregulation) affect firm productivity is also an interesting topic for future research.

8 Acknowledgment

This paper is a substantially revised version of the paper: "Agency Problems, Trade Liberalization, and Within-Firm Productivity Gains: Theory and Evidence". Previous versions of this paper were circulated under the names of "Heterogeneous Firms with Agency Problem–Theory and Evidence" and "Trade Liberalization and Within-Firm Productivity Gains". The author is grateful to Gene Grossman, Esteban Rossi-Hansberg, and Stephen Redding for invaluable guidance and to Bob Staiger (the editor) and two anonymous referees for providing insightful comments on the paper. The author also thanks Pol Antràs, Costas Arkolakis, Davin Chor, Liang Dai, Svetlana Demidova, Taiji Furusawa, Swati Dhingra, Keith Head, Wen-Tai Hsu, Amanda Jakobson, Beata Javorcik, Amit Khandelwal, Patrick Legros, Andrei Levchenko, Lin Ma, Marc Melitz, Kalina Manova, Dilip Mookherjee, John Morrow, Peter Neary, Andrew Newman, Morten Olsen, Gianmarco Ottaviano, Larry Qiu, Ferdinand Rauch, Richard Rogerson, Thomas Sampson, Chang Sun, Zhigang Tao, Luhang Wang, Zhihong Yu and seminar participants at Montreal (ESWC), GWU, HKU, Indiana, LSE, Nottingham, Oxford, Princeton, Singapore Management University, UIBE, University of Kansas, ULB (Thred) for their valuable comments. Financial support from the University of Hong Kong and Hong Kong General Research Fund (project code: 17507916) is greatly appreciated.

References:

1. Aghion, Philippe, Nick Bloom, Richard Blundell, Rachel Griffith, and Peter Howitt (2005): "Competition and Innovation: An Inverted-U Relationship," *Quarterly Journal of Economics* 120: 701-728.

2. Aghion, Philippe, Mathias Dewatripont, and Patrick Rey (1997): "Corporate Governance, Competition Policy and Industrial Policy," *European Economic Review* 41: 797-805.

3. Aghion, Philippe, and Peter Howitt (1992): "A Model of Growth through Creative Destruction," *Econometrica* 60: 323-351.

4. Antoniades, Alexis (2015): "Heterogeneous Firms, Quality, and Trade," *Journal of International Economics* 95: 263-273.

5. Bandiera, Oriana, Andrea Prat, Luigi Guiso, and Raffaella Sadun (2011): "What does a CEO Do?" *CEPR Discussion Papers* 8235.

6. Berle Adolf A., and Gardiner Means (1932): "The Modern Corporation and Private Property," New York: Macmillan.

7. Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott (2007): "Firms in International Trade," *Journal of Economic Perspectives* 21: 105-130.

8. Van Biesebroeck, Johannes (2006): "Exporting Raises Productivity in Sub-Saharan African manufacturing Firms," *Journal of International Economics* 67: 373-391.

9. Brandt, Loren, Johannes Van Biesebroeck, Luhang Wang, and Yifan Zhang (2017): "WTO Accession and Performance of Chinese Manufacturing Firms," *American Economic Review*: forthcoming.

10. Bloom, Nicholas, and John Van Reenen (2007): "Measuring and Explaining Management Practices across Firms and Countries," *Quarterly Journal of Economics* 122: 1351-1408.

11. Bloom, Nicholas, and John Van Reenen (2010): "Why do Management Practices Differ across Firms and Countries?" *Journal of Economic Perspectives* 24: 203-224.

12. Bloom, Nicholas, Mirko Draca, and John Van Reenen (2016): "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," *Review of Economic Studies* 83: 87-117.

13. Bloom, Nick, Kalina Manova, John Van Reenen, Stephen Sun, and Zhihong Yu (2016) "Managing Trade: Evidence from China and the US," Unpublished manuscript, Stanford University.

14. Bolton, Patrick, and David S. Scharfstein (1990): "A Theory of Predation Based on Agency Problems in Financial Contracting," *American Economic Review* 80: 93-106.

15. Bustos, Paula (2011): "Trade Liberalization, Exports and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms," *American Economic Review* 101: 304-340.

16. Chaney, Thomas (2008): "Distorted Gravity: the Intensive and Extensive Margins of International Trade," *American Economic Review* 98: 1707-1721.

17. Chen, Cheng (2017): "Management Quality and Firm Organization in Industry Equilibrium," *American Economic Journal: Microeconomics*: forthcoming.

18. Conconi, Paola, Patrick Legros, and Andrew F. Newman (2012): "Trade Liberalization and Organizational Change," *Journal of International economics* 86: 197-208.

19. De Loecker, Jan (2007): "Do Exports Generate Higher Productivity? Evidence from Slovenia," *Journal of International Economics* 73: 69-98.

20. Dixit, Avinash, and Joseph Stiglitz (1977): "Monopolistic Competition and Optimum Product Diversity," *American Economics Review* 67: 297-308.

21. Fernandes, Ana M. (2007): "Trade Policy, Trade Volumes and Plant-Level Productivity in Colombian Manufacturing Industries," *Journal of International Economics* 71: 52-71.

22. Foster, Lucia, John Haltiwanger, and Chad Syverson (2016): "The Slow Growth of New Plants: Learning about Demand?" *Economica* 83: 91-129.

23. Griffith, Rachel (2001): "Product Market Competition, Efficiency and Agency Costs: An Empirical Analysis," *The Institute for Fiscal Studies* Working Paper 01/12.

24. Grossman, Gene, and Elhanan Helpman (1991): "Quality Ladders in the Theory of Growth," *Review of Economic Studies* 68: 43-61.

25. Hart, Oliver (1983): "The Market Mechanism as an Incentive Scheme," *Bell Journal of Economics* 14: 366-382.

26. Hart, Oliver, and John Moore (1994): "A Theory of Debt based on the Inalienability of Human Capital," *Quarterly Journal of Economics* 109: 841-879.

27. Hart, Oliver, and John Moore (1998): "Default and Renegotiation: A Dynamic Model of Debt," *Quarterly Journal of Economics* 113: 1-41.

28. Hermalin, Benjamin (1992): "The Effects of Competition on Executive Behavior," *RAND Journal of Economics* 23: 350-365.

29. Lileeva, Alla, and Daniel Trefler (2010): "Improved Access to Foreign Markets Raises Plant-Level Productivity ... for Some Plants," *Quarterly Journal of Economics* 125: 1051-1099.

30. Lucas, Robert (1978): "On the Size Distribution of Business Firms," *Bell Journal of Economics* 9: 508-523.

31. Marin, Dalia, and Thierry Verdier (2008): "Competing in Organizations: Firm Heterogeneity and International Trade," In *The Organization of Firms in a Global Economy*, Elhanan Helpman, Dalia Marin, and Thierry Verdier, ed. (Cambridge, MA: Harvard University Press).

32. Marin, Dalia, and Thierry Verdier (2014): "Corporate Hierarchies and International Trade: Theory and Evidence," *Journal of International Economics* 94: 295-310.

