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Kwang-Myoung Hwang

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FINANCIAL CONSTRAINTS AND INTERNATIONAL TRADE FOR HETEROGENEOUS FIRMS

By

Kwang-Myoung Hwang

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ABSTRACT

FINACIAL CONSTRAINTS AND INTENATIONAL TRADE FOR HETEROGENEOUS FIRMS

By

Kwang-Myoung Hwang

This dissertation consists of three essays exploring international trade models for heterogeneous firms regarding productivity and financial constraints. It also investigates the effects of financial liberalization on trade patterns using this model.

In the fist chapter, I present a general equilibrium model of heterogeneous firms in which firms differ in productivity and face financial constraints to pay fixed costs for production. I consider how the relaxation of financial constraints for domestic sellers and exporters affects firms' entry and export decisions. I have the following findings. (1) The relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market, while driving less productive exporters out of the export market. (2) The relaxation of financial constraints for exporters helps less productive firms survive in the export market, while pushing less productive domestic sellers out of the market. (3) Financial liberalization may help less productive exporters survive in the export market, while driving less productive domestic sellers out of the market.

In the second chapter, I examine empirically the impacts of financial liberalization and the relaxation of financial constraints on exporters and domestic sellers. Unlike the existing literature, I use a ratio of exports to domestic production instead of export volumes as the dependent variable. I find that financial liberalization and real interest rates (a measure of costs of external funds) are important determinants of international trade patterns. In particular, financial liberalization and a reduction in the real interest rate

increase the ratio of export to domestic production disproportionately more in industries with a higher degree of external finance dependence. In addition, I find that the effects are greater in financially under-developed countries. I also find the role of changes in costs of external financing in making export decisions, which implies that changes in costs of external credits have different effects on exporters and domestic sellers. My finding supports that exporters have lower contractibility than domestic sellers because of their higher risks in exporting.

In the last chapter, I present a heterogeneous firm model in which firms differ not only in productivity but also in financial constraints. My model is general in the sense that it incorporates many factors affecting firms' variable costs into the heterogeneity in productivity levels, and those affecting firms' fixed costs into the heterogeneity in financial constraints. I show that firms with low productivity levels and severe financial constraints will immediately exit the market while firms with high productivity levels and few financial constraints can stay in the market. I also show that even if the fixed costs for exports are bigger than those for domestic sales, it does not imply that only high productive firms can export. Moreover, I show that firms make different decisions on exports and domestic sales even when they have the same productivity levels. My model has the strength in explain the stylized fact in international trade that some firms with low productivity levels are exporters while some firms with high productivity levels sell only domestically. It can also explain the extreme case that some exporters do not sell domestically.

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Chapter 1: The Heterogeneous Firm Trade Model with Financial Constraints

1. Introduction

There is an emerging literature on financial constraints and international trade. Mostly, they augment the Melitz (2003) model which emphasizes the role of productivity in firms' export decisions. Chaney (2005), for instance, focuses on liquidity constrained exporting firms, assuming that firms inherit an exogenous amount of liquidity. Manova (2006) assumes that firms can only partially finance the fixed costs of trade internally with fractions differing across industries exogenously. Garcia-Vega and Guariglia (2007) analyze the effects of firms' exogenous income shocks on their probability of survival and their decisions to enter export markets.

I follow the basic idea of Manova (2006) in constructing the financially constrained heterogeneous firm model. She explains the effects of financial constraints in a micro-based way. She argues that credit constraints interact with firms' heterogeneity and reinforce the selection of the most productive firms into exporting. Her intuition is that more productive firms can offer creditors a greater return in the case of repayments and are more likely to secure the outside capital necessary for exporting because they raise higher revenues.

In her model, credit constraints have different effects on firms in different countries and sectors. Credit constraints vary across countries because contracts between firms and investors are more likely to be enforced in more financially developed countries. In addition, sectors differ in their endowments of tangible assets that can serve as collateral. If a financial contract is enforced, a firm makes payments to investors; otherwise the firm defaults and creditors claim collaterals. Firms, therefore, find it easier to obtain external finance in countries with a high level of financial contractibility and in sectors with large endowments of tangible assets. Therefore, the productivity cut-off value for exporting varies systematically across countries and sectors. It is higher in financially vulnerable industries which require more outside finance or have less collateralizable assets, and is lower in countries with high levels of financial contractibility or with many collateralizable assets. The effects of financial development are more pronounced in financially vulnerable sectors.

However, not all firms or industries face the same amount of financial constraints. Chaney (2005) argues that more productive firms are less likely to be credit constrained because they generate large liquidity from their domestic sales. Therefore, these productive or wealthy firms that inherit a large amount of liquidity are more likely to export. However, he does not examine the implication of financial constraints in domestic sectors.

In reality, every firm or sector confronts different degrees of financial constraints. Thus, questions arise in which firms or sectors and how much their financial constraints change. Will the relaxation of financial constraints in some firms or sectors make favorable effects on the other firms and sectors? To answer these questions, it is necessary to analyze the effects of financial constraints with a general equilibrium framework.

This chapter mainly focuses on how the relaxation of financial constraints in some sectors affect the decisions of firms in other sectors on entry and export. I divide sectors into two categories; one for domestic sellers and the other for exporters.[1] In a general equilibrium framework with heterogeneity in firms' productivity, I show that changes in financial constraints in each sector have different effects on cut-off productivity levels of entry and export. Specifically, the relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market, while driving less productive exporters out of the export market. The relaxation of financial constraints for exporters, however, helps less productive firms survive in the export market, while pushing less productive domestic sellers out of the market.

My model can be applied to analyze the effects of financial liberalization. Financial liberalization is one of the most interesting topics these days. It serves as a

[1]The degrees of financial constraints differ between exporters and domestic sellers because of different loan contracts such as export subsidy. Different amount of information also leads to different degrees of financial constraints between exporters and domestic sellers. For example, if foreign investors have more information on exporting firms than non-trade firms, contractibility or collateralizability of exporters would become higher after financial liberalization.

source of exogenous changes in financial conditions. Levine (1997) classifies channels that financial liberalization improves firms' financial conditions. The improvement of firms' financial conditions would affect their decisions on entry and export. He argues that financial liberalization would lead to financial development in the home country through 1) facilitating the risk amelioration by trading, hedging, diversifying, and pooling risks, 2) acquiring information about investments and allocating resources, 3) monitoring managers and exerting corporate control, 4) mobilizing savings, and 5) facilitating the exchange of goods and services. Due to these channels, financial development can be accomplished, which further reduces firms' costs of external financing.

Demirguc-Kunt and Levine (1996), however, introduce the other channels in stock markets through which financial liberalization makes contrary effects. 1) Greater liquidity in stock markets after financial liberalization may reduce savings rates by increasing the returns to investments and by making negative impacts on uncertainty because less uncertainty may decrease the demand for precautionary savings. 2) Due to the euphoria and myopia that may be encouraged by highly liquid stock markets, dissatisfied participants find it easy to sell quickly, which can lead to disincentives to exert corporate control, affecting adversely corporate governance and hurting economic growth.

The above literature is all based on the assumption that all sectors and firms are affected at the same time, in the same direction, and to the same extent because of the changes in financial constraints due to financial liberalization. The effects of financial liberalization on firms' financial constraints, however, can differ across sectors and times. Thus, previous models cannot analyze the precise effects of various changes in financial constraints on firms' decisions on entry and export. Therefore, it is useful to consider the changes in financial conditions in specific sectors, and their effects on other sectors after financial liberalization.

Financial liberalization can be interpreted as free flows of credits among countries.

Free flows of credits induce two different effects on domestic financial markets. One is to change firms' financial constraints. If foreign investors have more information on exporting firms than domestic investors, contractibility and collateralizability of foreign investors regarding exporters will be higher than those of domestic investors. This will lead to lower repayments of external financing to foreign investors, and they can start to invest in exporting sectors by making contracts with exporters.

The other effects of financial liberalization are changes in the return to capital. Due to changes in the amount of credits, the return to capital changes after the liberalization. There is consensus in the literature that the return to capital decreases after financial liberalization, especially in developing countries. [See Bacchetta (1992) and Henry (2000a)] Bacchetta (1992) shows that a likely outcome of financial liberalization is an initial net inflow, followed by an outflow. His intuition is that the liberalization of financial markets leads to better allocation of resources and makes the country more attractive to both domestic and foreign investors. Thus, there are few incentives for outflows and strong incentives for inflows at the beginning. Therefore, the return to capital will decline after financial liberalization.

I show that in both cases, financial liberalization will help less productive exporters survive in the export market, but keep less productive domestic sellers out of the domestic market because financial liberalization induces higher contractibility and collateralizability in financial markets for exporters due to the participation of foreign investors. I also show that the number of exporters relative to domestic sellers decreases with the contractibility of exporters but increases with their collateralizability when the return to capital decreases. It is generally accepted that contractibility of exporters is lower than that of domestic sellers. Therefore, financial liberalization will increase the exporting sector while decreasing the domestic sector.

This chapter makes two contributions to the literature on international trade. First, the existing literature largely assumes that changes in financial conditions happen in all sectors, at the same time, and to the same extent. In contrast, in this chapter, I consider the case where financial constraints are relaxed only in some sectors, and analyze the impacts on the other sectors in which financial constraints are not relaxed. Thus, my analysis provides a general equilibrium view of the impacts of financial constraints on production and exports. Second, my model sheds new light on the effects of financial liberalization on different sectors in the economy. Specifically, financial liberalization reduces interest rates, through which raises the number of firms in both domestic and export sectors. In addition, the number of exporters relative to domestic sellers decreases with contractibility of exporters but increases with their collateralizability when overall interest rates decrease.

The structure of this chapter is as follows. In section 2, I present a model of heterogeneous firms which incorporates financial constraints to exporters and domestic sellers, and do comparative statics in section 3. In section 4, I apply the model to analyze effects of financial liberalization, and conclusions follow in section 5.

2. A Heterogeneous Firm Model with Financial Constraints

I incorporate financial constraints to the Melitz (2003) model. Consider the home country and n foreign countries. A continuum of heterogeneous firms produces differentiated goods in each country, and varieties produced by country j are distinct from those produced by country i. Consumers exhibit love of variety and can consume all available differentiated products. The utility function for the representative consumer in each country is given by the CES preference function with a constant elasticity of substitution (σ), which is greater than one.

The problem of the representative consumer in the home country can be written as

$$\max U = [\int_{\omega\in\Omega} q(\omega)^{(\sigma-1)/\sigma} d\omega]^{\sigma/(\sigma-1)}, \text{ subject to } R = \int_{\omega\in\Omega} p(\omega)q(\omega)d\omega, \quad (1)$$

where U and R represent her total utility and revenue. $p(\omega)$ and $q(\omega)$ are the price of and the demand for each good.

The utility maximization implies that the demand for variety ω is

$$q(\omega) = R[\frac{p(\omega)^{-\sigma}}{P^{1-\sigma}}], \text{ and } P = [\int_{\omega\in\Omega} p(\omega)^{1-\sigma} d\omega]^{1/(1-\sigma)}, \tag{2}$$

where P is the price index.

As in Melitz (2003), firms incur a sunk cost to enter a market. Then, they learn their productivity levels, and make entry and export decisions. Production requires only one input, labor (l), where wage is normalized to one. Each firm uses k_d unit of labor for investment, which is necessary prior to production. Production for the domestic market involves constant variable costs, which are lower in more productive firms. Thus, q/φ units of labor are necessary to produce q units of goods, where φ represents a firm's productivity level.

According to the optimal pricing rule, the individual price and profit for the firm with productivity level φ can be derived as

$$p(\varphi) = \frac{1}{\rho\varphi}, \tag{3}$$

$$\pi(\varphi) = \frac{1}{\sigma} R[P\rho\varphi]^{\sigma-1} - k_d,$$

where $\frac{1}{\rho} \equiv \frac{\sigma}{\sigma-1}$ is the mark-up.

An equilibrium is characterized by a mass of firms M and the distribution of productivity level $\mu(\varphi)$ over a subset of $(0, \infty)$. The aggregate price level can be written in terms of M and the average productivity level.

$$P = [\int_0^\infty p(\varphi)^{1-\sigma} M\mu(\varphi) d\varphi]^{1/(1-\sigma)} = M^{1/(1-\sigma)} p(\widetilde{\varphi}), \tag{4}$$

where $\widetilde{\varphi} = [\int_0^\infty \varphi^{\sigma-1} \mu(\varphi) d\varphi]^{1/(\sigma-1)}$ is the average productivity level.

To enter, firms must make an initial investment as a fixed entry cost $k_e > 0$, which is thereafter sunk. They also face a constant probability δ in each period of a bad event that will force them to exit. The δ is independent of firms' productivity. Therefore, an entering firm with a productivity level φ will immediately exit if the expectation of profits is negative, or will produce and earn non-negative profits in every period until it is hit with a bad event, and is forced to exit. Assuming that there is no time discounting, each firm's expected value function is given by

$$v(\varphi) = \max\{0, \sum_{t=0}^{\infty}(1-\delta)^t\pi(\varphi)\} = \max\{0, \tfrac{1}{\delta}\pi(\varphi)\}. \quad (5)$$

If the exit procedure does not affect the equilibrium productivity distribution, this distribution must be determined by the initial productivity draw, conditional on successful entry. Hence, the conditional distribution of $g(\varphi)$ can be derived as

$$\begin{aligned}\mu(\varphi) &= \tfrac{g(\varphi)}{1-G(\varphi')} \text{ if } \varphi' \leq \varphi, \\ &= 0 \quad \text{otherwise,}\end{aligned} \quad (6)$$

where φ' is the cut-off productivity level of entry and $p_{in} \equiv 1 - G(\varphi')$ is the ex-ante probability of successful entry.

The average productivity level $\widetilde{\varphi}$ is a function of the cut-off productivity level φ'.

$$\widetilde{\varphi}(\varphi') = [\tfrac{1}{1-G(\varphi')} \int_{\varphi'}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi]^{1/(\sigma-1)}. \quad (7)$$

The economy has n identical foreign countries. Ex ante, firms in each country have an identical productivity distribution. Consumers share the same utility function. These symmetry assumptions ensure the same wage rate, which is still normalized to one. There is an ice-berg transportation cost τ, which represents trade resistance costs, where $\tau > 1$. For simplicity, I do not allow transportation costs to differ across countries. I assume, however, that an additional fixed cost k_x is required for exporting. It can be shown easily that if $\tau^{\sigma-1}k_x > k_d$, low productive firms exit the markets immediately, intermediate productive firms only sell domestically, and high productive firms sell both in the domestic market and the export market. When firms produce for the export market, there are no changes in their productivity levels.

Once again, the ex-ante probability of successful entry is $p_{in} \equiv 1 - G(\varphi')$. Moreover, $p_x \equiv [1 - G(\varphi'_x)]/[1 - G(\varphi')]$ now represents the ex-ante probability that one of these successful firms will export. φ'_x is the critical productivity level for exporting. The mass of exporting firms in the country will be $M_x = p_x M$, and the total number of varieties available to consumers in any country will be $M_t = M + nM_x$. The average productivity level of domestic sellers and exporters (from foreign countries) can be written as

$$\widetilde{\varphi}_t = \{\frac{1}{M_t}[M\widetilde{\varphi}^{\sigma-1} + nM_x(\tau\widetilde{\varphi_x})^{\sigma-1}]\}^{1/(\sigma-1)}, \tag{8}$$

where $\widetilde{\varphi_x} = [\frac{1}{1-G(\varphi_x')}\int_{\varphi_x'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi]^{1/(\sigma-1)}$.