33. Melitz, Marc J. (2003): "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity," *Econometrica* 71: 1695-1725.

34. Monte, Ferdinando (2011): "Skill Bias, Trade, and Wage Dispersion," *Journal of International Economics* 83: 202-218.

35. Pavcnik, Nina (2002): "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *Review of Economic Studies* 69: 245-276.

36. Raith, Michael (2003): "Competition, Risk and Managerial Incentives," *American Economic Review* 93: 1424-1436.

37. Schmidt, Klaus (1997): "Managerial Incentives and Product Market Competition," *Review of Economic Studies* 64: 191-213.

38. Schmitz, James Jr. (2005): "What Determines Productivity? Lessons from the Dramatic Recovery of the U.S. and Canadian Iron Ore Industries Following Their Early 1980s Crisis," *Journal of Political Economy* 113: 582-625.

39. Schor, Adriana (2004): "Heterogeneous Productivity Response to Tariff Reduction: Evidence from Brazilian Manufacturing Firms," *Journal of Development Economics* 75: 373-396.

40. Trefler, Daniel (2004): "The Long and Short of the Canada-U.S. Free Trade Agreement," *American Economic Review* 94: 870-895.

41. Trindade, Vitor (2008): "Openness and Productivity: A Model of Trade and Firm-owners' Effort," Unpublished manuscript, University of Missouri, Columbia.

42. Vives, Xavier (2008): "Innovation and Competitive Pressure," *Journal of Industrial Economics* 56: 419-469.

43. Wu, Yanhui (2011): "The Impact of International Trade on Pay Structure and Wage Inequality," Unpublished manuscript, University of Southern California.

9 Appendix: For Online Publication

9.1 Proof of Lemma 1

Proof. The proof proceeds in three steps. First, I discuss agents with $\phi \geq \phi^{'}$. For this type of agent, $\beta_s(\alpha, \eta, \phi)$ is the optimal effort choice, as the operating profit received by the investor is higher than the fixed cost under the second-best level of effort. I.e., the participation constraint of the investor does not bind. In addition, Assumption 1 assures that the type of agent (i.e., manager) receives an (ex post) payoff higher than his outside option when $\phi \geq \phi^{'}$ and $\beta = \beta_s(\alpha, \eta, \phi)$. Moreover, the ex ante transfer to this type of manager equals the investor's net profit or

$$(1-\alpha)\eta\phi\beta(\alpha, \eta, \phi) - f,$$

which is strictly positive. Therefore, this type of agent chooses to be the manager.

When $\phi \in [\phi^*, \phi^{'})$, the investor's profit under the second-best level of effort is smaller than the fixed production cost, f. As argued in the main text, the effort level of $\frac{\beta_s(\alpha,\eta,\phi^{'})\phi^{'}}{\phi}$ is the minimal as well as the optimal effort level for this type of manager. Under this effort level, the ex post payoff to the manager is

$$\frac{\alpha f}{1-\alpha}\Big[1 - \Big(\frac{\phi^{'}}{\phi}\Big)^{\theta}\frac{1}{\theta}\Big],$$

which increases in ϕ and is bigger than or equal to one when $\phi \geq \phi^*$. Since the investor makes zero net profit ex post, the ex ante transfer to the manager is zero. Thus, the total payoff to this type of manager increases in ϕ and equals one when $\phi = \phi^*$. Therefore, it is optimal for this type of agent to choose to be the manager.

When $\phi < \phi^*$, the agent has to exert at the level of $\frac{\beta_s(\alpha,\eta,\phi^{'})\phi^{'}}{\phi}$ in order to induce the investor to start production.[46] However, this would lead to a payoff (to the manager) strictly below one. Moreover, since the investor makes zero net profit ex post, the ex ante transfer to the manager is zero. Therefore, the total payoff to this type of agent would be strictly below one, if he decides to be a manager. As a result, this type of agent chooses to become the worker and receive wage income. QED.

9.2 The Ideal Price Index in the Close Economy

In this subsection, I derive the ideal price in the closed economy. The expression of the ideal price index in the closed economy is[47]

$$P = [\int_{\phi^*}^{\infty} p(\phi)^{1-\sigma} L d\phi]^{\frac{1}{1-\sigma}} = L^{\frac{1}{1-\sigma}}(\beta(\alpha, \eta, \phi^{'})\phi^{'})^{\frac{1}{1-\sigma}}\Bigg[\int_{\phi^{'}}^{\infty} k\Big(\frac{\phi}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}}\phi^{-k-1}d\phi + \Big(\frac{1}{\phi^{*k}} - \frac{1}{\phi^{'k}}\Big)\Bigg]^{\frac{1}{1-\sigma}} \quad (28)$$

[46] It is never optimal for the agent to be a manager and have no production afterwards, as this would lead to zero or negative payoff to the manager which is strictly below the manager's outside option (i.e., the wage).

[47] Note that firms with productivity draws between ϕ^* and $\phi^{'}$ choose the same price.

which can be rewritten as

$$P^{\frac{\theta}{\theta-1}} = \frac{L^{\frac{1}{1-\sigma}}}{\lambda}\Bigg[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}\Bigg]^{\frac{1}{1-\sigma}}\Bigg[\phi'^{(\frac{\theta}{\theta-1}-k)}\Big(\frac{\alpha\lambda^{\sigma-1}Y}{\sigma\theta}\Big)^{\frac{1}{\theta-1}}\Bigg]^{\frac{1}{1-\sigma}}. \tag{29}$$

9.3 Equilibrium Conditions in the Open Economy

I analyze equilibrium conditions in the open economy in this subsection. First, the ideal price index in the open economy equals

$$\begin{aligned} P &= L^{\frac{1}{1-\sigma}}(\beta(\alpha,\eta,\phi')\phi')^{\frac{1}{1-\sigma}}\Bigg[\int_{\phi'}^{\phi_x^*} k\Big(\frac{\phi}{\phi'}\Big)^{\frac{\theta}{\theta-1}}\phi^{-k-1}d\phi + \Big(\frac{1}{\phi^{*k}}-\frac{1}{\phi'^k}\Big)+(1+\tau^{1-\sigma}) \\ &\quad \int_{\phi_x'}^{\infty} k(1+\tau^{1-\sigma})^{\frac{1}{\theta-1}}\Big(\frac{\phi}{\phi'}\Big)^{\frac{\theta}{\theta-1}}\phi^{-k-1}d\phi + \Big(\frac{1}{\phi_x^{*k}}-\frac{1}{\phi_x'^k}\Big)\Big(\frac{\phi_x'}{\phi'}\Big)^{\frac{\theta}{\theta-1}}(1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}\Bigg]^{\frac{1}{1-\sigma}}. \end{aligned}$$