The way of incorporating financial sectors is similar to that of Manova (2006). I assume that variable costs are covered by internal finance, which implies that firms can compensate their production costs by selling their goods. Fixed costs (k_d and k_x) however, cannot be covered by internal finance, and firms should make loans from financial sectors before making investments.[2] In the following, subscript d and x represent the domestic sector and the export sector respectively. In obtaining outside finance, firms pledge tangible assets as collateral. I also assume that a fraction (t_d and t_x) of fixed costs goes towards collateralizable assets, (e.g. plants, properties, and equipment), which depend on properties of sectors and goods. For example, the fraction of collateral in the manufacturing sector may be greater than that in the service sector because investors can obtain inventories in the manufacturing sector when firms default.

Financial institutions cannot make perfect enforcement in terms of contractibility because of imperfect information. In particular, investors can expect to be repaid with probability λ_d and λ_x, which are exogenous and less than one when they make loans to domestic sellers and exporters. With probability $(1 - \lambda)$, financial contracts are not enforced, firms default, and creditors claim the collaterals ($t_d k_d$ and $t_x k_x$). Even though investors cannot make perfect enforcement because of imperfect information, they know in which sector, the domestic one or the export one, the investments have been made.

Financial contracts proceed as follows. At the beginning of each period, every

[2]The underlying assumption is that firms cannot use profits from one period to finance future operations. This assumption can be justified if firms cannot retain earnings but have to distribute all profits to shareholders at the end of each period.

firm makes a take-it-or-leave-it offer to potential investors.[3] This contract specifies the amount of credits that a firm needs to borrow, its repayments $[F_d(\varphi)$ and $F_x(\varphi)]$ when the contract is enforced, and the collaterals $[t_d k_d$ and $t_x k_x]$ in the case of default. Revenues are then realized and investors receive the repayments at the end of the period.

The problem of profit-maximizing firms for domestic sales and exports is

$$\begin{aligned} \max_{p_d, p_x, F_d(\varphi), F_x(\varphi)} \quad & \Pi(\varphi) = p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - \lambda_d F_d(\varphi) - (1-\lambda_d)t_d k_d \\ & + n[p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - \lambda_x F_x(\varphi) - (1-\lambda_x)t_x k_x], \end{aligned} \tag{9}$$

$$\begin{aligned} \text{subject to } & 1)\ q_d(\varphi) = \frac{p_d(\varphi)^{-\sigma} R}{P^{1-\sigma}} \\ & 2)\ q_x(\varphi) = \frac{p_x(\varphi)^{-\sigma} R}{P^{1-\sigma}} \\ & 3)\ A_d(\varphi) \equiv p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi \geq F_d(\varphi) \\ & 4)\ A_x(\varphi) \equiv p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi \geq F_x(\varphi) \\ & 5)\ B_d(\varphi) \equiv -k_d + \lambda_d F_d(\varphi) + (1-\lambda_d)t_d k_d \geq 0 \\ & 6)\ B_x(\varphi) \equiv -k_x + \lambda_x F_x(\varphi) + (1-\lambda_x)t_x k_x \geq 0. \end{aligned}$$

All firms maximize their profits subject to the demand function in equation (2). With external financing, two additional constraints bind firms' decisions. When the financial contract is enforced, an entrepreneur can offer at most her net revenues, which are represented by $A_d(\varphi)$ and $A_x(\varphi)$, to creditors. In addition, investors only extend finance to the firm if they expect a non-negative return. $B_d(\varphi)$ and $B_x(\varphi)$ represent net returns to creditors. Equations (5) and (6) express investors' participation constraints with their outside options normalized as zero. These constraints will be generalized in section 4.

With competitive credit markets, all investors break even and make zero expected profits.[4] A firm adjusts its repayments so as to bring investors to their participation

[3]The assumption of a take-it-or-leave-it offer does not affect the results. See appendix A for the Nash bargaining solutions.

[4]In the case of uncompetitive markets, the outside options will not be zero. However, the results do not change qualitatively.

constraints. Thus, $B_d(\varphi) = B_x(\varphi) = 0$ in equilibrium, and the maximization problem reduces to the firm's problem in the absence of financial frictions, except for credit constraints that repayments are not greater than the firm's net revenues. Each firm optimally chooses the same quantities and prices, raises the same revenues and earns the same profits before repayments as in Melitz (2003).

Therefore, the solution for the above problem is the same as one without financial constraints except substituting repayments $[F_d(\varphi)$ and $F_x(\varphi)]$ for fixed costs $[k_d$ and $k_x]$ in firms' ordinary maximization problems. Constraints (5) and (6) in the maximization problem are binding because of competitive financial markets. Thus, repayments of domestic sellers and exporters do not depend on firms' productivity levels, and can be written as

$$F_d(\varphi) = \frac{[1-(1-\lambda_d)t_d]k_d}{\lambda_d}, \text{ and } F_x(\varphi) = \frac{[1-(1-\lambda_x)t_x]k_x}{\lambda_x}. \tag{10}$$

The equilibrium solution for critical productivity levels for entrance and export can be derived from two conditions. One is the zero cut-off profit condition (ZCP), and the other is the free entry condition (FE).[5]

The ZCP condition for incumbent firms implies that all firms should have non-negative profits in order to stay in the market. The ZCP condition implies $\pi_d(\varphi') = 0$ in the domestic market and $\pi(\varphi'_x) = 0$ in the export market. These conditions can be written in terms of the average productivity level because of the relationship between the average productivity level and cut-off productivity levels for entrance and export. The ZCP condition can be written as

$$\pi(\widetilde{\varphi}_t) = \pi_d(\widetilde{\varphi}) + p_x n \pi_x(\widetilde{\varphi}_x) = F_d(\lambda_d, t_d, k_d) f(\varphi') + p_x n F_x(\lambda_x, t_x, k_x) f(\varphi'_x), \tag{11}$$

where $f(\varphi') = [\widetilde{\varphi}/\varphi']^{\sigma-1} - 1$.

The free entry condition can be found from expected average profit flows of incumbents. For a potential entrant to make investment in order to enter the market,

[5]See Melitz (2003) for details.

the expected value for the entrant should be equal to zero. If the expected value for the potential entrant is less than zero, no firm will enter the market. On the other hand, if the expected value for the potential entrant is greater than zero, all potential firms will enter the market. Both cases cannot be the equilibrium. Let $\overline{v} = (1/\delta)\pi(\widetilde{\varphi})$ represent the present value of expected average profit flows. Further define v_e as the net value of entry. The FE condition can be written as

$$v_e = p_{in}\overline{v} - k_e = 0 \Longleftrightarrow \pi(\widetilde{\varphi}) = \frac{\delta k_e}{[1-G(\varphi')]}. \tag{12}$$

Finally, the equilibrium cut-off productivity level can be derived from the two conditions. From equations (11) and (12),

$$\frac{\delta k_e}{p_{in}} = F_d f(\varphi') + F_x p_x n f(\varphi'_x), \text{ where } f(\varphi') = [\widetilde{\varphi}/\varphi']^{\sigma-1} - 1 \tag{13}$$

There is a unique solution for the equilibrium cut-off value because the ZCP curve is decreasing in φ while the FE curve is increasing in φ.[6] In a stationary equilibrium, all aggregate variables must remain constant over time. This requires a mass M_e of new entrants in every period, such that they exactly replace the mass of incumbents who are hit with bad events and exit the market; $p_{in}M_e = \delta M$. The equilibrium φ' determines the export productivity cut-off level φ'_x as well as $\widetilde{\varphi}, \widetilde{\varphi}_x, \widetilde{\varphi}_t$, and ex-ante probabilities of entry and exports (p_{in} and p_x) because φ'_x is defined as a function of φ'.

$$\frac{r_x(\varphi'_x)}{r_d(\varphi')} = [\frac{\varphi'_x}{\tau\varphi'}]^{\sigma-1} = \frac{F_x}{F_d} \Longleftrightarrow \varphi'_x = \tau\varphi'[\frac{F_x}{F_d}]^{1/(\sigma-1)}. \tag{14}$$

Market clearing conditions for labor and goods lead to the aggregate labor supply $L = L_p + L_e$, where L_p and L_e represent the aggregate labor used for production and the amount of investments by new entrants respectively. According to the ZCP condition, aggregate profits (Π) equal to L_e, and $R = L$.

3. Comparative Statics

[6]See Figure 1 in Melitz (2003) for details.

o Proposition 1: The relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market. However, it keeps less productive exporters out of the export market.

Proof: From equation (10), $\frac{dF_d}{d\lambda_d} = \frac{-[1-t_d]k_d}{\lambda_d^2} < 0$. $\frac{dF_d}{dt_d} = \frac{-[1-\lambda_d]k_d}{\lambda_d} < 0$. From equation (13), $\frac{d\varphi'}{dF_d} = \{\frac{\varphi'}{\sigma-1}\}\frac{[1-G(\varphi')]\{[\widetilde{\varphi}]^{\sigma-1}-\varphi'^{\sigma-1}\}+\tau^{1-\sigma}[1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}}{[1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}} > 0$. $\frac{d\varphi'_x}{dF_d} = -\{\frac{\varphi'_x}{\sigma-1}\}\frac{\varphi_x'^{\sigma-1}[1-G(\varphi')]}{\tau^{\sigma-1}[1-G(\varphi')]F_x[\widetilde{\varphi}]^{\sigma-1}+[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}} < 0$. Thus, $\frac{d\varphi'}{d\lambda_d} = \frac{d\varphi'}{dF_d}\frac{dF_d}{d\lambda_d} < 0$, $\frac{d\varphi'}{dt_d} = \frac{d\varphi'}{dF_d}\frac{dF_d}{dt_d} < 0$, $\frac{d\varphi'_x}{d\lambda_d} = \frac{d\varphi'_x}{dF_d}\frac{dF_d}{d\lambda_d} > 0$, and $\frac{d\varphi'_x}{dt_d} = \frac{d\varphi'_x}{dF_d}\frac{dF_d}{dt_d} > 0$.

The relaxation of financial constraints for domestic sellers can be represented by higher contractibility and more collateralizability in financial markets for domestic sellers, which implies high λ_d and t_d. If λ_d and t_d increase, repayments of domestic sellers to investors (F_d) will decrease. Due to competitive financial markets, the break even point for investors goes down as contractibility or collateralizability increases. Therefore, contracts are made with lower repayments for domestic sellers. If λ_d and t_d increase, φ' decreases while φ'_x increases. This implies that the relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market. However, it keeps less productive exporters out of the export market, and makes them focus only on the domestic market.

It is not counter-intuitive that the relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market. Higher contractibility and more collateralizability in financial markets for domestic sellers lower their repayments for external financing. Thus, less productive firms, which earned negative profits in the domestic market before, can repay to investors, and finally survive in the market.

The cut-off productivity level for exporters, however, increases, which implies that lower productive exporters give up the export market and sell only to the domestic market. They still have high productivity levels, compared to domestic sellers. Hence, it will not happen for less productive exporters to exit both markets at the same time due to the relaxation of financial constraints for domestic sellers.

Two forces drive these results. One is the increase of profits in the domestic market for incumbents. Due to the entrance of less productive firms into the domestic market, firms can earn more profits in the domestic market. The aggregate price level in the domestic market increases due to the entrance of less productive firms. The demand for each good increases because of the inverse relationship between the demand and the aggregate price level. Therefore, profits from domestic sales increase, and the cut-off productivity level for domestic sellers decreases.

The other force is due to the increase of labor costs. The demand for labor increases because of new entrants in the domestic market. Wages increase as a consequence. The increase of the number of firms reduces the amount of labor that goes to an individual firm because the labor supply in the country is fixed. Thus, less productive exporters, who are not profitable enough to pay high wages, give up exporting. In other words, less productive firms, which barely earned profits in the export market before, exit the export market, and focus only on the domestic market because of increased profits in the domestic market and the inability to obtain inputs for exporting.

In brief, lower repayments for domestic sellers encourage potential entrants to enter the domestic market. Domestic sellers are competing with exporters in the labor market. The increase of the number of domestic sellers increases the degree of competition in the labor market, and the exporters with low productivity levels become losers.

∘ Corollary 1: The effects of the relaxation of financial constraints for domestic sellers on cut-off productivity levels are greater under lower contractibility, lesser collateralizability, and a smaller elasticity of substitution between varieties.

This implies that changes in financial constraints have strong effects when financial constraints are severe. They also produce strong effects when the elasticity of substitution between varieties is smaller. A smaller elasticity of substitution means a higher degree of product differentiation. If products are highly differentiated, it makes it easier for less productive domestic sellers to survive when their financial constraints are relaxed. Consider new entrants with low productivity levels. Their prices are high, compared to the aggregate price level. If their products are highly differentiated, however, their high prices will not reduce the demand for their goods much. This makes it easier for new entrants with low productivity levels to survive in the market.

∘ Proposition 2: The relaxation of financial constraints for exporters helps less productive exporters survive in the export market. However, it keeps less productive domestic sellers out of the market.

Proof: From equation (10), $\frac{dF_x}{d\lambda_x} = \frac{-[1-t_x]k_x}{\lambda_x^2} < 0$. $\frac{dF_x}{dt_x} = \frac{-[1-\lambda_x]k_x}{\lambda_x} < 0$. From equation (13), $\frac{d\varphi'}{dF_x} = -\{\frac{\varphi'}{\sigma-1}\}\frac{\varphi'^{\sigma-1}[1-G(\varphi'_x)]n}{[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}} < 0$. $\frac{d\varphi'_x}{dF_x} = \{\frac{\varphi'_x}{\sigma-1}\}\frac{[1-G(\varphi'_x)]n\{[\widetilde{\varphi_x}]^{\sigma-1}-\varphi'^{\sigma-1}_x\}+\tau^{\sigma-1}[1-G(\varphi')][\tilde{\varphi}]^{\sigma-1}}{[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}+\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1}} > 0$. Thus, $\frac{d\varphi'}{d\lambda_x} = \frac{d\varphi'}{dF_x}\frac{dF_x}{d\lambda_x} > 0$, $\frac{d\varphi'}{dt_d} = \frac{d\varphi'}{dF_x}\frac{dF_x}{dt_x} > 0$, $\frac{d\varphi'_x}{d\lambda_x} = \frac{d\varphi'_x}{dF_x}\frac{dF_x}{d\lambda_x} < 0$, and $\frac{d\varphi'_x}{dt_x} = \frac{d\varphi'_x}{dF_x}\frac{dF_x}{dt_x} < 0$.

The relaxation of financial constraints for exporters is represented by higher contractibility and more collateralizability in financial markets for exporters, which implies high λ_x and t_x. If λ_x and t_x increase, repayments of exporters to investors (F_x) decrease. Due to competitive financial markets, the break even point for investors goes down in the case of higher contractibility and more collateralizability. Therefore, contracts can be made with lower repayments for exporters. If λ_x and t_x increase, φ' increases while φ'_x decreases. This implies that the relaxation of financial constraints for exporters helps less productive firms survive in the export market. However, it keeps less productive domestic sellers out of the market.

It is not counter-intuitive that the relaxation of financial constraints for exporters helps less productive firms survive in the export market. Higher contractibility and more collateralizability in financial markets for exporters lower their repayments for external financing. Hence, potential exporters, which would earn negative profits in the export market before, can repay to investors and finally survive in the export market.

The cut-off productivity level for domestic sellers, however, increases, which implies that lower productive domestic sellers give up production. When financial constraints of exporters are relaxed, lower productive firms enter the export market due to lower repayments in export financing. The production for exporting increases. However, the labor supply for production is fixed in the country. The increase of exporting goods increases the demand for labor, which increases the wage rate. As a result, lower productive domestic sellers exit the market because they cannot be profitable enough to pay high labor costs for production. In other words, the wage rate increases because new exporters try to obtain more units of labor, and lower productive domestic sellers, which cannot afford the increase of labor costs, earn negative profits and exit the market.

In conclusion, lower repayments for exporters encourage domestic sellers with high productivity levels to enter the export market. Exporters are competing with domestic sellers in the labor market. Therefore, the increase of the number of exporters increases the degree of competition in the labor market, and the domestic sellers with low productivity levels become losers, give up production, and exit the market.

∘ Corollary 2: The effects of the relaxation of financial constraints for exporters on cut-off productivity levels are greater under lower contractibility, lesser collateralizability, and a smaller elasticity of substitution between varieties.

This implies that changes in financial constraints have strong effects when financial constraints are severe. They also produce strong effects when the elasticity of substitution is smaller. The intuition is similar to that of corollary 1.

4. An application: the Effects of Financial Liberalization

The above results can be applied to analyze the effects of financial liberalization on international trade. Financial liberalization has broad aspects. For example, Kaminsky and Schmukler (2003) consider three dimensions of financial liberalization: (1) in a liberalized capital account economy, banks and corporations are allowed to borrow from foreign countries freely; (2) a liberalized domestic financial system is characterized as the lack of controls on lending and borrowing interest rates as well as the lack of credit controls; (3) a liberalized stock market implies that foreign investors are allowed to hold domestic equity without restrictions and capital, dividends and interest can be repatriated freely within two years of the initial investment.

In this chapter, my analysis focuses on the first aspect of financial liberalization-the deregulation of the foreign sector capital account. Due to the liberalization, foreign investors can invest in loan markets in the home country without any governmental intervention. Domestic investors also can invest in foreign financial markets without any intervention. These free movements of credits among countries induce two different effects on domestic financial markets.

One is to change firms' financial constraints because of the severe competition between domestic investors and foreign investors. Kletzer and Bardhan (1987), Beck (2002), Matsuyama(2004), Ju and Wei(2005), and Becker and Greenberg(2005) show that different financial conditions become a source of the comparative advantage in the presence of credit constraints. For example, Kletzer and Bardhan (1987) show that countries with relatively well-developed financial sectors have a comparative advantage in industries and sectors that rely more on external finance. Beck (2002) sets up an open economy model with two production technologies, one with constant returns to scale and the other with increasing returns to scale. He shows that the sector with scale economies makes more profits than the other sector in countries with a higher level of financial development. Therefore, more financially developed countries have a comparative advantage in the sector with scale economies, and are net exporters of goods that are produced in the sector with scale economies.

Different financial constraints can be interpreted as differences in contractibility and collateralizability in financial markets. For simplicity, I assume that contractibility and collateralizability of domestic investors do not change after financial liberalization.[7] As financial liberalization proceeds, many foreign investors with different contractibility and collateralizability will enter domestic financial markets. Because foreign investors have more information on exporting firms in the home country than on non-exporting firms, at the beginning of financial liberalization, foreign investors will enter the financial market for exporters first.

If contractibility and collateralizability of foreign investors for exporters are lower than those of domestic investors, it will not have any effect. There is no incentive for exporters in the home country to sign contracts with foreign investors because foreign investors require higher repayments due to their lower contractibility and collateralizability. Therefore, there will be no inflows of credits or changes in firms' financial constraints regardless of financial liberalization, which implies no effects on cut-off productivity levels for entry and export.

If foreign investors have more information on exporting firms than domestic investors, however, they will begin to invest in the export sector. If contractibility and collateralizability of foreign investors are higher than those of domestic investors, foreign investors can sign contracts with exporters because of lower repayments of exporters in external financing.[8] According to proposition 2, the cut-off productivity level for exporters decreases while that for domestic sellers increases. Potential exporters, which would earn negative profits in the export market before, can repay to foreign investors and finally survive in the export market. The cut-off productivity level for domestic sellers, however, increases. This implies that low productive domestic sellers make negative profits and exit the market because of high wages, resulting

[7] I analyze the effects of changes in financial conditions for both domestic sellers and exporters in proposition 4.

[8] There is also the possibility that contractibility and collateralizability of domestic investors for exporters increase because of the severe competition with foreign investors. Either case will reduce repayments of exporters in external financing.

from the high demand for labor due to the increased number of exporters.

The other effects of financial liberalization are due to changes in the return to capital. Due to increased flows of credits, the return to capital changes after the liberalization. There is consensus in the literature that the return to capital decreases after financial liberalization, especially in developing countries. [See Bacchetta (1992) and Henry (2000a)]

Bacchetta (1992) analyzes the dynamic impacts of financial liberalization on the return to capital. He considers two experiments, a simultaneous liberalization of the domestic financial sector and the capital account, and a sequential liberalization in which the liberalization of the domestic financial sector is followed by the capital account liberalization. He shows that a likely outcome of liberalization is an initial net inflow followed by an outflow. His intuition is that the liberalization of the domestic financial sector leads to better allocation of resources and makes the home country more attractive to both domestic and foreign investors. As a result, initially there are few incentives for outflows and strong incentives for inflows. Thus, the return to capital will decline after financial liberalization.

If financial liberalization attracts foreign credits into domestic financial markets, the return to capital will go down. The effects can be analyzed as a variant of the maximization problem (9). Consider inflows of credits in financial markets for exporters. The return to capital decreases because of an increase of capital supply. This case can be represented by the generalized constraint (6) in the maximization problem (9); $B_x(\varphi) \equiv -k_x + \lambda_x F_x(\varphi) + (1-\lambda_x)t_x k_x \geq r_x k_x$, where r_x is the risk free return to capital in financial markets for exporters.

Repayments of exporters can be calculated as

$$F_x(\varphi) = [1-(1-\lambda_x)t_x+r_x]k_x/\lambda_x. \tag{15}$$

A decrease of the risk free return to capital in financial markets for exporters reduces their repayments because $\frac{dF_x}{dr_x} = k_x/\lambda_x > 0$. The direction of the effects on cut-off productivity levels is identical to the case of higher contractibility and more collateralizability in financial markets for exporters.

∘ Proposition 3: Financial liberalization helps less productive exporters survive in the export market, but keeps less productive domestic sellers out of the market.

Proof: From equation (13) and (15), $\frac{dF_x}{dr_x} = k_x/\lambda_x > 0$, $\frac{d\varphi'}{dr_x} = \frac{d\varphi'}{dF_x}\frac{dF_x}{dr_x} < 0$, and $\frac{d\varphi'_x}{dr_x} = \frac{d\varphi'_x}{dF_x}\frac{dF_x}{dr_x} > 0$.

Financial liberalization leads to higher contractibility and collateralizability in financial markets for exporters due to the participation of foreign investors, and reduces the risk free return to capital in financial markets for exporters because of inflows of foreign capital. In both cases, the export sector expands, while the domestic sector shrinks. Due to financial liberalization, foreign investors invest more in the export sector because they have more information on it. Inflows of credits also reduce outside options of domestic investors in financial markets for exporters due to the severe competition with foreign investors. This has favorable effects on exporters, decreasing their repayments. However, domestic sellers with lower productivity levels exit the market because they cannot obtain labor due to high wages.

∘ Corollary 3: The effects of a decrease of the return to capital for exporters on cut-off productivity levels are greater under lower contractibility, lesser collateralizability, and a smaller elasticity of substitution between varieties.

This implies that changes in the return to capital in financial markets for exporters have stronger effects on cut-off productivity levels when their financial constraints are more severe. The changes also produce stronger effects under a smaller elasticity of substitution between varieties because of the same reasoning described in corollary 1.

Increased flows of credits due to financial liberalization can affect financial markets for domestic sellers as well. Inflows of credits reduce the overall interest rate in the home country. In general, outside options in financial markets for both domestic sellers and exporters will decrease after financial liberalization.

∘ Proposition 4: The decrease of interest rates due to inflows of credits increases the number of both domestic sellers and exporters. The number of exporters relative to domestic sellers decreases with contractibility of exporters but increases with their collateralizability when overall interest rates decrease.

Proof: Let r be the overall interest rate. $F_d(\varphi) = [1-(1-\lambda_d)t_d + r]k_d/\lambda_d$ and $F_x(\varphi) = [1-(1-\lambda_x)t_x + r]k_x/\lambda_x$. From equation (13), $\frac{d\varphi'}{dr}$ is positive when λ_x and t_x are not much different from λ_d and t_d, and $\frac{d\varphi_x'}{dr}$ is positive when λ_x and t_x are not much different from λ_d and t_d. Moreover, let $ratio = \frac{\varphi_x'}{\varphi'}$.[9] $\frac{d}{dr}ratio = \tau^{\sigma-1}\frac{F_x'F_d - F_xF_d'}{F_d^2}$. This is positive when λ_x is smaller than λ_d or t_x is bigger than t_d. See appendix B-3.

If inflows of credits decrease overall interest rates, repayments of both domestic sellers and exporters decrease. The number of firms in both sectors increase, when λ_x and t_x are not much different from λ_d and t_d. Furthermore, the effects on exporters are greater than those on domestic sellers when λ_x is smaller than λ_d or t_x is bigger than t_d. The intuition is that the effects of a decrease of overall interest rates on exporters are greater than those on domestic sellers when exporters are more financially constrained than domestic sellers. If exporters can offer more tangible assets, the effects on exporters are also greater.

There is little evidence for differences in the fraction of collaterals between domestic sellers and exporters in the same industry because the fraction depends mostly on properties of goods. In light of the substantial turnover rate in the product composition in exporting, however, the probability of default will be higher in the export

[9]The increase of the *ratio* implies the decrease of the number of exporters relative to that of domestic sellers.

sector than in the domestic sector.[10] Exporting has more risks than domestic sales. It needs higher fixed costs and higher transportation costs. Exporters also face more credential risks than domestic sellers because of higher probability that they may not have payments from buyers. More risks lead to lower contractibility, which implies that exporters are more financially constrained than domestic sellers. Thus, a decrease of overall interest rates has bigger effects on exporters than on domestic sellers, and the relaxation of financial constraints due to financial liberalization leads to more favorable outcomes for exporters than for domestic sellers.

5. Conclusions

In this chapter, I have presented a general equilibrium model of heterogeneous firms in which firms differ in productivity and face financial constraints to pay fixed costs for production. I consider how the relaxation of financial constraints for domestic sellers and exporters affects firms' entry and export decisions. I have the following findings. (1) The relaxation of financial constraints for domestic sellers helps less productive firms survive in the domestic market, while driving less productive exporters out of the export market. (2) The relaxation of financial constraints for exporters helps less productive firms survive in the export market, while pushing less productive domestic sellers out of the market. (3) Financial liberalization may help less productive exporters survive in the export market, while driving less productive domestic sellers out of the market.

This chapter makes two contributions to the literature on international trade. First, the existing literature largely assumes that changes in financial conditions happen in all sectors, at the same time, and to the same extent. In contrast, in this chapter, I consider the case where financial constraints are relaxed only in some sectors, and analyze the impacts on the other sectors in which financial constraints are

[10] According to Manova (2006), more than a quarter of exported products are discontinued from one year to the next and replaced by new ones, resulting in a reallocation of 16% of bilateral trade by value.

not relaxed. Thus, my analysis provides a general equilibrium view of the impacts of financial constraints on production and exports. Second, my model sheds new light on the effects of financial liberalization on different sectors in the economy. Specifically, financial liberalization reduces interest rates, through which raises the number of firms in both domestic and export sectors. In addition, the number of exporters relative to domestic sellers decreases with contractibility of exporters but increases with their collateralizability when overall interest rates decrease.

Chapter 2: Estimating the Effects of Financial Liberalization on Exporters and Domestic Sellers

1. Introduction

In recent years, international economists start investigating the effects of financial liberalization on trade patterns. If there are no financial constraints, the Heckscher-Ohlin model predicts that a country will export the goods which use abundant input factors. Financial liberalization does not affect trade patterns in this case. In the presence of financial frictions, however, borrowing constraints, which vary across industries and firms, affect the composition of a country's export by limiting investment opportunities open to producers with lower financial credits. This serves a ground for financial liberalization, which changes firms' financial constraints, to affect the production of an individual firm differently, and thus the export composition of goods.

Beck (2003), Becker and Greenberg (2005), Svaleryd and Vlachos (2005), and Hur et al. (2006) find that financially developed countries export relatively more in sectors that require more outside finance or are intensive in fixed up-front costs. Recently, by examining the impacts of equity market liberalizations on the export behavior of 91 countries in 1980-1997, Manova (2008) also shows that financial liberalization increases exports disproportionately more in financially vulnerable sectors that require more outside finance or having fewer collateralizable assets.

These empirical studies use the volume of exports as the dependent variable. Their focus is on the effects of financial development only on exporters. In contrast, I am interested in the effects of financial liberalization on both exporters and domestic sellers. Thus, unlike the existing studies, I use the ratio of exports to domestic productions as the dependant variable. My analyses will show how much financial liberalization affects the export sector compared to the domestic sector.

Financial liberalization has different effects on exporters and domestic sellers because the liberalization will relax financial constraints of exporters more than those of domestic sellers, and help the export sector expand while causing the domestic sector to shrink. As financial liberalization proceeds, many foreign investors will enter domestic financial markets. They may have different amount of information on exporters and domestic sellers in the country, which leads to different contractibility or collateralizability for exporters and domestic sellers from those of domestic investors. It is widely accepted that foreign investors have more information on exporting firms than on non-trade entrepreneurs. If foreign investors have more information on exporting firms than domestic investors, foreign investors can make contracts with exporters because they can offer lower repayments than domestic investors to exporters due to their higher contractibility or collateralizability.[11]

According to proposition 2 in chapter 1, the relaxation of financial constraints of exporters allows low productive exporters, which would earn negative profits in the export market before, to make repayments to investors and thus survive in the market. Low productive domestic sellers, however, have negative profits and exit the market because of high input costs, resulting from intense competition with exporters in labor markets.