After substituting the optimal effort choices into the above expression, I can derive the price index as

$$\begin{aligned} P^{\frac{\theta}{\theta-1}} &= \frac{L^{\frac{1}{1-\sigma}}}{\lambda}\Bigg[\phi'^{(\frac{\theta}{\theta-1}-k)}\Big(\frac{\alpha\lambda^{\sigma-1}Y}{\sigma\theta}\Big)^{\frac{1}{\theta-1}}\Bigg]^{\frac{1}{1-\sigma}}\Bigg[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}} \\ &\quad -\frac{k}{k-\frac{\theta}{\theta-1}}\Bigg[\frac{f_x\tau^{\sigma-1}}{f(1+\frac{1}{\tau^{\sigma-1}})^{\frac{1}{\theta-1}}\Big[\theta-\frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}\Big]^{\frac{1}{\theta-1}}}\Bigg]^{1-\frac{(\theta-1)k}{\theta}} + (1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}} \\ &\quad \Bigg(\Big[\theta-\frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}\Big]^{\frac{k}{\theta}} + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\Bigg)\Big(\frac{(f_x\tau^{\sigma-1}/f)^{\frac{\theta-1}{\theta}}}{(1+\tau^{1-\sigma})^{\frac{1}{\theta}}}\Big)^{\frac{\theta}{\theta-1}-k}\Bigg]^{\frac{1}{1-\sigma}} \end{aligned} \tag{30}$$

Note that the ideal price index is well defined only when $k > \frac{\theta}{\theta-1}$. Also note that the price index is smaller in the open economy than in the closed economy, conditioning on ϕ' and Y, as

$$\Big(\frac{\phi_x'^k}{\phi_x^{*k}} + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\Big) > 1 + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} = \frac{k}{k-\frac{\theta}{\theta-1}}.$$

Based on equation (30), I can rewrite ZPC in the open economy as

$$\frac{f}{(1-\alpha)} = B(\alpha,\theta,k,\sigma,f,\lambda)\phi'^k Y, \tag{31}$$

where $B(\alpha, \theta, k, \sigma, f, \lambda)$ is defined as

$$
\begin{aligned}
\frac{1}{B(\alpha,\theta,k,\sigma,f,\lambda)} \equiv\ & L\sigma\Bigg[\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \left(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\right)^{\frac{k}{\theta}} \\
& -\frac{k}{k-\frac{\theta}{\theta-1}}\left[\frac{f_x\tau^{\sigma-1}}{f(1+\frac{1}{\tau^{\sigma-1}})^{\frac{1}{\theta-1}}\Big[\theta-\frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}\Big]^{\frac{1}{\theta-1}}}\right]^{1-\frac{(\theta-1)k}{\theta}} \\
& +(1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}\left(\Big[\theta-\frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}\Big]^{\frac{k}{\theta}}+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}\right)\Big(\frac{(f_x\tau^{\sigma-1}/f)^{\frac{\theta-1}{\theta}}}{(1+\tau^{1-\sigma})^{\frac{1}{\theta}}}\Big)^{\frac{\theta}{\theta-1}-k}\Bigg].
\end{aligned}
$$

Next, I derive the labor-market-clearing condition in the open economy. It is still true that the variable cost which is eventually paid to workers constitutes $\frac{\sigma-1}{\sigma}$ fraction of the total income, Y. Also note that managers eventually receive all the profits, and the ratio of the aggregate fixed costs (domestic production and exporting) to the total operating profit is

$$
\frac{Lf\frac{1}{\phi^{*k}}+Lf_x\frac{1}{\phi_x^{*k}}}{\frac{Lf}{(1-\alpha)\phi'^k}\left[\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi'_x}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}+\Big(\frac{\phi_x^*}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}\Big[(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi'}{\phi_x^*}\Big)^{\frac{\theta}{\theta-1}}-\frac{k}{k-\frac{\theta}{\theta-1}}\Big]\right]},
$$

which can be reduced to

$$
\begin{aligned}
& A(\alpha,\theta,k,\sigma,f,\lambda) \\
\equiv\ & \frac{(1-\alpha)\left[\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}+\frac{f_x}{f}\Big(\big(\frac{f}{f_x}\big)^{\frac{\theta-1}{\theta}}\frac{(1+\tau^{\sigma-1})^{\frac{1}{\theta}}}{\tau^{\sigma-1}}\Big)^k\Big[\theta-\frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}\Big]^{\frac{k}{\theta}}\right]}{\left[\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}+\frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi'_x}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}+\Big(\frac{\phi_x^*}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}\Big[(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi'}{\phi_x^*}\Big)^{\frac{\theta}{\theta-1}}-\frac{k}{k-\frac{\theta}{\theta-1}}\Big]\right]}.
\end{aligned}
$$

Therefore, the labor-market-clearing condition in the open economy can be written as

$$
\begin{aligned}
Y &= \Big(1-\frac{1}{\phi^{*k}}\Big)\frac{L\sigma}{(\sigma-1)+A(\alpha,\theta,k,\sigma,f,\lambda)} \\
&= \left(1-\frac{\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}}{\phi'^k}\right)\frac{L\sigma}{(\sigma-1)+A(\alpha,\theta,k,\sigma,f,\lambda)}. \qquad (32)
\end{aligned}
$$

Since $\frac{\phi'_x}{\phi'}$, $\frac{\phi^*_x}{\phi'}$ and $\frac{\phi'}{\phi^*}$ are pinned down by exogenous parameters, I can solve for ϕ' and Y in the open economy using equations (31) and (32):

$$
\frac{f}{(1-\alpha)B(\alpha,\theta,k,\sigma,f,\lambda)} = \phi'^k Y = \left(\phi'^k-\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}\right)\frac{L\sigma}{(\sigma-1)+A(\alpha,\theta,k,\sigma,f,\lambda)},
$$

which leads to the solution of $\phi^{'}$ as

$$\phi^{'} = \phi_1(\alpha,\theta,k,\sigma,f,\lambda) \equiv \Bigg[\frac{f[(\sigma-1)+A(\alpha,\theta,k,\sigma,f,\lambda)]}{L\sigma(1-\alpha)B(\alpha,\theta,k,\sigma,f,\lambda)} + \Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}}\Bigg]^{\frac{1}{k}}. \tag{33}$$

In the open economy, ZPC and the labor-market-clearing condition still pin down a negative and a positive relationship between $\phi^{'}$ and Y. Therefore, if

$$\phi_1(\alpha,\theta,k,\sigma,f,\lambda) > \phi_{min} \equiv 1,$$

the equilibrium in the open economy exists and is unique.

Finally, I derive a lower bound on I above which the amount of available financial resources is more than what is needed to form firms. The investors need financial resources to make the ex ante transfers and payments of the fixed production cost *and* the fixed exporting cost. The constraint now becomes

$$\frac{f}{\phi'^k}\Bigg[\Big(\frac{\theta[\alpha f-(1-\alpha)]}{\alpha f}\Big)^{\frac{k}{\theta}} + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}} + \frac{\frac{\theta}{\theta-1}}{k-\frac{\theta}{\theta-1}}(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi_x^{'}}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}$$
$$+\Big(\frac{\phi_x^*}{\phi'}\Big)^{\frac{\theta}{\theta-1}-k}\Big[(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}\Big(\frac{\phi'}{\phi_x^*}\Big)^{\frac{\theta}{\theta-1}} - \frac{k}{k-\frac{\theta}{\theta-1}}\Big]\Bigg] \leq \frac{I}{L}. \tag{34}$$

Again, if the financial resources eventually come from agents' savings, equation (34) states that there is a lower bound on average savings of agents above which total available financial resources are more than enough to fund all firms in the economy.