In addition to the effects of financial liberalization on trade, I find the role of changes in costs of external financing in affecting export decisions. To my knowledge, this topic has not been examined in the literature. Changes in interest rates have been considered only as affecting import demands through changes in total incomes in the home country. The channel that changes in costs of external credits can have different effects on exporters and domestic sellers has been neglected. According to proposition 4 in chapter 1, a decrease of the overall interest rate increases the number of both domestic sellers and exporters. Furthermore, the number of exporters relative to domestic sellers decreases with contractibility of exporters but increases with their collateralizability when overall interest rates decrease. In other words, when the overall interest rate decreases, benefits to exporters are greater than those to domestic sellers if contractibility of exporters is smaller than that of domestic sellers or their collateralizability is higher.

[11]There is also a possibility that contractibility and collateralizability of domestic investors for exporters increase because of intense competition with foreign investors. Either case will reduce repayments of exporters in external financing.

There is little direct evidence showing differences in the fraction of collaterals between domestic sellers and exporters in the same industry. This is because the fraction of collaterals depends mostly on properties of goods. However, the substantial turnover rate in the product composition in the export market implies that contractibility of exporters is lower than that of domestic sellers.[12] In part, it results from higher risks in exporting than those in domestic sales. Exporting requires larger amount of fixed costs while it loses more portions of values than domestic sales due to higher transportation costs. Exporters also have higher credential risks than domestic sellers because of the higher probability that they cannot receive payments from buyers. Higher risks make lower contractibility. Thus, changes in the overall interest rate have more effects on exporters than on domestic sellers, which implies that a decrease of the overall interest rate expands the export sector more than the domestic sector.

Using data for 91 countries in 27 industries from 1980 to 1997, I find strong evidence for the effects of financial liberalization and interest rates on trade patterns. Here, interest rates are used to measure costs of external financing. Coefficients on the interaction between financial liberalization and external financial dependence are positive and statistically significant in all model specifications, which implies that financial liberalization benefits exporters more than domestic sellers, and that the effects are greater if they depend more on external financing. Asset tangibility, however, does not play a significant role in this process. I also find that real interest rates perform an important role in firms' export decisions. Due to the different degree of sensitivity between exporters and domestic sellers to changes in interest rates, the export sector expands relatively more than the domestic sector when real interest rates decrease. The more an industry depends on external financing, the larger will be the effects of changes in real interest rates on trade patterns. In addition, I find

[12] According to Manova (2006), more than a quarter of exported products are discontinued from one year to the next and replaced by new ones, resulting in a reallocation of 16% of bilateral trade in value.

that the effects are greater in countries with under-developed financial markets.

The structure of this chapter is as follows. In section 2, I describe the data and present some descriptive statistics, and introduce models for the estimation in section 3. In section 4, I show the results of analyses, and conclusions follow in section 5.

2. A Glance of Data

2.1 The Ratio of Exports to Domestic Sales

I obtain most data from Manova (2008). Feenstra's World Trade Database provides export flows in dollars at the 4-digit SITC Rev.2 industry level in each country. Using Haveman's concordance, they are aggregated in terms of 3-digit ISIC industries, for which the industry-level data on financial vulnerability is available. The data on industrial productions at the 3-digit ISIC Rev.2 comes from the Industrial Statistics Yearbook and International Yearbook of Industrial Statistics published by the United Nations. The production data is available in national currency while the export data is provided in dollars. Thus, I convert the export data using the exchange rate obtained from the Penn World Table.

Calculating the ratio of exports to industrial productions, I find that 2,105 out of 18,908 observations (11.1%) are greater than one, which means that the volume of exports is greater than domestic production. This is mainly due to the fact that domestic productions are net outputs, but exports are gross outputs which may double count intermediate inputs. However, because I am interest in changes in the ratio of exports to domestic sales, this should not cause a problem to my analysis as long as the differences in standards are stable and persistent.

Hence, I normalize industrial export ratios in each industry and country using the formula: $(ER_{cit} - AER_{ci})/STD_{ci} * 100$, where ER, AER, and STD represent the export ratio of industry i in country c in year t, the average export ratio, and the standard deviation during the period respectively. On average, the average of the export ratio is 86.9%, and its standard deviation is 80.1%. This normalization method will alleviate the effects of extreme values on estimates by making all averages of trade ratios in each industry and country the same as those in other industries and countries. The most extreme values may occur in the sector where the amount of export or production is small. They, however, will dominate the other observations and distort analyses if they are used without standardization. The standardized trade ratio ranges between -333.9 and 393.2 with a mean of zero and a standard deviation of 95.8.

2.2 Measures of Financial Liberalization

The equity market liberalization is used as a proxy for financial liberalization. It is available for 91 countries between 1980 and 1997 in Bekaert, Harvey and Lundblad (2005) (BHL). 39 countries opened their stock markets to foreign investors during this period, and 16 countries liberalized prior to 1980 while 36 countries did not remove equity market restrictions until 1997. BHL dates both the official year of stock market reforms and the "first sign" of the liberalization. This first-sign year is the earliest of three dates; official liberalization, first American Depository Receipt (ADR) announcement, and first country fund launch. BHL also constructs measures of the intensity of openness, reflecting the degree of the equity market in which foreigners can invest. The intensity measures of the liberalization are purely cross-sectional, which varies between zero and one, where a ratio of one implies no restrictions regarding foreign ownership. Official and first-sign liberalization intensities are set at zero prior to the liberalization, and later at the intensity level in the year of the liberalization.

2.3 Measures of External Finance Dependence and Asset Tangibility

Measures of industry-level external finance dependence and asset tangibility for 27 3-digit ISIC industries come from Braun (2003). They are constructed from the data on all publicly traded U.S.-based companies in COMPUSTAT.[13] The indicator of

[13]Constructing industrial measures of external finance dependence and asset tangibility from the

the industrial reliance on outside finance is made by the ratio of capital expenditures minus cash flow from operations to capital expenditures for the median firm in each industry. This ratio ranges from -0.4512 to 1.1401. I add 0.5 to the original value in order to set the measure as positive. It will not change the results of analyses qualitatively because only differences in the measure across industries matter in the estimation. Another reason for setting the value as positive is to have reasonable values when interaction terms are made. In the case of the negative real interest rate, for example, the interaction term between the real interest rate and negative external finance dependence will be positive, which will mislead analyses.

Similarly, the measure of asset tangibility is constructed as the share of net property, plant, and equipment in total book-value assets for the median firm of all publicly traded U.S.-based companies in a sector in COMPUSTAT. It ranges from 0.0745 to 0.6708. Both measures for external finance dependence and asset tangibility are used as averages for the 1986-1995 period. They appear very stable over time.

The average and standard deviation of external finance dependence across all 27 industries is 75% and 32% and those of asset tangibility are 30% and 13%, respectively. Industries in the greatest need for external funds such as professional and scientific equipment and electric machinery are mostly intensive in large up-front investment. On the other hand, non-ferrous metals, apparel, and beverages, which do not need much up-front investment, do not depend much on external finance. Industries with the lowest levels of tangibility are pottery, china, and earthenware; leather products; and apparel. Industries with the highest levels of tangibility are petroleum refineries; paper and products; iron and steel; and industrial chemicals.

U.S. data can be supported by following reasons. The United States has one of the most advanced and sophisticated financial systems, which makes it reasonable to believe that the measures reflect firms' true demand for outside capital and tangible assets. Using the U.S. as the reference country is also convenient because of the limited data on many other countries. Moreover, it can reduce the possibility for the measures to endogenously respond to a country's availability of external credits. If entrepreneurs use more internal financing in countries with stricter equity market restrictions, for instance, estimates of the effects of financial liberalization will be biased downwards.

2.4 Other Data[14]

I obtain interest rates and CPI for 91 countries from International Financial Statistics (IFS) provided by the IMF. Both are measured in percentage. The lending rate is used as the measure of the overall interest rate because my analysis focuses on the changes in firms' decisions when facing borrowing constraints. The real interest rate is obtained by subtracting CPI from the lending rate. I standardize the real interest rate using the same formula as that of the export ratio. To control the trend of the export ratio, I use the total export ratio to GDP in each country. It is calculated from the value of exporting goods and services divided by GDP in National Account, available in the United Nations Statistics Division.

3. Empirical Specifications

Based on the financial constraint model in chapter 1, I use a generalized difference-in-difference approach to test for the differential effects of financial liberalization on the export ratio across sectors. I include interaction terms of the country-level measure of financial liberalization ($Liberal_{ct}$) with industry-level measures of external finance dependence ($FinDep_i$) and asset tangibility ($Tang_i$). I also add the real interest rate ($Interest_{ct}$) and its interaction with external finance dependence.

$$T_{cit} = \beta_0 * Liberal_{ct} + \beta_1 * Liberal_{ct} * FinDep_i + \beta_2 Liberal_{ct} * Tang_i + \gamma_0 Interest_{ct} + \gamma_1 Interest_{ct} * FinDep_i + \delta Controls_{cit} + \alpha_0 + \alpha_1 T_{ct} + \eta_c + \eta_i + \eta_t + \epsilon_{cit}, \quad (1)$$

where T_{cit} is the standardized export ratio of industry i in country c in year t. $Liberal_{ct}$ is a binary variable which is equal to one in the year of and all years after financial liberalization, and zero otherwise. For robustness checks, I also use liberalization intensity measures which reflect the fraction of equity market openness in which foreigners are permitted to invest. $FinDep_i$ and $Tang_i$ correspond to the level of external finance dependence and asset tangibility in sector i respectively. Coefficients

[14] See the Manova's paper (2008), "Credit Constraints, Equity Market Liberalizations and International Trade", for the detailed description of other variables used in the estimation.

of my interests are β_1, β_2, and γ_1. If $\beta_1 > 0$ and $\beta_2 < 0$, financial liberalization increases export ratios relatively more in sectors intensive in external financing or having more tangible assets. If $\gamma_1 < 0$, a decrease of the real interest rate increases export ratios relatively more in sectors intensive in outside capital.

I allow for country, sector, and year-fixed effects, and cluster errors by countries. I also control for the ratio of total export to GDP in each country. I do not estimate main effects of $FinDep_i$ and $Tang_i$ in themselves because they are absorbed in industry-fixed effects which also capture other industry-specific omitted characteristics. Time-fixed effects account for changes in global economic conditions that affect all countries and industries equally, such as technological improvements, demand shifts, or world price movements. Country-fixed effects control for country-specific characteristics that would affect export ratios of all industries in a country such as remoteness or institution systems that do not change during the sample period. Thus, the main effect of financial liberalization (β_0) is identified from within-country over time variations.

The coefficient on the interaction between the real interest rate and external finance dependence (γ_1) expects to be negative, which implies that exporters are more sensitive to changes in the real interest rate and benefit more from a decrease of the interest rate. Moreover, considering industrial differences in the degree of external finance dependence, the effects of changes in the real interest rate on the export ratio will be greater in the sector that relies more on external financing.

In panel analyses, the estimates, β_1 and β_2, come from the combination of cross-sectional and time-series variations due to financial liberalization across countries regarding external finance dependence and asset tangibility. These coefficients, thus, reveal the comparative advantage in financially vulnerable sectors that a country with open financial markets has relative to the financially closed economy. In other words, if financial liberalization relaxes financial constraints of exporters more than those of domestic sellers, exporters in the industry with a higher degree of external finance dependence benefit more from the liberalization than those in other industries with a lower degree of external finance dependence. Hence, the export ratio would increase more in industries with higher external finance dependence after the liberalization. Similarly, the interaction term between the real interest rate and external finance dependence shows the changes in the pattern of the comparative advantage due to changes in costs of outside capital.

Recall that the industrial characteristics, $FinDep_i$ and $Tang_i$, are obtained only from the U.S. data. While the measures do not require that all firms in each industry have exactly the same tangibility and external finance dependence levels across all countries, the effectiveness of the results relies on the fact that the ranking of sectors remain relatively stable across countries. Rajan and Zingales (1998) and Braun (2003) argue that the measures, which they constructed, capture technological components that are innate to a sector, and thus the measures are good proxies for external finance dependence and asset tangibility in all countries. They also point out that the measures have significant variations more across sectors than across firms within an industry.

$Controls_{cit}$ includes factor endowments and trade liberalization. I include factor endowments to control for traditional explanations for trade patterns. For robustness checks, I analyze only switching countries which open their financial markets during 1981-1997 in order to avoid distortions arising from including countries which do not make financial reforms during the period. Moreover, I divide the sample into two groups in terms of income levels in order to examine if the effects are different among countries. Furthermore, I analyze long-term effects of financial liberalization by averaging out unobserved systematic differences at the time of the liberalization.

Interpreting the results of model specification (1) as a causal relationship relies in part on the assumption that financial liberalization provides exogenous shocks to the availability of external finance and its costs. In the absence of credit constraints, if the liberalization is anticipated, export ratios should not respond either ahead of or after the liberalization. When financial frictions exist, however, export ratios may increase prior to the official liberalization date if the easier external financing in the future is expected. This suggests that specification (1) may underestimate the actual impacts of financial market liberalization on trade patterns.

4. Empirical Results

4.1 The Effects on Trade patterns: Basic Results

The results of the basic estimation are presented in Table 2-1. I estimate specification (1) using the full panel of standardized export ratios for 91 countries and 27 industries in the 1980-1997 period. I trim the data by dropping outliers of export ratios and real interest rates whose values are outside of the range of 3-standard deviations. I control for country, industry, year-fixed effects, and the standardized total export ratio to GDP. I also include factor endowments to control for traditional explanations of trade patterns. Those variables are per capita physical capital, human capital, and natural resources, and their interaction terms with intensities by industries. The data on physical capital and human capital is obtained from Caselli (2005), and that of natural resources is available in the World Bank (1997). Their intensities by industries are available in Braun (2003). I use both official liberalization and first-sign liberalization dummies in the estimation.

According to Table 2-1, the coefficients on the interaction between liberalization and external finance dependence are positive and significant at the 5 or 1 % level. This implies that financial liberalization benefits exporters more than domestic sellers. The more the exporters depend on outside funding, the bigger are the effects.

After financial liberalization, the industry in the upper 75% percentile in external finance dependence exports more by 3% points on average than the industry in the lower 25% percentile in external finance dependence.[15] The average of the standard

[15] Due to the standardization of variables, estimates implies different amount of the effects on actual export ratios, which depends on the specific industry and country.

deviation of export ratios across all industries and countries is 67%. Hence, the estimate can be converted to the amount of changes in export ratios using the formula: estimates*the difference in the explanatory variable*the average of the standard deviation of export ratios/100. Unlike Manova (2008), the coefficients on the interaction between liberalization and asset tangibility are negative but statistically insignificant.

I also find that the coefficients on the interaction between real interest rates and external finance dependence are negative and significant at the 1% level. A reduction of the real interest rate can also be used as a proxy for the relaxation of financial constraints. The negative estimates show that exporters are more sensitive to changes in the real interest rate. The more the exporters depend on outside credits, the bigger are the effects. This may suggest that exporters have less contractibility than domestic sellers due to higher risks and costs in exporting (e.g. higher credential risks and transportation costs).

A decrease of the overall real interest rate by 1% point increases the export ratio by 0.09% point more on average for the industry in the upper 75% percentile in external finance dependence compared to the industry in the lower 25% percentile in external finance dependence. Similar to the previous calculation method, the estimate can be converted to the amount of changes in the export ratio using the formula: estimates*the difference in external finance dependence*the average of the standard deviation of export ratios/the average of the standard deviation of the real interest rate.

In order to examine whether the effects of financial liberalization differ across countries at different development levels, I divide the sample into two groups based on financial market capacity. I use stock market capitalization (the value of all publicly listed companies) relative to GDP averaged between 1980 and 1984 as the proxy for financial market capitalization. The more-developed group contains countries whose stock market capitalization is above the sample average while the less-developed group includes countries whose stock market capitalization is below the sample average.

According to Table 2-1, the effects of financial liberalization are bigger for financially under-developed countries. The coefficients on the interaction between liberalization and external finance dependence are positive and statistically significant at the 1% level for under-developed countries. The coefficients on the interaction term of the real interest rate are negative and significant at the 1 % level for those countries. On the other hand, the estimates for more-developed countries are statistically insignificant. These results support Manova's argument that countries with under-developed stock markets gain more benefits from financial liberalization. Therefore, exporters in countries with under-developed stock markets and those in industries which need more external financing can get bigger benefits from financial liberalization.

4.2 The Effects on Trade patterns: Switchers Only

In Table 2-2, I analyze only the countries which opened their financial markets during the sample period. The analysis in Table 2-2 includes 16 countries that liberalized equity flows before 1980 and 36 countries that remained financially closed until 1997, which would distort the results of the analysis. Thus, I analyze only 39 countries that underwent financial reforms during the sample period. Precisely, 30 countries are included in the analysis because of the limitation of the data on industrial productions and real interest rates. I also control for factor endowments, country, industry, year-fixed effects, and the standardized total export ratio to GDP.

The results do not change qualitatively when I focus only on 39 switchers that removed capital flow restrictions between 1981 and 1997. The coefficients on the interaction between liberalization and external finance dependence are positive and significant, and those between real interest rates and external finance dependence are negative and significant. Overall, the estimates become stronger while their t-values do not increase much because of a sample size. The results show that financial liberalization provides a large direct boost to the export sector and results in a substantial reallocation towards exporters in the sector with greater reliance on external finance.

Moreover, exporters have higher sensitivity to changes in the real interest rate than domestic sellers, and the effects are bigger in financially under-developed countries.

4.3 Long-term Analysis

The basic specification (1) can be rewritten in terms of the time of financial liberalization. $t = 0$ represents the time before the liberalization and $t = 1$ represents the time after the liberalization. I take a difference between them, and have the following specification;

$$\Delta T_{ci} = \beta_0 * Liberal_c + \beta_1 * \Delta Liberal_c * FinDep_i + \beta_2 \Delta Liberal_c * Tang_i + \gamma_0 \Delta Interest_c + \gamma_1 \Delta Interest_c * FinDep_i + \alpha_1 \Delta T_c + \Delta \epsilon_{ci}. \quad (2)$$

Note that the constant term α_0 is dropped out of the regression. First-differencing also removes all country and sector-fixed effects, (η_c, η_i), and thus provides cleaner estimates for the impacts of financial liberalization on trade patterns. As in the previous panel analysis, this may still incur downward biased estimates since export ratios incorporate any response of exports to an anticipated liberalization. Since countries liberalize their financial markets in different years, I control for liberalization-year fixed effects.

I average out all the data in the three-year period. Technically, I calculate averages of T_{cit-1}, T_{cit-2}, T_{cit-3}, and T_{cit+1}, T_{cit+2}, T_{cit+3}, where t is the time of financial liberalization. I then take a difference between them, and use OLS regression. According to Table 2-3, I have the similar results as those of the basic specification. The coefficients on the interaction between liberalization and external finance dependence are positive and significant at the 10 or 5 % level and those between real interest rates and external finance dependence are negative and significant at the 10% level, which means that financial liberalization benefits exporters more than domestic sellers and a decrease of the real interest rate increases export ratios. The more the industry depends on outside finance, the bigger are the effects.

4.4 Controlling Trade Openness

Financial liberalization is sometimes part of a broader program of deregulations that may include reforms of trade policies. In Table 2-4, I confirm that my findings are not driven by simultaneous changes in trade policies. The data on trade openness is obtained from Wacziarg and Welch (2003), who updated the binary indicator originally developed by Sachs and Warner (1995). According to their criteria, a country is labeled closed to international trade if at least one of the following conditions is met: average tariff rates are at least 40%; non-tariff barriers cover at least 40% of trade; a black market exchange rate exists and is on average depreciated at least 20% relative to the official exchange rate; the country holds a monopoly on major exports; or it has a socialist economic system. According to the classification, a country can be "closed" to international trade due to high trade costs, but may still participate in the trade.

The data on trade openness is available for 70 of the 91 countries in my sample. I focus on countries that remove credit flow restrictions during the 1981-1997 period. I also allow trade openness to affect sectors differently by interacting it with industry measures of financial vulnerability. I control for country, industry, year-fixed effects, factor endowments, and the total export ratio to GDP. As in Table 2-4, the inclusion of trade openness changes little the estimated effects of financial liberalization and real interest rates on export ratios. The coefficients on the interaction between liberalization and external finance dependence are positive and significant, and those between real interest rates and external finance dependence are negative and significant, while those between liberalization and asset tangibility are still negative but insignificant. The effects are bigger in financially under-developed countries.

4.5 Comparison with Cases that use Trade Volumes

In Table 2-5, I follow the model specification of Manova (2008) in order to compare the two different specifications. She uses export volumes as the dependent variable, and I use export ratios. I use the same samples with those in Table 2-1. I control for country, industry, year-fixed effects, and factor endowments. I also control for the log of GDP instead of the total export ratio to GDP when export volumes are used as the dependent variable. The last two columns come from Table 2-1.

In the first two columns, I do not include the real interest rate and its interaction term. The model specification is the same as that in her paper. As in Table 2-5, the coefficients on the interaction of the liberalization with external financial dependence are positive and significant, and those with asset tangibility are negative and significant. These results show that financial liberalization increases exports disproportionately more in financially vulnerable sectors that require more outside finance or employ fewer collateralizable assets.

In the third and fourth columns, I include the real interest rate and its interaction with external finance dependence into her model. I do not standardize the real interest rate because the dependent variable is not standardized. Her arguments still hold with the inclusion of the real interest rate. Estimates of the interaction of the liberalization with external financial dependence are positive and significant, and those with asset tangibility are negative and significant. Furthermore, I find weak evidence that exporters have higher sensitivity to changes in the real interest rate than domestic sellers. Estimates of the interaction of the real interest rate with external financial dependence are negative, and they are significant at the 10% level when the first-sign liberalization dummy is used.

4.6 Robustness Checks

In Table 2-6, I do robustness checks. The first two columns come from Table 2-1. In the third and fourth columns, I use liberalization intensity measures. The results are qualitatively the same as those when liberalization dummies are used. In the last two columns, I use different liberalization measures and include trade openness. My results are changed little for all these alternative specifications.

Finally, there is concern that financial liberalization may be endogenous. However, this does not appear problematic for my results because of the following reasons. First, the exact timing of financial liberalization is the procedure of complex political decisions and thus plausibly exogenous from the view point of an individual firm and investor. Second, prior evidence suggests that equity market liberalizations do not follow surges in investment (Henry, 2000b) and that to control for growth opportunities or world business cycle effects does not eliminate the impacts of the liberalization on growth (Bekaert et al., 2005; Gupta and Yuan, 2004). Finally, if domestic credit markets are frictionless and a country expects higher export demand for sectors intensive in external finance, it can liberalize financial markets to increase the availability of funding. Capitals will then flow freely and allow firms to meet the demand. Hence, we can observe that financial liberalization follows higher exports in financially dependent sectors even in the absence of credit constraints, which will lead to downward biased estimates.

5. Conclusions

I have examined empirically the impacts of financial liberalization and the relaxation of financial constraints on exporters and domestic sellers. Unlike the existing literature, I use a ratio of exports to domestic production instead of export volumes as the dependent variable. I find that financial liberalization and real interest rates (a measure of costs of external funds) are important determinants of international trade patterns. In particular, financial liberalization and a reduction in the real interest rate increase the ratio of export to domestic production disproportionately more in industries with a higher degree of external finance dependence. In addition, I find that the effects are greater in financially under-developed countries.

I also find the role of changes in costs of external financing in making export decisions. Previous literature focuses only on the role of interest rates in affecting import demands through changes in total incomes. However, I find that changes in costs of external credits have different effects on exporters and domestic sellers. My finding supports that exporters have lower contractibility than domestic sellers because of their higher risks in exporting.

This chapter contributes to the growing literature on determinants of trade patterns. My analysis focuses on how much financial liberalization affects the export sector compared to the domestic sector. Therefore, my results provide stronger evidence on the effects of financial liberalization on international trade.

Table 2-1: The Effects on Trade patterns: Basic Results

	Official Liberalization Dummy			First Sign Liberalization Dummy		
	Trimmed	More financially developed	Less financially developed	Trimmed	More financially developed	Less financially developed
Liberalization	-12.739 (-1.13)	-28.544 (-1.37)	-11.144 (-0.85)	-3.750 (-0.34)	-18.252 (-0.77)	-7.485 (-0.63)
Lib*External finance dependence	12.893 (2.51)**	4.497 (0.78)	19.207 (2.70)***	15.442 (3.06)***	6.735 (1.34)	22.429 (3.14)***
Lib*Asset tangibility	-13.702 (-0.85)	-14.039 (-1.40)	-12.364 (-0.46)	-19.450 (-1.39)	-12.877 (-1.33)	-22.525 (-1.00)
Interest*External finance dependence	-0.077 (-2.59)***	0.020 (0.73)	-0.142 (-3.42)***	-0.082 (-2.73)***	0.018 (0.66)	-0.151 (-3.61)***
Interest	0.018 (0.60)	-0.014 (-0.29)	0.062 (1.58)	0.017 (0.57)	-0.017 (-0.39)	0.068 (1.72)*
R-square	0.188	0.190	0.217	0.188	0.188	0.218
# of observations	12,797	5,078	7,719	12,797	5,078	7,719
# of exporters	49	22	27	49	22	27

Note: I control for country, industry, year-fixed effects, the total export ratio to GDP, and factor endowments. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

Table 2-2: The Effects on Trade patterns: Switchers Only

	Official Liberalization Dummy			First Sign Liberalization Dummy		
	Trimmed	More financially developed	Less financially developed	Trimmed	More financially developed	Less financially developed
Liberalization	3.395 (0.22)	11.001 (0.44)	-14.730 (-0.69)	14.348 (0.89)	19.918 (0.74)	-7.809 (-0.40)
Lib*External finance dependence	20.659 (1.92)*	2.024 (0.13)	29.008 (2.40)**	23.793 (2.61)***	7.991 (0.65)	31.232 (2.97)***
Lib*Asset tangibility	-21.688 (-0.68)	-37.836 (-1.98) **	-14.895 (-0.30)	-30.902 (-1.23)	-36.186 (-2.08) **	-30.404 (-0.83)
Interest*External finance dependence	-0.086 (-2.11)**	0.035 (0.69)	-0.138 (-2.97)**	-0.098 (-2.41)**	0.022 (0.45)	-0.157 (-3.42)***
Interest	0.029 (0.98)	0.061 (0.91)	0.072 (1.90)*	0.024 (0.79)	0.062 (0.93)	0.082 (2.14)**
R-square	0.158	0.135	0.221	0.161	0.136	0.222
# of observations	7,240	2,421	4,819	7,240	2,421	4,819
# of exporters	26	8	18	26	8	18

Note: I control for country, industry, year-fixed effects, the total export ratio to GDP, and factor endowments. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

Table 2-3: Long-term Analyses

3 year average	Official Liberalization Dummy			First Sign Liberalization Dummy		
	All	More financially developed	Less financially developed	All	More financially developed	Less financially developed
Liberalization	5.614 (0.20)	-73.079 (-1.49)	83.384 (2.82)***	48.874 (1.20)	-100.229 (-1.86)*	61.612 (1.94)*
Lib*External finance dependence	42.566 (1.81)*	58.952 (1.10)	23.004 (0.93)	51.838 (2.07)**	63.291 (1.26)	52.686 (1.79)*
Lib*Asset tangibility	-20.417 (-0.39)	1.843 (0.02)	-43.870 (-0.76)	-9.994 (-0.20)	92.055 (0.75)	-37.980 (-0.73)
Interest*External finance dependence	-0.363 (-1.74)*	-0.191 (-0.51)	-0.587 (-2.25)**	-0.372 (-1.69)*	-0.280 (-0.80)	-0.499 (-1.76)*
Interest	-0.132 (-0.65)	0.348 (1.15)	-0.044 (-0.19)	-0.154 (-0.71)	0.421 (1.37)	-0.107 (-0.44)
R-square	0.201	0.091	0.363	0.167	0.130	0.254
# of observations	207	72	135	216	54	162

Note: I calculate an average of all variables before and after the liberalization, take their differences, and do OLS estimation. I use the difference of the total export ratio as a control variable. I control for liberalization-year fixed effects. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

Table 2-4: Controlling Trade Openness

	Official Liberalization Dummy			Official Liberalization Dummy		
	Trimmed	More financially developed	Less financially developed	Trimmed	More financially developed	Less financially developed
Liberalization	-13.162 (-1.13)	-26.708 (-1.36)	-8.714 (-0.69)	-15.894 (-1.30)	-28.127 (-1.50)	-11.707 (-0.93)
Lib*External finance dependence	10.578 (2.09)**	3.851 (0.62)	16.099 (2.30)**	14.467 (2.04)**	12.018 (1.24)	18.114 (2.01)**
Lib*Asset tangibility	-19.900 (-1.29)	-17.715 (-1.84)*	-20.505 (-0.78)	-20.480 (-1.14)	-33.142 (-2.58)***	-15.583 (-0.55)
Interest*External finance dependence	-0.069 (-2.26)**	0.018 (0.66)	-0.133 (-2.93)***	-0.067 (-2.20)**	0.024 (0.98)	-0.132 (-2.92)***
Interest	0.018 (0.53)	-0.016 (-0.34)	0.045 (0.95)	0.016 (0.49)	-0.021 (-0.46)	0.045 (0.94)
Trade openness	-1.662 (-0.12)	0.758 (0.06)	-8.714 (-0.47)	4.293 (0.25)	2.300 (0.14)	0.486 (0.02)
Trade openness* External finance dependence				-8.454 (-1.23)	-13.930 (-1.43)	-5.523 (-0.65)
Trade openness *Asset tangibility				1.336 (0.08)	29.848 (1.34)	-16.660 (-0.72)
R-square	0.181	0.196	0.204	0.181	0.196	0.204
# of observations	11,872	4,899	6,973	11,872	4,899	6,973
# of exporters	44	19	25	44	19	25

Note: I control for country, industry, year-fixed effects, factor endowments, and the total export ratio to GDP. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

Table 2-5: Comparison with Cases that use Trade Volumes[1)]

	Official Liberal Dummy	First Sign Liberal Dummy	Official Liberal Dummy[2)]	First Sign Liberal Dummy[2)]	Official Liberal Dummy	First Sign Liberal Dummy
Dependent Variable	Log(export)	Log(export)	Log(export)	Log(export)	Export ratio	Export ratio
Liberal	0.027 (0.14)	0.103 (0.52)	0.028 (0.14)	0.102 (0.51)	-12.739 (-1.13)	-3.750 (-0.34)
Lib*Ext Fin Dep	0.850 (4.74)***	0.947 (4.54)***	0.852 (4.72)***	0.951 (4.53)***	12.893 (2.51)**	15.442 (3.06)***
Lib*Asset Tang	-1.770 (-3.03)***	-2.173 (-4.00)***	-1.771 (-3.03)***	-2.174 (-4.00)***	-13.702 (-0.85)	-19.450 (-1.39)
Interest*Ext Fin Dep			-0.011 (-1.14)	-0.017 (-1.77)*	-0.077 (-2.59)***	-0.082 (-2.73)***
Interest			-0.004 (-0.55)	0.000 (0.01)	0.018 (0.60)	0.017 (0.57)
R-square	0.795	0.796	0.795	0.797	0.188	0.188
# of Obs	12,797	12,797	12,797	12,797	12,797	12,797
# of Exporters	49	49	49	49	49	49

Note: 1) I control for country, industry, year-fixed effects, and factor endowments. I also control for the log of GDP when the dependent variable is log(export), and the total export ratio to GDP when the dependent variable is the export ratio. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

2) I use real interest rates without standardization.