9.4 Proof of Proposition 1

Proof. First, I consider a manager whose initial quality draw is so high that his investor is willing to export (and start production), even if the manager exerts effort at the second-best level. Specifically, the manager's objective function in this case is

$$\max_{\beta} \quad \alpha\eta(P,Y)\phi\beta\Big(1+\frac{1}{\tau^{\sigma-1}}\Big)-\beta^{\theta}, \tag{35}$$

which yields the solution:

$$\beta(\alpha,\eta,\phi) = \Big(\frac{\alpha\eta(P,Y)\phi}{\theta}(1+\frac{1}{\tau^{\sigma-1}})\Big)^{\frac{1}{\theta-1}}. \tag{36}$$

The term $\Big(1+\frac{1}{\tau^{\sigma-1}}\Big)$ shows the complementarity between exporting and the manager's effort. The resulting firm productivity is

$$\phi\beta(\alpha,\eta,\phi) = \Big(\frac{\alpha\eta(P,Y)\phi^{\theta}}{\theta}(1+\frac{1}{\tau^{\sigma-1}})\Big)^{\frac{1}{\theta-1}}. \tag{37}$$

Based on equation (37), I derive a cutoff on the initial quality as

$$\phi_x^{'} = (\frac{f_x}{f})^{\frac{\theta-1}{\theta}} \frac{\tau^{\sigma-1}}{(1+\tau^{\sigma-1})^{\frac{1}{\theta}}} \phi^{'}. \tag{38}$$

In total, if the initial quality of the idea is bigger than $\phi_x^{'}$, the manager exerts effort at the second-best level according to equation (36), and the investor chooses to both produce and export.

Second, if the initial quality is below $\phi_x^{'}$, the manager realizes that if he exerts effort at the second-best level dictated by equation (36), his investor will not start to export. However, there is room for achieving a Pareto improvement. That is, the manager can exert effort at the level under which realized total productivity equals $\phi_x^{'}\beta(\alpha, \eta, \phi_x^{'})$. Under this level of effort, the investor is willing to export which generates more operating profit.[48] Alternatively, the manager can exert effort at the level as specified in equation (24), and his investor will not export as this level is below $\frac{\phi_x^{'}\beta(\alpha,\eta,\phi_x^{'})}{\phi}$, which validates the manager's effort choice. Now, the question becomes which option yields a higher payoff to the manager. If the manager chooses to exert effort at the level indicated by equation (24), his payoff is

$$\frac{\theta-1}{\theta} \frac{\alpha f}{(1-\alpha)} \Big(\frac{\phi}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}}, \tag{39}$$

where $\frac{\theta-1}{\theta}\frac{\alpha f}{(1-\alpha)}$ is the payoff received by the manager whose product's initial quality is $\phi^{'}$. Second, if the manager wants to induce his investor to export, he has to exert effort at the level of

$$\frac{\beta(\alpha, \eta, \phi_x^{'})\phi_x^{'}}{\phi} = \Big(\frac{\alpha\eta(P, Y)\phi_x^{'\theta}}{\theta\phi^{\theta-1}}(1 + \frac{1}{\tau^{\sigma-1}})\Big)^{\frac{1}{\theta-1}}, \tag{40}$$

which yields the payoff for the manager as follows:

$$\frac{\theta - (\frac{\phi_x^{'}}{\phi})^{\theta}}{\theta} \frac{\alpha f}{(1-\alpha)} \Big(\frac{\phi}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}} (1 + \frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}. \tag{41}$$

By comparing equation (39) with equation (41), I conclude that a manager with $\phi < \phi_x^{'}$ chooses the effort indicated by equation (40), if and only if

$$\phi \geq \phi_x^* \equiv \frac{\phi_x^{'}}{\left[\theta - \frac{\theta-1}{\left(1+\frac{1}{\tau^{\sigma-1}}\right)^{\frac{\theta}{\theta-1}}}\right]^{\frac{1}{\theta}}} \tag{42}$$

and $\phi < \phi_x^{'}$. Since exporters are rare in the data and most of them make positive profit, I adopt an assumption to assure that all exporters make positive profit. This implies that $\phi_x^* \geq \phi^{'}$ (i.e.,

[48] Similar to the reasoning used in the closed economy, the manager has no incentives to exert effort higher than this level.

the zero profit cutoff). By comparing equation (42) with equation (38), I obtain the following condition:

$$\frac{f_x \tau^{\sigma-1}}{f} \geq (1 + \frac{1}{\tau^{\sigma-1}})^{\frac{1}{\theta-1}} \left[\theta - \frac{\theta - 1}{(1 + \frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}} \right]^{\frac{1}{\theta-1}}. \tag{43}$$

Note that the above inequality holds, if either the variable trade cost or the fixed trade cost is high enough.

Third, when $\phi < \phi^*_x$, the analysis is the same as what I have done for the closed economy. If the initial quality of the idea is between $\phi^{'}$ and ϕ^*_x, the manager's optimal effort choice is

$$\beta(\alpha, \eta, \phi) = \Big(\frac{\alpha\eta(P, Y)\phi}{\theta}\Big)^{\frac{1}{\theta-1}},$$

and his investor starts production but does not export. If the initial quality is between ϕ^* and $\phi^{'}$, the optimal effort level is

$$\beta(\alpha, \eta, \phi) = \frac{\beta(\alpha, \eta, \phi^{'})\phi^{'}}{\phi},$$

and his investor starts production but does not export as well. If the initial quality ϕ is smaller than ϕ^*, the manager quits the firm and becomes a worker. QED.

9.5 Proof of Proposition 2

Proof. I prove this proposition by contradiction. Suppose the exit cutoff decreases when the two symmetric economies open up to trade (i.e., $\phi^{'}_a \geq \phi^{'}_o$), where subscript a refers to variables in autarky and subscript o refers to variables in the open economy. This implies that $\phi^*_o \leq \phi^*_a$. Then, I must have

$$\eta_a \equiv \eta(P_a, Y_a) \leq \eta_o \equiv \eta(P_o, Y_o),$$

which means that market size faced by non-exporting firms, η, weakly increases. Of course, it also implies that market size faced by exporting firms, $\eta(1 + \frac{1}{\tau^{\sigma-1}})$ strictly increases. I argue that these results combined imply that total labor demand increases. First, more labor is used to pay the fixed (production and exporting) costs in the open economy under this assumption, as