Table 2-6: Robustness Checks

	Official Liberal Dummy	First Sign Liberal Dummy	Official Liberal Intensity	First Sign Liberal Intensity	First Sign liberal dummy	First Sign liberal dummy
Liberalization	-12.739 (-1.13)	-3.750 (-0.34)	-34.146 (-1.44)	-10.933 (-0.38)	-2.995 (-0.27)	-6.547 (-0.55)
Lib*External finance dependence	12.893 (2.51)**	15.442 (3.06)***	4.024 (1.53)	4.753 (1.88)*	13.044 (2.65)***	19.034 (2.48)**
Lib*Asset tangibility	-13.702 (-0.85)	-19.450 (-1.39)	-10.420 (-1.76)*	-11.872 (-2.06)**	-24.740 (-1.81)*	-27.855 (-1.69)*
Interest*External finance dependence	-0.077 (-2.59)***	-0.082 (-2.73)***	-0.066 (-2.28)**	-0.067 (-2.29)**	-0.073 (-2.40)**	-0.071 (-2.35)**
Interest	0.018 (0.60)	0.017 (0.57)	0.011 (0.35)	0.009 (0.29)	0.017 (0.51)	0.015 (0.47)
Trade openness					-3.259 (-0.22)	3.755 (0.21)
Trade Open * External finance dep						-12.080 (-1.55)
Trade Open *Asset tangibility						6.892 (0.39)
R-square	0.188	0.188	0.188	0.187	0.180	0.180
# of Obs	12,797	12,797	12,797	12,797	11,872	11,872
# of Exporters	49	49	49	49	44	44

Note: I use the trimmed data. I control for country, industry, year-fixed effects, the total export ratio to GDP, and factor endowments. t-statistics are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level.

Chapter 3: A Two-Dimension Heterogeneous Firm Model

1. Introduction

Melitz (2003) explains export decisions based on firm-level productivity differences and fixed costs of exporting. He assumes higher fixed costs for exporting than those for domestic sales, and shows that only the most productive firms which can make enough profits to cover higher fixed costs for exports will export. The intermediate productive firms which can make enough profits to cover the fixed costs for domestic sales choose to sell to the domestic market while the least productive firms exit the market.

However, the Melitz model cannot explain the interesting fact in international trade that some less productive firms export while some high productive firms do not export. Bernard, Eaton, Jensen, and Kortum (2003) show the productivity dispersion among firms, and find that exporters, on average, have higher productivity levels than domestic sellers. According to the 1992 U.S. Census of Manufactures, exporters had a 33-percent advantage in labor productivity overall and a 15-percent advantage relative to non-exporters within the same 4-digit industry. Interestingly, their Figure 2A and 2B show that some firms with low productivity levels are exporters while some firms with high productivity levels sell only domestically.[16]

The Melitz model cannot explain this fact because he only allows productivity to differ across firms while assuming fixed costs to be the same among exporters or domestic sellers. The same amount of fixed costs interacting with firm-level heterogeneity in productivity leads firms to sort into serving the domestic or foreign markets based on their productivity levels.

Many researches find that fixed costs for export are important components in affecting firms' export decisions. Roberts and Tybout (1997) report firm-level evidence for sunk costs in exporting. Using data on Colombian firms, they find that a firm's current exporting status is largely determined by its previous export experience.[17]

[16]Figure 3-1 and 3-2 come from their Figure 2A and 2B.

[17]Similar findings are reported for other countries. For example, see Bernard and Wagner (2001)

Becker and Greenberg (2007) also show that the effects of financial development on exports are stronger when fixed costs are larger.

An interesting survey carried out by the World Bank, which is summarized in the World Bank Standards and Trade Database, investigates the costs incurred by exporting firms.(See Otsuki and Wilson (2004)) The survey reveals that exporting firms commonly make additional investment in both compliance costs and new plant or equipment, and that firms perceive the access to credits to be a major obstacle to exporting. The survey also shows that fixed up-front costs have long gestation periods, and that they are firm- or even employee-specific due to the different degree of accessibility to credits. Thus, this survey points out that financial constraints can lead to firm-level heterogeneity in fixed costs.

Therefore, in this chapter, I am going to present a heterogeneous firm model in which firms differ in both variable and fixed costs. My model is general in the sense that it can easily incorporate the factors affecting firms' variable costs such as productivity and labor quality, and the factors affecting firm's fixed costs such as financial constraints and searching costs.

My way of incorporating financial constraints into a trade model with heterogeneous firms follows Manova (2006). She extends the Melitz model and finds that credit constraints interact with firm-level heterogeneity in productivity and reinforce the selection of only the most productive firms into exporting. She incorporates fixed costs in a way with repayments. If a firm cannot cover fixed costs before production, the firm should borrow loans from financial sectors before making investments. In obtaining outside finance, firms pledge tangible assets as collateral. She also assumes that financial institutions cannot make perfect enforcement in terms of contractibility because of imperfect information.

In her models, credit constraints affect firms in different countries and sectors differently. Credit constraints vary across countries because contracts between firms and

for Germany and Bernard and Jensen (2004) for the United States.

investors are more likely to be enforced in countries with a higher level of financial development. Sectors differ in their endowments of tangible assets that can serve as collateral. If a financial contract is enforced, a firm makes payments to investors; otherwise, the firm defaults and creditors claim collaterals. Firms, therefore, find it easier to obtain external finance in countries with a high level of financial contractibility and in industries with more tangible assets. However, Manova focuses only on partial equilibrium outcomes and does not allow firm-level differences in financial constraints. Thus, repayments for exporters and domestic sellers are identical in the same industry regardless of their productivity levels.

However, firms in the same industry can have different degrees of financial constraints. One reason for this is because investors may have different information on individual firms. Some firms, for example, may have long credit histories or good reputations. Investors will take this into account when they make investment contracts, which specify repayments when the contracts mature.

Using my model with firm-level heterogeneities in both fixed and variable costs, I can explain several interesting stylized facts when firms make decisions on entry and export that cannot explained by the Melitz model. For example, my model can explain why some less productive firms export while some high productive firms do not export. My model can also explain the fact that some exporters do not sell in the domestic market. According to the Korea Investors Service Incorporation (KIS), 46 out of 1,576 (2.9%) Korean firms in the survey reported exports without domestic sales in 2005.

The structure of this chapter is as follows. In section 2, I set up the closed economy model of two-dimension heterogeneous firms. I extend the model for the open economy in section 3. Conclusions follow in section 4.

2. The Model for the Closed Economy

I incorporate financial constraints into the Melitz (2003) model of international trade in order to allow firm-level heterogeneities in both variable costs and fixed costs. Consider a country with a continuum of heterogeneous firms producing differentiated goods. Consumers exhibit love of variety and can consume all available differentiated products. The utility function for the representative consumer in each country is given by the CES preference function with a constant elasticity of substitution (σ), which is greater than one. The maximization problem of the representative consumer can be written as

$$\max U = [\int_{\omega \in \Omega} q(\omega)^{(\sigma-1)/\sigma} d\omega]^{\sigma/(\sigma-1)}, \text{ subject to } R = \int_{\omega \in \Omega} p(\omega) q(\omega) d\omega. \tag{1}$$

where U and R represent her total utility and revenue. $p(\omega)$ and $q(\omega)$ are the price of and the demand for each good.

The optimal consumption and expenditure decisions for each variety can be characterized as

$$q(\omega) = Q[\frac{p(\omega)}{P}]^{-\sigma}, r(\omega) = R[\frac{p(\omega)}{P}]^{1-\sigma}, \tag{2}$$

where aggregate expenditure and aggregate price index P is denoted by

$$R = PQ = \int_{\omega \in \Omega} r(\omega) d\omega, \ P = [\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega]^{1/(1-\sigma)}. \tag{3}$$

Production requires only one factor, labor (l), where wage is normalized to one. If a firm does not have any financial constraint, it uses k_d units of labor for the investment that is necessary before production. Marginal production of labor is constant for all firms with a given productivity level. Hence, to produce q units of goods, q/φ units of labor are necessary, where φ represents the firm's productivity level.

Variable costs are covered by internal finance, which implies that firms can compensate their production costs by selling their goods. Fixed costs (k_d), however, should be covered either by internal financing or external funding. Firms that do not have enough internal financing should borrow loans from financial sectors before making investments. In obtaining outside finance, financial institutions cannot make perfect enforcement in terms of contractibility because of imperfect information. In particular, investors can expect to be repaid with probability $\lambda(\omega)$, which is less than one. $\lambda(\omega)$ also represents financial conditions for an individual firm. With probability $[1-\lambda(\omega)]$, financial contracts cannot be enforced, firms default, and creditors cannot have repayments.

The timing is the following. At the beginning, a firm invests an entry cost (k_e). After the investment, the firm learns its productivity level (φ) and its financial conditions ($\beta \equiv \frac{1}{\lambda}$).[18] Productivity levels and financial conditions may depend on each other. Let $g(\varphi, \beta)$ be a joint distribution of φ and β, where $\varphi \in [0, \infty)$, and $\beta \in [1, \infty)$.

Given (φ, β), a financial contract proceeds as follows. At the beginning of each period, every firm makes a take-it-or-leave-it offer to potential investors.[19] This contract specifies the amount that a firm need to borrow, and its repayments $[F_d(\varphi, \beta)]$ when the contract is enforced. Revenues are then realized and investors receive the repayments at the end of the period. When the firm defaults, investors receive nothing.[20]

The problem of a profit-maximizing firm with (φ, β) can be written as

$$\max_{p, F_d} \Pi(\varphi, \beta) = p(\varphi, \beta) q(\varphi, \beta) - q(\varphi, \beta)/\varphi - \frac{F_d(\varphi, \beta)}{\beta}, \tag{4}$$

$$\begin{aligned} \text{subject to} \quad & 1)\ q(\varphi, \beta) = \frac{p(\varphi)^{-\sigma} R}{P^{1-\sigma}} \\ & 2)\ A(\varphi, \beta) \equiv p(\varphi, \beta) q(\varphi, \beta) - q(\varphi, \beta)/\varphi \geq F_d(\varphi, \beta) \\ & 3)\ B(\varphi, \beta) \equiv -k_d + \frac{F_d(\varphi, \beta)}{\beta} \geq 0 \end{aligned}$$

When there is external financing, two additional constraints bind the firm's decisions in the maximization problem. When a financial contract is enforced, an entrepreneur can offer at most her net revenues to creditors, which is represented by

[18] If a firm's internal funds are insufficient to cover all fixed costs, the firm will need to obtain external financing to cover its fixed costs. β can be adjusted properly in this case. Thus, β represents the firm's financial conditions and the portion of external financing in general. See appendix C.

[19] The assumption of take-it-or-leave-it offers does not change my results. See appendix A for the Nash bargaining solution in chapter 1.

[20] Some papers such as Manova (2006) consider collaterals in analyzing financial contracts. In my model, the fraction of collaterals which goes to investors when firms default can be incorporated into β. See appendix D.

$A(\varphi, \beta)$. In addition, investors only extend finance to the firm if they expect a non-negative net return. $B(\varphi, \beta)$ represents the net return to creditors. Thus, constraint (3) is the investors' participation constraint with their outside options normalized to be zero.[21]

Financial markets are assumed to be competitive.[22] In competitive credit markets, all investors earn zero expected profits. A firm, therefore, adjusts its repayments so that the investors' participation constraint is satisfied. Thus, $B(\varphi, \beta) = 0$ in equilibrium, and the maximization problem reduces to the firm's problem in the absence of financial frictions, except for the credit constraint that repayments are no greater than the firm's net revenues. Hence, each firm optimally chooses the same quantity and the same price, raises the same revenues, and earns the same profits before repayments as in Melitz (2003). The amount of repayments does not depend on firms' productivity levels in equilibrium because $F_d(\varphi, \beta) = \beta k_d$.

The optimal pricing rule and individual profits can be derived as

$$\begin{aligned} &p(\varphi, \beta) = \frac{1}{\rho\varphi}, \text{ where } \frac{1}{\rho} \equiv \frac{\sigma}{\sigma - 1} \text{ is the mark-up.} \\ &\pi(\varphi, \beta) = r(\varphi) - q/\varphi - F_d(\beta) = \frac{1}{\sigma} r(\varphi) - \beta k_d, \text{ where } r(\varphi) = R[P\rho\varphi]^{\sigma-1}. \end{aligned} \tag{5}$$

Firm-level heterogeneities come from various sources such as differences in productivity, input quality, financial constraints, or searching costs. These heterogeneities can be classified into two categories. One includes factors affecting firms' variable costs, and the other includes factors affecting firms' fixed costs.

Factors that affect firms' variable costs include productivity and input quality. Both result in affecting prices of goods. If a firm has a high productivity level, for instance, it can sell its good at a low price. The quality of labor may also change variable costs. For example, assume that each firm find inputs with the quality t,

[21] This can be generalized. See chapter 1.

[22] The assumption of competitive financial markets is not critical. If financial markets are not competitive, there can be the extra amount of the return to capital. In other words, outside options for creditors will not be zero in uncompetitive markets. However, the results do not change qualitatively. See chapter 1.

where t differs across firms and follows a certain distribution. A well-known firm can attract workers with higher quality than little-known firms because many workers are eager to work in the well-known firm. Thus, the firm can select workers from a larger pool of job applicants than little-known firms, and have high qualified workers.

If a firm has to pay w for one unit of labor with the quality t, the optimal price of the good produced by the firm with a productivity level φ is $\frac{1}{\rho\varphi t}$.[23] If φ and t have a joint distribution $b(\varphi, t)$, there exists a new distribution of $\psi \equiv \varphi t$. The price of the good is $p(\varphi, t) \equiv p(\psi) = \frac{1}{\rho\psi}$. Therefore, productivity and input quality are incorporated into one variable (ψ), which represents the heterogeneity in variable costs.