$$L[1 - G(\phi^*_o)]f + L[1 - G(\phi^*_x)]f_x > L[1 - G(\phi^*_a)]f.$$

Second, for firms whose quality draws are above ϕ^*_x, their operating profit and revenue (which equals σ times the operating profit) increase after the economy opens up to trade. This is because $\eta_o(1 + \frac{1}{\tau^{\sigma-1}}) > \eta_a$ and managers with $\phi \in [\phi^*_x, \phi^{'}_x)$ exert effort higher than the second-best level in the open economy (and at the second-best level in the closed economy). As a result, these firms demand more labor to pay the variable cost. Finally, for non-exports in the open economy, they also demand more labor, as their operating profit and revenue increase (i.e., $\eta_o > \eta_a$). Specifically, for firms with $\phi \in [\phi^{'}_a, \phi^*_x]$, their revenue increases as $\eta_o \geq \eta_a$. For firms with $\phi \in [\phi_a^*, \phi_a^{'}]$, their revenue either increases or stays the same at $\frac{\sigma f}{1-\alpha}$. In addition, I have newly entering firms with $\phi \in [\phi_o^*, \phi_a^*]$ in the open economy which demand labor inputs. Therefore, labor demanded by non-exports also increases. In total, aggregate labor demand, which is used to pay the fixed costs and the variable cost, increases strictly after opening up to trade, if $\phi_o^{'} \leq \phi_a^{'}$. However, the assumption that $\phi_a^{'} \geq \phi_o^{'}$ (and $\phi_a^* \geq \phi_o^*$) implies that labor supply which is $LG(\phi^*)$ is weakly smaller in the open economy than in the closed economy, which leads to a contradiction. Therefore, I must have $\phi_o^{'} > \phi_a^{'}$ and $\phi_o^* > \phi_a^*$. In other words, it is tougher for non-exporting firms to survive in the open economy than in the closed economy as market size shrinks.

Next, I prove that when trade costs are not sufficiently small in the open economy, managers of the least productive surviving non-exporters must exert more effort in the open economy than in the closed economy. First, calculation shows that managers with the quality draw that equals the zero profit cutoff exert the same level of effort in the open economy as in the closed economy, or

$$\beta(\alpha, \eta_a, \phi_a^{'}) = \Big[\frac{\alpha f}{\theta(1-\alpha)}\Big]^{\frac{1}{\theta}} = \beta(\alpha, \eta_o, \phi_o^{'}),$$

which implies that

$$\beta(\alpha, \eta_o, \phi_o^{'}) = \beta(\alpha, \eta_a, \phi_a^{'}) > \beta(\alpha, \eta_a, \phi_o^{'}).$$

Namely, managers with the draw of $\phi_o^{'}$ exert more effort in the open economy than in the closed economy. Next, when trade costs are not sufficiently small in the open economy, the increase in the zero profit cutoff is not too large. Since the relationship between the exit cutoff and the zero profit cutoff is unaffected by trade costs, one of the following two cases has to be true: $\phi_o^* < \phi_a^{'}$ or $\phi_o^* \geq \phi_a^{'}$ and $\beta(\alpha, \eta_o, \phi_o^*) > \beta(\alpha, \eta_a, \phi_o^*)$.[49]

In the first case, for firms with the random draw of $\phi_a^{'}$, I must have $\beta(\alpha, \eta_o, \phi_a^{'}) > \beta(\alpha, \eta_o, \phi_o^{'}) = \beta(\alpha, \eta_a, \phi_a^{'})$. Since $\beta(\alpha, \eta_o, \phi)$ decreases continuously with ϕ when $\phi \in [\phi_a^{'}, \phi_o^{'}]$, and $\beta(\alpha, \eta_a, \phi)$ increases continuously with ϕ when $\phi \in [\phi_a^{'}, \phi_o^{'}]$, it must be true that there exists a cutoff $\phi^{''} \in (\phi_a^{'}, \phi_o^{'})$ such that the effort level of managers whose products' initial quality is between ϕ_o^* and $\phi_o^{''}$ is higher in the open economy than in the closed economy.

In the second case, I have $\beta(\alpha, \eta_o, \phi_o^*) > \beta(\alpha, \eta_a, \phi_o^*))$ and $\phi_o^* \geq \phi_a^{'}$. Since $\beta(\alpha, \eta_o, \phi)$ decreases continuously with ϕ when $\phi \in [\phi_o^*, \phi_o^{'}]$, and $\beta(\alpha, \eta_a, \phi)$ increases continuously with ϕ when $\phi \in [\phi_o^*, \phi_o^{'}]$, it must be true that there exists a cutoff $\phi^{''} \in (\phi_o^*, \phi_o^{'})$ such that the effort level of managers whose products' initial quality is between ϕ_o^* and $\phi^{''}$ is higher in the open economy than in the closed economy.

Finally, I prove that the effort level of managers of the least productive exporting firms is strictly higher in the open economy than in the closed economy. Suppose it is not. This would imply

$$\beta(\alpha, \eta_o, \phi_x^*) \leq \beta(\alpha, \eta_a, \phi_x^*).$$

[49] Figure 3 represents the first case, while figure 8 represents the second case.

As

$$\beta(\alpha, \eta_o, \phi_x^{'})\phi_x^{'} = \beta(\alpha, \eta_o, \phi_x^*)\phi_x^* \leq \beta(\alpha, \eta_a, \phi_x^*)\phi_x^*,$$

it must be true that

$$\Big(\frac{\phi_x^{'}}{\phi_x^*}\Big)^{\frac{\theta}{\theta-1}}\Big(\frac{\eta_o}{\eta_a}\Big)^{\frac{1}{\theta-1}}(1+\tau^{1-\sigma})^{\frac{1}{\theta-1}} \leq 1. \tag{44}$$

One immediate implication from the above inequality is that market size faced by exporters (and non-exporters) is strictly smaller in the open economy than in the closed economy:

$$\eta_o < (1+\tau^{1-\sigma})\eta_o < \eta_a,$$

as $\phi_x^{'} > \phi_x^*$.

Now, I derive the contradiction that aggregate labor demand would be smaller in the open economy than in the closed economy under the above assumption. First, note that firms with $\phi \in [\phi_a^*, \phi_o^*]$ do not exist in the open economy. Therefore, they demand less labor in the open economy. Second, for non-exporters, they demand less labor (i.e., zero) as their sales and operating profits are lower in the open economy. Third, for exporters in the open economy, the additional labor demand which does no exist in the closed economy comes from the payment of the fixed trade cost. However, their sales and operating profit shrink, as I assume that the managerial effort is lower in the open economy. I show that the overall labor demand (variable costs plus the fixed costs) goes down for *every* exporting firm in the open economy. First, as exporting generates more operating profit to the investor, I must have

$$f_x \leq \frac{1}{1+\tau^{\sigma-1}}(1-\alpha)\pi(\phi, \eta_o) = \frac{1}{1+\tau^{\sigma-1}}\frac{1-\alpha}{\sigma}R(\phi, \eta_o)$$

for $\phi \geq \phi_x^*$, where $\pi(\phi, \eta_o)$ and $R(\phi, \eta_o)$ are the operating profit and revenue of the firm in the open economy. Next, among exporters the percentage drop in the operating profit (and revenue) is the smallest for the firm with $\phi = \phi_x^*$, as the percentage drop in the managerial effort is the smallest for this type of firm. I show that even for this type of firm, the overall change in labor demand is negative which implies that the overall change in labor demand is even more negative for exporting firms with $\phi > \phi_x^*$. Thanks to equation (44), I have

$$\frac{R(\phi_x^*, \eta_a)}{R(\phi_x^*, \eta_o)} \geq \frac{\eta_a}{(1+\tau^{1-\sigma})\eta_o} \geq \Big(\frac{\phi_x^{'}}{\phi_x^*}\Big)^{\theta} = \theta - \frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}}.$$

Note that variable costs account for $\frac{\sigma-1}{\sigma}$ fraction of firm revenue and wage is normalized to one. Therefore, if

$$\frac{\sigma-1}{\sigma}\Bigg[\theta - \frac{\theta-1}{(1+\frac{1}{\tau^{\sigma-1}})^{\frac{\theta}{\theta-1}}} - 1\Bigg] = \frac{(\sigma-1)(\theta-1)}{\sigma}\frac{(1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}-1}{(1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}} > \frac{1}{1+\tau^{\sigma-1}}\frac{1-\alpha}{\sigma},$$

then the decrease in labor demand (due to the smaller variable costs) dominates the increase in labor demand coming from the extra payment of the fixed exporting cost. As

$$(1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}} - 1 > \frac{\theta}{\theta-1}\tau^{1-\sigma},$$

what I have to prove becomes

$$\frac{\theta(\sigma-1)}{1-\alpha} > (1+\tau^{1-\sigma})^{\frac{1}{\theta-1}}.$$

Note that if τ is big enough, the above inequality must hold. In particular, when $\theta = 2$ (i.e., a quadratic cost function of exerting effort) and $\sigma > 2-\alpha$ (note that most estimates of σ are between two and five), the above inequality holds for any $\tau \geq 1$. Therefore, labor demand of each single exporting firm (and of all exporting firms) falls under our assumption that the managerial effort of all exporting firms is lower in the open economy. In total, I show that aggregate labor demand must fall when the economy moves from autarky to the open economy, if the managerial effort of the least productive exporting firms decreases. As I have just shown that aggregate labor supply and the cutoff for becoming a manager go up when the economy moves from autarky to the open economy, the labor market would not be in an equilibrium under this assumption. Therefore, the managerial effort of the least productive exporting firms must increase when the economy moves from autarky to the open economy. QED.

9.6 Proof of Proposition 3

Proof. The proof is similar to the proof of Proposition 2. Using the same method, I can prove that both the exit cutoff and the zero profit cutoff increase after the economy opens up to trade. As a result, I have

$$\eta(P_a, Y_a) > \eta(P_o, Y_o),$$

where subscript a refers to variables in autarky and subscript o refers to variables in the open economy. Namely, the adjusted market size shrinks for non-exporters when the economy opens up to trade. Next, when trade costs are sufficiently small in the open economy, the increase in the above two cutoffs is large. This must lead to $\phi_o^* > \phi_a^{'}$ and

$$\beta(\alpha, \eta_a, \phi_a^*) = \beta(\alpha, \eta_o, \phi_o^*) < \beta(\alpha, \eta_a, \phi_o^*).$$

In this case, the manager with the random draw of $\phi \in [\phi_o^*, \phi_o^{'}]$ exerts less effort, since

$$\beta(\alpha, \eta_o, \phi) \leq \beta(\alpha, \eta_o, \phi_o^*) < \beta(\alpha, \eta_a, \phi_o^*) \leq \beta(\alpha, \eta_a, \phi).$$

Moreover, the manager with the random draw of $\phi > \phi_o^{'}$ also exerts less effort, since

$$\beta(\alpha, \eta_o, \phi) = \beta_s(\alpha, \eta_o, \phi) < \beta_s(\alpha, \eta_a, \phi) = \beta(\alpha, \eta_a, \phi).$$

In total, productivity of all non-exporters decreases. Figure 9 represents this case.

Finally, I prove that the percentage decrease in productivity is smaller for non-exporting firms with $\phi \in [\phi_o^*, \phi_o^{'})$ than for non-exporting firms with $\phi \geq \phi_o^{'}$. Simple calculation shows that

$$\begin{aligned} & \log(\phi\beta(\alpha, \eta_o, \phi) - \log(\phi\beta(\alpha, \eta_a, \phi)) = \log(\phi\beta_s(\alpha, \eta_o, \phi) - \log(\phi\beta_s(\alpha, \eta_a, \phi)) \\ = \; & \frac{1}{\theta - 1}[\log(\eta(P_o, Y_o)) - \log(\eta(P_a, Y_a))] \end{aligned}$$

for $\phi \in [\phi_o^{'}, \phi_x^*)$ and

$$\begin{aligned} & \log(\phi\beta(\alpha, \eta_o, \phi) - \log(\phi\beta(\alpha, \eta_a, \phi)) > \log(\phi\beta_s(\alpha, \eta_o, \phi) - \log(\phi\beta_s(\alpha, \eta_a, \phi)) \\ > \; & \frac{1}{\theta - 1}[\log(\eta(P_o, Y_o)) - \log(\eta(P_a, Y_a))] \end{aligned}$$

for $\phi \in [\phi_o^*, \phi_o^{'})$. Therefore, the percentage decrease in productivity (i.e., decrease in log productivity) is smaller for less productive non-exporting firms (i.e., $\phi \in [\phi_o^*, \phi_o^{'})$) than for more productive non-exporting firms ($\phi \in [\phi_o^{'}, \phi_x^*)$). QED.

9.7 Proof of Proposition 4

Prof. When there is no separation of ownership and control, the manager who has enough financial resources to pay the fixed cost forms the firm. As a result, the manager (and the owner)'s objective function is

$$\begin{aligned} \max_{\beta} \quad & \phi\beta\eta(P, Y) - \beta^\theta \\ s.t. \quad & \phi\beta\eta(P, Y) - \beta^\theta \geq 1 + f, \end{aligned}$$

where the term, $1 + f$, is the sum of the outside option of the manager and the fixed production cost.

In the closed economy, the optimal effort level is

$$\beta(\alpha, \eta_a, \phi) = \Big(\frac{\eta(P_a, Y_a)\phi}{\theta}\Big)^{\frac{1}{\theta-1}}. \tag{45}$$

The resulting operating profit is

$$\pi(\phi, \beta(\alpha, \eta_a, \phi)) = \theta\Big(\frac{\eta(P_a, Y_a)\phi}{\theta}\Big)^{\frac{\theta}{\theta-1}},$$

and the payoff to the manager is

$$\phi\beta(\alpha,\eta_a,\phi)\eta(P_a,Y_a)-\beta(\alpha,\eta_a,\phi)^{\theta}=(\theta-1)\Big(\frac{\eta(P_a,Y_a)\phi}{\theta}\Big)^{\frac{\theta}{\theta-1}}.$$

The ideal price index in the closed economy can be derived as

$$P^{\frac{\theta}{\theta-1}}=\frac{L^{\frac{1}{1-\sigma}}}{\lambda}\Bigg[\frac{k}{k-\frac{\theta}{\theta-1}}\phi^{'(\frac{\theta}{\theta-1}-k)}\Bigg(\frac{\lambda^{\sigma-1}Y}{\sigma\theta}\Bigg)^{\frac{1}{\theta-1}}\Bigg]^{\frac{1}{1-\sigma}},\tag{46}$$

where $\phi^{'}$ is the exit cutoff. Therefore, ZPC can be expressed as

$$1+f=\frac{\frac{\theta-1}{\theta}\phi^{'k}Y}{L\sigma\frac{k}{k-\frac{\theta}{\theta-1}}},\tag{47}$$

The labor-market-clearing condition now becomes

$$Y=\Bigg(1-\frac{1}{\phi^{'k}}\Bigg)\frac{L\sigma}{(\sigma-1)+\frac{f}{(\frac{1+f}{\frac{\theta-1}{\theta}})(\frac{k}{k-\frac{\theta}{\theta-1}})}}.\tag{48}$$

Based on the two equilibrium conditions in equations (51) and (52), I can solve the equilibrium in the closed economy (i.e., $\phi^{'}$ and Y).