Factors that affect firms' fixed costs include financial constraints and searching costs. Heterogeneity in firms' financial constraints results in different amount of repayments to investors, which can be interpreted as differences in fixed costs without financial frictions. Searching costs may also be included in fixed costs. All firms have to pay more or less for collecting information when they enter a new market. For example, they need to pay for collecting data on the market demand. Some entrepreneurs may have much experience in the market. Thus, they do not have to pay much for collecting the market information, but those with little experience may have to pay much for it. Firms also have to pay some fixed amount of money for searching qualified workers, which is differently distributed across firms. If there are searching costs before production, constraint (2) in equation (4) should be changed to $A(\varphi, \beta, S) \equiv p(\varphi, \beta)q(\varphi, \beta) - q(\varphi, \beta)/\varphi \geq F_d(\varphi, \beta) + S$, where S represents searching costs that differ across firms. If β and S have a joint distribution of $d(\beta, S)$, there exists a distribution $e(\epsilon)$, where $\epsilon \equiv F_d(\varphi, \beta) + S = \beta k_d + S$. Therefore, financial constraints and searching costs are incorporated into one variable (ϵ) that captures the heterogeneity in fixed costs.

To summarize, my model incorporates firm-level heterogeneities into two dimen-

[23] Recall that wage is normalized to one.

sions. Specifically, I allow for heterogeneities in both variable costs and fixed costs. In the following, I will refer to all the heterogeneities in variable costs as that of productivity, and all the heterogeneities in fixed costs as that of financial constraints.

Now, I examine firms' decisions on entry and export. To enter, firms must make an initial investment as a fixed entry cost ($k_e > 0$), which is thereafter sunk. After the investment, they draw their own productivity levels and financial conditions. If their productivity levels are low and their financial conditions are bad, they immediately exit the market. If their productivity levels are high and their financial conditions are good enough, they can make borrowing contracts with financial institutes specifying repayments $[F_d(\beta)]$ in order to finance fixed costs for production. Even if they make financial contracts successfully and stay in the market, they face a constant probability δ in each period of a bad event that would force them to exit the market. The δ is independent of productivity levels. Therefore, an entering firm with a specific productivity level and financial conditions (φ, β) will immediately exit if its expected profits are negative, or will produce and earn profits in every period until it is hit with a bad event and is forced to exit. For simplicity, I assume that there is no time discounting.

Equilibrium cutoff productivity levels and financial conditions can be obtained by the zero cutoff profit (ZCP) condition and the free entry (FE) condition. The ZCP condition implies that all firms in the market should have non-negative profits. The marginal firm that has a zero profit can be represented by

$$\begin{aligned} &\pi(\varphi, \beta) = 0 \Longleftrightarrow r(\varphi) = \beta k_d \Longleftrightarrow R[P\rho\varphi]^{\sigma-1} = \beta\sigma k_d \qquad (6) \\ &\pi(\varphi', \beta = 1) = 0 \Longleftrightarrow r(\varphi') = k_d \Longleftrightarrow R[P\rho\varphi']^{\sigma-1} = \sigma k_d, \end{aligned}$$

where φ' represents the critical productivity level of incumbent firms when they have no financial constraints.

If a firm with $(\varphi^{(1)}, \beta^{(1)})$ has a zero profit, there is another firm with $(\varphi^{(2)}, \beta^{(2)})$ that earns a zero profit if $\beta^{(1)} = R[P\rho\varphi^{(1)}]^{\sigma-1}/\sigma k_d$ and $\beta^{(2)} = R[P\rho\varphi^{(2)}]^{\sigma-1}/\sigma k_d$.

Therefore, the ZCP condition can be represented by a curve that satisfies $\beta(\varphi, \varphi') = [\frac{\varphi}{\varphi'}]^{\sigma-1}$.

The FE condition implies that for potential entrants to make investments in order to enter the market, the expected profit should be equal to zero. If the expected profit for potential entrants is negative, no firm will enter the market, and if the expected profit is positive, all potential entrants will enter the market. Hence, equilibrium solutions cannot be found in both cases.

Each firm's expected value function can be written as follows

$$v(\varphi, \beta) = \max\{0, \sum_{t=0}^{\infty}(1-\delta)^t \pi(\varphi, \beta)\} = \max\{0, \tfrac{1}{\delta}\pi(\varphi, \beta)\}. \tag{7}$$

If the exit process does not affect the distribution of productivity and financial constraints, the distribution $g(\varphi, \beta)$ must be determined by the initial draw of productivity levels and financial constraints conditional on successful entry. Hence, $\mu(\varphi, \beta)$ is the conditional distribution of $g(\varphi, \beta)$ on $\varphi \in [0, \infty)$ and $\beta \in [1, \infty)$, where

$$\begin{aligned} \mu(\varphi, \beta) &= \frac{g(\varphi, \beta)}{pr_{in}} \text{ if the firm is in the market,} \\ &= 0 \quad \text{otherwise,} \end{aligned} \tag{8}$$

where pr_{in} is the probability of successful entry. Let $\bar{v} = (1/\delta)\widetilde{\pi}(\varphi, \beta)$ represent the present value of expected profits, where $\widetilde{\pi}(\varphi, \beta)$ is the average profit of incumbent firms in one period. Furthermore, v_e is defined as the net value of entrance. The FE condition can be written as

$$v_e = pr_{in}\bar{v} - k_e = 0 \Longleftrightarrow \widetilde{\pi}(\varphi, \beta) = \frac{\delta k_e}{pr_{in}}. \tag{9}$$

Considering that decisions of potential entrants depend on the conditional distribution of successful entry, average profits can be written as follows

$$\widetilde{\pi}(\varphi, \beta) = \int_{\varphi'}^{\infty} \int_{1}^{\beta^*(\varphi^*, \varphi')} \pi(\varphi^*, \beta)\mu(\varphi^*, \beta) d\beta d\varphi^*, \tag{10}$$

where $\beta^*(\varphi^*, \varphi') = [\frac{\varphi^*}{\varphi'}]^{\sigma-1}$.

An equilibrium can be characterized by a mass (M) of firms and the distribution of productivity and financial conditions $\mu(\varphi, \beta)$ over the subset of $\varphi \in [0, \infty)$ and $\beta \in [1, \infty)$. Hence, the aggregate price level can be written by a mass of firms and the average productivity level weighted by financial constraints:

$$P = [\int_{\varphi'}^{\infty} \int_{1}^{\beta^*(\varphi^*)} p(\varphi^*, \beta)^{1-\sigma} M \mu(\varphi^*, \beta) d\beta d\varphi^*]^{1/(1-\sigma)} = M^{1/(1-\sigma)} p(\widetilde{\varphi}), \quad (11)$$

where $\widetilde{\varphi} = [\int_{\varphi'}^{\infty} \int_{1}^{\beta^*(\varphi^*)} \varphi^{*\sigma-1} \mu(\varphi^*, \beta) d\beta d\varphi^*]^{1/(\sigma-1)}$ is the weighted average of incumbent firms' productivity levels.

The ZCP condition can also be restated in terms of φ' and the average profit because the amount of production depends only on productivity levels.[24] Finally, equilibrium solutions can be derived from the following two equations:

$$\widetilde{\pi}(\varphi, \beta) = \int_{\varphi'}^{\infty} \int_{1}^{\beta^*(\varphi^*, \varphi')} \pi(\varphi^*, \beta) \mu(\varphi^*, \beta) d\beta d\varphi^* \qquad \text{(ZCP)} \qquad (12)$$

$$\widetilde{\pi}(\varphi, \beta) = \frac{\delta k_e}{pr_{in}} \qquad \text{(FE)}$$

Figure 3-3 shows the equilibrium solution for the cut-off productivity level and financial constraints. φ^* is obtained from the fact that the average profit of incumbents under the ZCP conditions should be equal to $\frac{\delta k_e}{pr_{in}}$. Thus, the equilibrium ZCP condition can be drawn at the cut-off productivity level φ^*. Firms that have drawn (φ, β) under the equilibrium ZCP condition can make positive profits and stay in the market until they are hit with bad events while firms that have drawn (φ, β) above the equilibrium ZCP condition will not enter the market.

◦ Proposition 1: The entry decision depends not only on a firm's productivity level, but also on her financial constraints.

Proof: The equilibrium solution that is obtained from equation (12) $\frac{\delta k_e}{k_d}$ =

[24] From (2) and (5), $\frac{r(\varphi^*)}{r(\varphi')} = [\frac{\varphi^*}{\varphi'}]^{\sigma-1}$.

$\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}(\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^*$ depends on both φ and β. See appendix E for the proof of the existence and uniqueness of the equilibrium solution.

Firms with low productivity levels and severe financial constraints will immediately exit the market while firms with high productivity levels and little financial constraints can stay in the market. A more productive firm can charge a lower price, sell larger amount of goods, and collect bigger revenues. Therefore, a more productive firm can earn more profits and cover the repayments to investors. A firm with little financial constraints does not have to promise large amount of repayments to investors when it makes contracts with them. Even if investors cannot collect large amount of repayments, they can break even in the financial market and survive after all because of the high contractibility of the firm. Lower repayments result in higher net profits, and help the firm survive in the market.

3. The Model for the Open Economy

In the open economy model, n represents the number of foreign countries. Firms are identical in terms of expected productivity levels and financial conditions. The ex ante distribution of productivity and financial constraints is the same across all countries. Consumers share the same utility function. These symmetrical assumptions ensure the same wage rate across countries, which is still normalized to one. I also assume an ice-berg transportation cost (τ), which is greater than one. Furthermore, I assume fixed costs for export (k_x), which are covered in part by external financing. It can be shown easily that if $\tau^{\sigma-1}k_x > k_d$ and there are no financial constraints, low productive firms exit the markets immediately, intermediate productive firms only sell domestically, and high productive firms sell both in the domestic and export markets.

The selling prices, revenues, and profits of a firm with the productivity level φ and no financial constraints are written as

$p(\omega) = \frac{1}{\rho\varphi}$ if it is sold in the domestic market, and (13)

$= \frac{\tau}{\rho\varphi}$ if it is exported.

$r(\varphi) = r_d(\varphi)$ if a firm does not export, and

$= r_d(\varphi) + nr_x(\varphi) = (1 + n\tau^{1-\sigma})r_d(\varphi)$ if it exports.

$\pi_d(\varphi) = \frac{r_d(\varphi)}{\sigma} - k_d$, and $\pi_x(\varphi) = \frac{r_x(\varphi)}{\sigma} - k_x$,

where subscript d and x represent the domestic sector and the export sector, respectively.

Variable costs of production for exports are covered by internal finance, which implies that firms can compensate their production costs by selling their goods. Fixed costs for exports (k_x), however, cannot be covered all by internal funding. Thus, firms without enough internal funding should obtain loans from financial sectors before producing goods for international markets.

In obtaining outside finance for exports, financial institutions cannot make perfect enforcement in terms of contractibility because of imperfect information. In particular, investors can expect to be repaid with probability $\lambda_x(\omega)$, which is less than one. $\lambda_x(\omega)$ represents financial constraints of a firm that produces goods for foreign markets. With probability $[1 - \lambda_x(\omega)]$, financial contracts are not enforced, the firm defaults, and creditors cannot have repayments.

With the given productivity level (φ), a firm should also draw its financial conditions for export ($\theta \equiv \frac{1}{\lambda_x}$). Thus, firms' heterogeneities depend on the distribution of productivity and two financial conditions, one for domestic sales and the other for exports. They are jointly distributed, which can be written as $h(\varphi, \beta, \theta)$ where $\varphi \in [0, \infty)$, $\beta \in [1, \infty)$, and $\theta \in [1, \infty)$. I assume no timing gap between the decision on domestic sales and that on exports while Melitz does.[25] In other words, potential entrants confront both the domestic and export markets at the same time when they enter the markets. If their productivity levels and financial conditions for domestic

[25] Melitz assumes that the decision on exports is made after the decision on domestic sales. Therefore, there is no uncertainty regarding productivity levels when firms make decisions on exports.

sales are good enough, they will sell their goods in the domestic market. If their productivity levels and financial conditions for exports are good enough, they will export.

I make another assumption that even if investors cannot make perfect enforcement because of imperfect information, they know in which sector, the domestic one or the export one, the investments are made. This implies that financial constraints in the domestic and exporting sectors are separable. However, it does not mean that financial conditions in those sectors of a certain firm are independent. This assumption can be described by the joint distribution $h(\varphi, \beta, \theta)$.

Financial contracts proceed as the same way as the case of the closed economy. At the beginning of each period, every firm makes a take-it-or-leave-it offer to potential investors. Contracts specify the amount of loans which a firm needs to borrow and its repayments, $F_d(\varphi, \beta, \theta)$ and $F_x(\varphi, \beta, \theta)$, when the contracts are enforced.[26] Revenues are then realized, and investors receive repayments at the end of the period. In the case of defaults, investors receive nothing.

The problem of a profit-maximizing firm with (φ, β, θ) can be written as[27]

$$\begin{aligned}
\max_{p_d, p_x, F_d, F_x} \quad & \Pi(\varphi, \beta, \theta) = p_d(\varphi, \beta, \theta) q_d(\varphi, \beta, \theta) - q_d(\varphi, \beta, \theta)/\varphi - \tfrac{F_d(\varphi, \beta, \theta)}{\beta} \qquad (14) \\
& + n\{p_x(\varphi, \beta, \theta) q(\varphi, \beta, \theta) - \tau q_x(\varphi, \beta, \theta)/\varphi - \tfrac{F_x(\varphi, \beta, \theta)}{\theta}\}, \\
\text{subject to} \quad & 1)\ q_d(\varphi, \beta, \theta) = \tfrac{p_d(\varphi)^{-\sigma} R}{P^{1-\sigma}} \\
& 2)\ q_x(\varphi, \beta, \theta) = \tfrac{p_x(\varphi)^{-\sigma} R}{P^{1-\sigma}} \\
& 3)\ A_d(\varphi, \beta, \theta) \equiv p_d(\varphi, \beta, \theta) q(\varphi, \beta, \theta) - q_d(\varphi, \beta, \theta)/\varphi \geq F_d(\varphi, \beta, \theta) \\
& 4)\ A_x(\varphi, \beta, \theta) \equiv p_x(\varphi, \beta, \theta) q(\varphi, \beta, \theta) - \tau q_x(\varphi, \beta, \theta)/\varphi \geq F_x(\varphi, \beta, \theta) \\
& 5)\ B_d(\varphi, \beta, \theta) \equiv -k_d + \tfrac{F_d(\varphi, \beta, \theta)}{\beta} \geq 0 \\
& 6)\ B_x(\varphi, \beta, \theta) \equiv -k_x + \tfrac{F_x(\varphi, \beta, \theta)}{\theta} \geq 0.
\end{aligned}$$

[26] If a firm can use internal financing, but it is not enough to cover all the fixed costs, the firm uses both external financing and internal financing in order to cover its fixed costs. β and θ can be adjusted in this case. Therefore, β and θ represent firm's financial conditions and the fraction of external financing in the domestic and export sectors.

[27] The maximization problem does not change qualitatively in the case of partial external financing. See appendix C.