Now, I discuss how to solve the equilibrium in an open economy. The ideal price index in the open economy can be derived

$$P^{\frac{\theta}{\theta-1}}=\frac{L^{\frac{1}{1-\sigma}}}{\lambda}\Bigg[\phi_o^{'(\frac{\theta}{\theta-1}-k)}\Bigg(\frac{\lambda^{\sigma-1}Y}{\sigma\theta}\Bigg)^{\frac{1}{\theta-1}}\Bigg]^{\frac{1}{1-\sigma}}\Bigg[\frac{k}{k-\frac{\theta}{\theta-1}}\Big(1+((1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}-1)\Big(\frac{\phi_x^{'}}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}-k}\Big)\Bigg]^{\frac{1}{1-\sigma}},\tag{49}$$

where $\phi^{'}$ is the exit cutoff and $\phi_x^{'}$ is the exporting cutoff. The relationship between the exit cutoff and the exporting cutoff can be derived as

$$\phi_x^{'}=(\frac{f_x}{f})^{\frac{\theta-1}{\theta}}\frac{\tau^{\sigma-1}}{(1+\tau^{\sigma-1})^{\frac{1}{\theta}}}\phi^{'}.\tag{50}$$

Therefore, ZPC in the open economy can be expressed as

$$1+f=\frac{\frac{\theta-1}{\theta}\phi^{'k}Y}{L\sigma\frac{k}{k-\frac{\theta}{\theta-1}}\Big(1+((1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}-1)\Big(\frac{\phi_x^{'}}{\phi^{'}}\Big)^{\frac{\theta}{\theta-1}-k}\Big)},\tag{51}$$

The labor-market-clearing condition in the open economy is

$$Y = \left(1 - \frac{1}{\phi'^k}\right) \frac{L\sigma}{(\sigma - 1) + \frac{f + f_x\left(\frac{\phi'}{\phi'_x}\right)^k}{\left(\frac{1+f}{\frac{\theta-1}{\theta}}\right)\left(\frac{k}{k-\frac{\theta}{\theta-1}}\right)\left(1+((1+\tau^{1-\sigma})^{\frac{\theta}{\theta-1}}-1)\left(\frac{\phi'_x}{\phi'}\right)^{\frac{\theta}{\theta-1}-k}\right)}}. \tag{52}$$

Based on the three equilibrium conditions in equations (50), (51) and (52), I can solve the equilibrium in the open economy (i.e., ϕ', ϕ'_x and Y). It is straightforward to show that $\phi'_a < \phi'_o$ which implies that

$$\eta(P_a, Y_a) > \eta(P_o, Y_o).$$

Furthermore, a proof by contradiction shows that

$$\eta(P_a, Y_a) < \eta(P_o, Y_o)(1 + \frac{1}{\tau^{\sigma-1}}).$$

I.e., non-exporters face shrinking market size, while exporters face increasing market size when the economy opens up to trade. Therefore, managers working in surviving non-exporting firms exert less effort when the economy opens up to trade, while managers working in exporting firms exert more effort when the economy opens up to trade. This leads to a productivity loss for non-exporters and a productivity gain for exporters. QED.

9.8 Extension

In this subsection, I introduce a non-operating profit into the model to generate the prediction that firm size increases with the initial quality draw even among the constrained non-exporters. Slightly different from the profit function defined in the main text, I define the total profit as

$$\pi(\rho, \psi) = \alpha\eta(P, Y)\phi\beta + \mu\beta - f, \tag{53}$$

where the first term is the operating profit and the last term is the fixed production cost. These two terms are the same as in the original profit function. Additionally, the second term, $\mu\beta$ ($\mu > 0$), denotes a non-operating profit (including investment profits and capital gains on firm assets) and positively depends on the managerial effort. Under this slightly modified profit function, firm sales and employment, which are positively related to the operating profit, increase with the initial quality draw, ϕ, even among the constrained non-exporters.[50] In addition, all other predictions of the original model are unchanged (e.g., the effort choice and productivity change after trade liberalization). Therefore, the managerial effort is "U"-shaped with respect

[50]To see this, first note that optimal managerial effort β still decreases with ϕ among the constrained non-exporters, as it is harder for the firm with a worse quality draw to satisfy the non-bankruptcy constraint. Second, as $\mu\beta$ decreases with ϕ among the constrained non-exporters in equilibrium, $\alpha\eta(P, Y)\phi\beta$ has to increases with ϕ in order to meet the non-bankruptcy constraint.

to the initial quality draw and *firm size* in our slightly modified model now. This validates the empirical analysis in Section 6.

9.9 Data

In this subsection, I describe how I merge and clean the data sets. In addition, I present summary statistics of the merge data set.

First, the two original data sets are the same as the ones used in Bloom and Van Reenen (2010). The first data set is called "*basic.dta*", which contains (cross-sectional) information on the overall management score and on the individual score of each of the 18 management practices defined by Bloom and Van Reenen (2010). The second (panel) data set is called "*paneldata.dta*" and contains production and financial information (e.g., employment, sales, value of tangible assets etc.) for most firms surveyed in the first data set. The second data set covers the 2003-2008 period. Using a common firm identifier, (a variable called "code"), I merge the two data sets to obtain the data set that is used in the empirical analysis of the paper. About 97% of the observations of the second data set (i.e., "*paneldata.dta*") are successfully matched with observations in the first data set (i.e., "*basic.dta*") , and I use observations that exist in both data sets in the empirical analysis. Table 10 presents summary statistics of several key variables of the merged data set.

Table 10: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
$lemp$	13881	5.668299	.9622046	0	10.66761
$lsales$	14715	10.70026	1.431843	0	17.4747
$management$	27943	2.96166	.6665573	1	4.888889
lpp_{emp}	27943	1.339333	1.842934	-4.480007	9.238641
$export$	3762	21.66443	30.61561	0	100

Total number of observations: 27943

$lemp$: Log of employment; $lsales$: Log of sales (in USD).

$management$: Overall management score; $export$: Share of exports in sales.

lpp_{emp}: Log of tangible fixed assets per employee (in USD).

9.10 Additional Empirical Analysis: Firm Size and Firm Age

The data set used in Bloom and Van Reenen (2007) is called "realdata.dta" and can be downloaded from Prof. Bloom's website. This data set has (panel-level) accounting information of the firm and (cross-sectional) information on management practices of the firm. This data set is smaller than the data sets used in Bloom and Van Reenen (2010) which are also the data sets used in the paper. It also has a smaller coverage of countries (i.e., U.K., U.S., France and Germany) and an earlier coverage of years (from 1994 to 2004). What makes this data set unique is that it has information on firm age that is missing in the data set used in the paper. The following table presents summary statistics of several key variables in this data set:

Table 11: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
lemp	6267	6.699247	1.334904	1.098612	11.02679
lsales	6267	11.79692	1.444214	5.384495	16.36409
lcapital	6049	10.11284	1.684821	3.258096	14.67922
management	6267	3.220505	.7492618	1.055556	4.861111
firm age	6267	55.32248	50.39279	3	689

Total number of observations: 6267

lemp: Log of employment; *lsales*: Log of sales (in USD).

management: Overall management score; *lcapital*: Log of capital (in USD).

I run the following regression to investigate how firm size and firm age affect management quality of the firm:

$$\begin{aligned} MS_i &= v_0 + v_1 \ln(size)_{i,t} + v_2 \ln(size)^2_{i,t} + type_{i,t} \\ &\quad + \ln(firm\ age)_{i,t} + ctryyr_{c,t} + ctrysic_{c,j} + \epsilon_{i,t}, \end{aligned} \tag{54}$$

where $ctryyr_{c,t}$ and $ctrysic_{c,j}$ are country-year and country-industry fixed effects, and employment and sales are used to proxy for firm size.[51] Variable $type_{i,t}$ is the ownership type of the firm (e.g., family firm, founder-run firm, private firm, institutionally held firm etc.) Regression results reported in Table 12 are qualitatively the same as the empirical results established in the paper. In addition, the estimated coefficient of firm age deserves special attention. It seems that firm age does negatively affect management quality, conditioning on firm size and a set of fixed effects. This is consistent with the hypothesis that young firms which tend to be small actually have better management quality than old firms, conditioning on other things' being equal. However, the addition of firm age into the regression does not change the empirical result on how firm size affects management quality of the firm among small (and non-exporting) firms. Therefore, this additional empirical analysis using another data set of management practices further confirms the empirical results established in the paper.

10 Tables and Figures: For Online Publication

[51] In this data set, there is no information on whether the firm is an MNE.

Table 12: Managerial Effort and Firm Size (with Firm Age): An “U”-shaped Curve

	Management Score					
$\ln(sales)$	-0.927***	-0.943***	-0.947***	-0.598*		
	(-3.33)	(-2.95)	(-2.96)	(-1.94)		
$\ln(sales)^2$	0.0538***	0.0516***	0.0500***	0.0326**		
	(3.93)	(3.49)	(3.45)	(2.35)		
$\ln(empl)$					-0.368*	-0.155
					(-1.74)	(-0.70)
$\ln(empl)^2$					0.0576***	0.0332*
					(2.96)	(1.76)
$\ln(firm\ age)$	-0.0564	-0.0879	-0.0861	-0.0719	-0.0985	-0.110*
	(-0.72)	(-1.29)	(-1.43)	(-1.42)	(-1.23)	(-1.71)
Cutoff Percentile	30%*th.*	40%*th.*	50%*th.*	60%*th.*	30%*th.*	40%*th.*
Country*Year FEs	yes	yes	yes	yes	yes	yes
Country*Industry FEs	yes	yes	yes	yes	yes	yes
N	1994	2610	3203	3847	2015	2628
R^2	0.690	0.624	0.580	0.555	0.671	0.618
adj. R^2	0.634	0.574	0.535	0.516	0.612	0.567

Standard errors are clustered at the firm level. t statistics in parentheses.

Management score: constant for a firm across years. Years covered: 1994-2004.

$\ln(sales)$: log sales; $\ln(empl)$: log employment; $\ln(firm\ age)$: log of firm age.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 7: Trade Liberalization and the Optimal Effort Choice: No Agency Problem

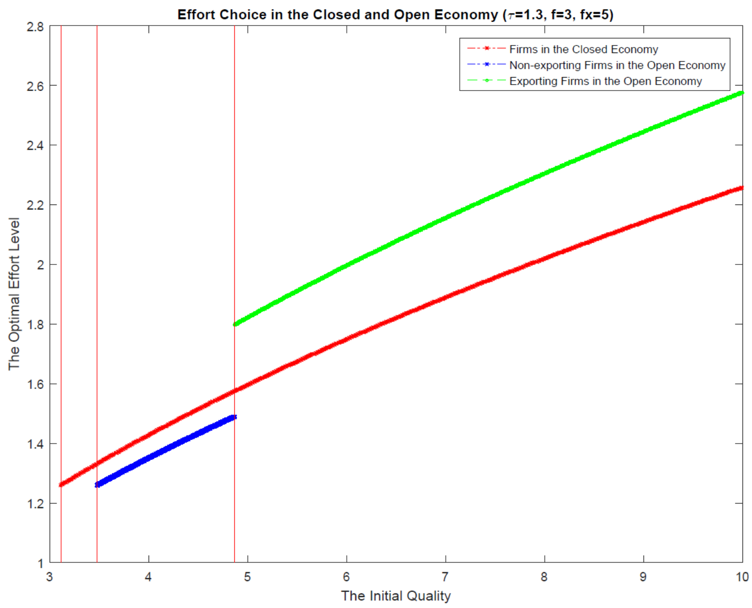


Figure 8: Impact of Trade on the Optimal Effort (Moderate Reduction in Trade Costs)

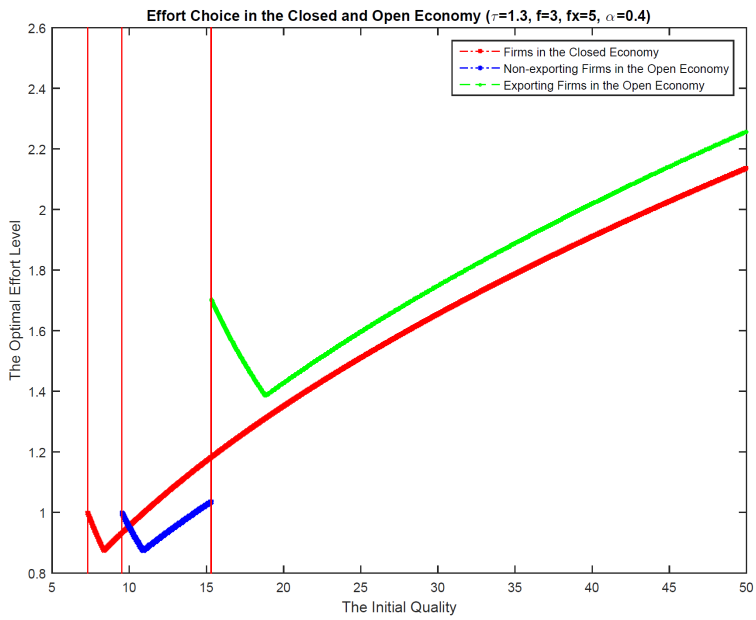


Figure 9: Impact of Trade on the Optimal Effort (Large Reduction in Trade Costs)