In competitive financial markets, repayments do not depend on firms' productivity levels: $F_d(\varphi,\beta,\theta) = \beta k_d$ and $F_x(\varphi,\beta,\theta) = \theta k_x$. Once again the ex-ante probability of successful entry in the domestic market is denoted by pr_d. Moreover, pr_x and pr_{dx} now represent the ex-ante successful entry in the export market and in both markets, respectively. The survival ratio of potential entrants, which can be characterized by the probability of entrance in either of the markets, is defined by $pr_{in} = pr_d + pr_x - pr_{dx}$.[28]

$$
\begin{aligned}
pr_d &= \int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}\int_{1}^{\infty} h(\varphi^*,\beta,\theta)d\theta d\beta d\varphi^* \\
pr_x &= \int_{\varphi'_x}^{\infty}\int_{1}^{\theta^*(\varphi^*,\varphi'_x)}\int_{1}^{\infty} h(\varphi^*,\beta,\theta)d\beta d\theta d\varphi^* \\
pr_{dx} &= \int_{\varphi'_x}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}\int_{1}^{\theta^*(\varphi^*,\varphi'_x)} h(\varphi^*,\beta,\theta)d\theta d\beta d\varphi^*.
\end{aligned} \tag{15}
$$

The mass of exporting firms in the country is $M_x = pr_x M_e$. The total mass of varieties available to consumers in the country is $M_t = M + nM_x$, where M is the total number of domestic sellers. The numbers of firms in both markets and the aggregate price level are described as

$$
\begin{aligned}
\frac{M}{pr_d} &= \frac{M_x}{pr_x} \\
P &= [\int_{\varphi'}^{\infty}\int_{1}^{\beta^*} p_d(\varphi^*,\beta,\theta)^{1-\sigma} M_d \mu_d(\varphi^*,\beta)d\beta d\varphi^* + \int_{\varphi'_x}^{\infty}\int_{1}^{\theta^*} p_x(\varphi^*,\beta,\theta)^{1-\sigma} nM_x
\end{aligned} \tag{16}
$$

$\mu_x(\varphi^*,\theta)d\theta d\varphi^*]^{1/(1-\sigma)}$, where $\mu_d(\varphi^*,\beta) = \frac{1}{pr_d}\int_{1}^{\infty} h(\varphi^*,\beta,\theta)d\theta$ if a firm sells in the domestic market and zero otherwise, and $\mu_x(\varphi^*,\theta) = \frac{1}{pr_x}\int_{1}^{\infty} h(\varphi^*,\beta,\theta)d\beta$ if a firm exports and zero otherwise.

φ'_x represents the critical productivity level of exporters when they have no financial constraints in exporting. φ'_x can be defined as a function of φ' because from equation (2) and (13),

$$
\frac{r_x(\varphi'_x)}{r_d(\varphi')} = [\frac{\varphi'_x}{\tau\varphi'}]^{\sigma-1} = \frac{k_x}{k_d} \Longleftrightarrow \varphi'_x = \tau\varphi'[\frac{k_x}{k_d}]^{1/(\sigma-1)}. \tag{17}
$$

[28]In the Melitz model, $pr_x = pr_{dx}$, and $pr_{in} = pr_d$.

The ZCP condition in the export sector is similar to that in the domestic sector. If an exporter with $(\varphi_x^{(1)}, \theta^{(1)})$ earns a zero profit in the export market, there is another exporter with $(\varphi^{(2)}, \theta^{(2)})$ that also earns a zero profit in the market if $\theta^{(1)} = R\tau^{1-\sigma}[P\rho\varphi_x^{(1)}]^{\sigma-1}/\sigma k_x$ and $\theta^{(2)} = R\tau^{1-\sigma}[P\rho\varphi_x^{(2)}]^{\sigma-1}/\sigma k_x$. Therefore, the ZCP conditions for the domestic and export markets can be written as

$\pi_d(\varphi, \beta, \theta) = 0 \Longleftrightarrow r_d(\varphi) = \beta k_d \Longleftrightarrow R[P\rho\varphi]^{\sigma-1} = \beta\sigma k_d$ for the domestic sector

$\pi_x(\varphi, \beta, \theta) = 0 \Longleftrightarrow r_x(\varphi) = \theta k_x \Longleftrightarrow R\tau^{1-\sigma}[P\rho\varphi]^{\sigma-1} = \theta\sigma k_x$ for the export sector. Using

$$\pi_d(\varphi', \beta = 1, \theta) = 0 \Longleftrightarrow r_d(\varphi') = k_d \Longleftrightarrow R[P\rho\varphi']^{\sigma-1} = \sigma k_d$$
$$\pi_x(\varphi_x', \beta, \theta = 1) = 0 \Longleftrightarrow r_x(\varphi_x') = k_x \Longleftrightarrow R\tau^{1-\sigma}[P\rho\varphi_x']^{\sigma-1} = \sigma k_x,$$

$$\beta = [\tfrac{\varphi}{\varphi'}]^{\sigma-1} \text{ and } \theta = [\tfrac{\varphi}{\varphi_x'}]^{\sigma-1}. \tag{18}$$

The FE condition is the same as that in the closed economy with $\widetilde{\pi}(\varphi, \beta, \theta)$ representing the average profit of incumbents that are in either of the markets:

$$\widetilde{\pi}(\varphi, \beta, \theta) = \tfrac{\delta k_e}{pr_{in}}, \text{ where } pr_{in} = pr_d + pr_x - pr_{dx}. \tag{19}$$

Equilibrium cutoff productivity levels and financial constraints can be calculated using the new ZCP and FE conditions.

$$\widetilde{\pi}(\varphi, \beta, \theta) = \tfrac{pr_d}{pr_{in}}\widetilde{\pi_d}(\varphi, \beta, \theta) + n\tfrac{pr_x}{pr_{in}}\widetilde{\pi_x}(\varphi, \beta, \theta) \qquad \text{(ZCP)} \tag{20}$$
$$\widetilde{\pi}(\varphi, \beta, \theta) =$$
$$\tfrac{pr_d}{pr_{in}}\int_{\varphi'}^{\infty}\int_1^{\beta^*}\pi_d(\varphi^*, \beta)\mu_d(\varphi^*, \beta)d\beta d\varphi^* + n\tfrac{pr_x}{pr_{in}}\int_{\varphi_x'}^{\infty}\int_1^{\theta^*}\pi_x(\varphi^*, \theta)\mu_x(\varphi^*, \theta)d\theta d\varphi^*$$
$$\widetilde{\pi}(\varphi, \beta, \theta) = \tfrac{\delta k_e}{pr_{in}}. \qquad \text{(FE)}$$

Figure 3-4 shows the equilibrium cut-off productivity level φ^* obtained from equation (20). The equilibrium cut-off productivity level determines the cut-off productivity level for exports φ_x^* as well as marginal financial constraints for domestic sellers and exporters (β, θ). Firms that draw (φ, β, θ) under the ZCP_d earn positive profits in the domestic market and stay in the market until they are hit by bad events while firms that draw (φ, β, θ) above the ZCP_d cannot enter the domestic market. Furthermore, firms that draw (φ, β, θ) under the ZCP_x earn positive profits in the export market and stay in the market until they are hit by bad events while firms that draw (φ, β, θ) above the ZCP_x cannot export. Due to the assumption on higher fixed costs for exports, the cutoff productivity level for domestic sales without financial constraints is lower than that for exports.

∘ Proposition 2: Even if fixed costs for exports are bigger than those for domestic sales, it does not imply that only high productive firms can export. It is also possible that some exporters do not sell in the domestic market.

Figure 3-5 shows the equilibrium ZCP conditions for exporters and domestic sellers. Firms under the ZCP_d can stay in the domestic market while firms under the ZCP_x can stay in the export market. According to Figure 3-5, some low productive firms which have little financial constraints can stay in the export market, while some high productive firms which have severe financial constraints cannot export.

With a productivity level φ_1, Figure 3-6 shows cutoff values of financial constraints in the domestic and export markets. The values of β_1 and θ_1 are obtained from Figure 3-5. The β_1 and θ_1 are the values of the points on the ZCP conditions for the domestic and export markets at the productivity level φ_1, respectively. β_1 is bigger than θ_1 because of lower fixed costs for domestic sales than those for exports. Recall that high β_1 implies severe financial constraints. Due to lower fixed costs for domestic sales, firms with more severe financial constraints can earn non-negative profits in the domestic market, and stay in the market. Therefore, as in Bernard, Eaton, Jensen, and Kortum (2003), exporters have higher productivity levels on average than domestic sellers.

According to Figure 3-6, firms can stay in the domestic market if β is lower than β_1. If θ is lower than θ_1, firms can also stay in the export market. The new equilibrium ZCP conditions contain the face made by the L-shaped line from the vertical and horizontal lines at β_1 and θ_1. It can be shown using a graph with 3 dimensions. Each axis should represent φ, β, and θ, respectively. Even if the productivity level is high, firms cannot export if their financial constraints for exports are not good enough, which incur high repayments to investors.

If a firm has financial conditions (β, θ) where θ is lower than θ_1 and β is higher than β_1, it will export without domestic sales. This result mainly comes from the possibility that some exporters may have severe financial constraints in production for domestic sales.[29] According to the COMPUSTAT, 22 U.S. firms out of 23,425 produced only for exports, not for domestic sales in 2005.[30] In small size economies, I can find a larger number of those firms. According to the Korea Investors Service Incorporation (KIS), 46 out of 1,576 (2.9%) Korean firms that reported the amounts of domestic sales and exports focused only on exports without domestic sales in 2005. The models that allow for heterogeneity only in productivity cannot explain these phenomena.[31]

o Proposition 3: There is a large overlap zone of productivity levels between exporters and domestic sellers.

According to Figure 3-6, the area below θ_1 shows the number of exporters while the area above θ_1 and below β_1 shows the number of domestic sellers. They all have the same productivity level. This implies that there is a separation between exporters and domestic sellers within firms with the same productivity levels. Thus, my model can explain the pattern in Figure 3-1 and 3-2.

4. Conclusions

[29] If the distribution of (β, θ) is highly correlated, most firms will be around the 45 degree line. The probability of exports without domestic sales will be very low. If φ, β, and θ are perfectly correlated, the result is the same as that of Melitz, which implies that only high productive firms can export and sell domestically.

[30] Precisely, their exports were greater than their net sales. I could not find the data on their gross sales. However, the data will show at least that some firms focus mostly on exports, not on domestic sales.

[31] Melitz (2003) eliminates this case from the beginning. He assumes that firms make decisions on whether they will export or not, after they enter the domestic market.

In this chapter, I have presented a heterogeneous firm model in which firms differ not only in productivity but also in financial constraints. My model is general in the sense that it incorporates many factors affecting firms' variable costs into the heterogeneity in productivity levels, and those affecting firms' fixed costs into the heterogeneity in financial constraints. I show that firms with low productivity levels and severe financial constraints will immediately exit the market while firms with high productivity levels and few financial constraints can stay in the market. I also show that even if the fixed costs for exports are bigger than those for domestic sales, it does not imply that only high productive firms can export. Moreover, I show that firms make different decisions on exports and domestic sales even when they have the same productivity levels. This result mainly comes from the possibility that firms with the same productivity levels may have different degrees of financial constraints.

My model has the strength in explain the stylized fact in international trade that some firms with low productivity levels are exporters while some firms with high productivity levels sell only domestically. It can also explain the extreme case that some exporters do not sell domestically.

Figure 3-1: Ratio of Plant Labor Productivity to Overall Mean

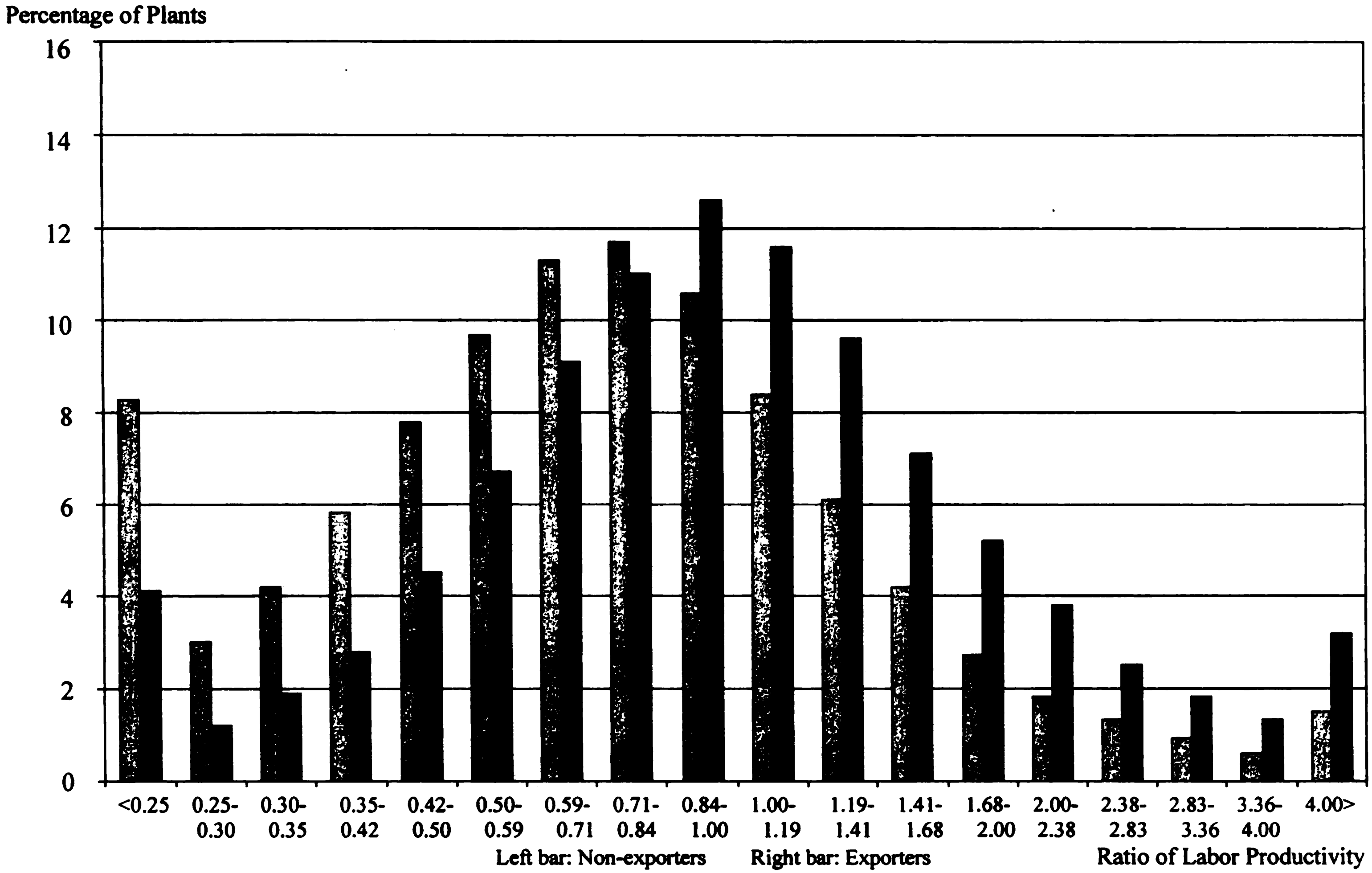


Figure 3-2: Ratio of Plant Labor Productivity to 4-Digit Industry Mean

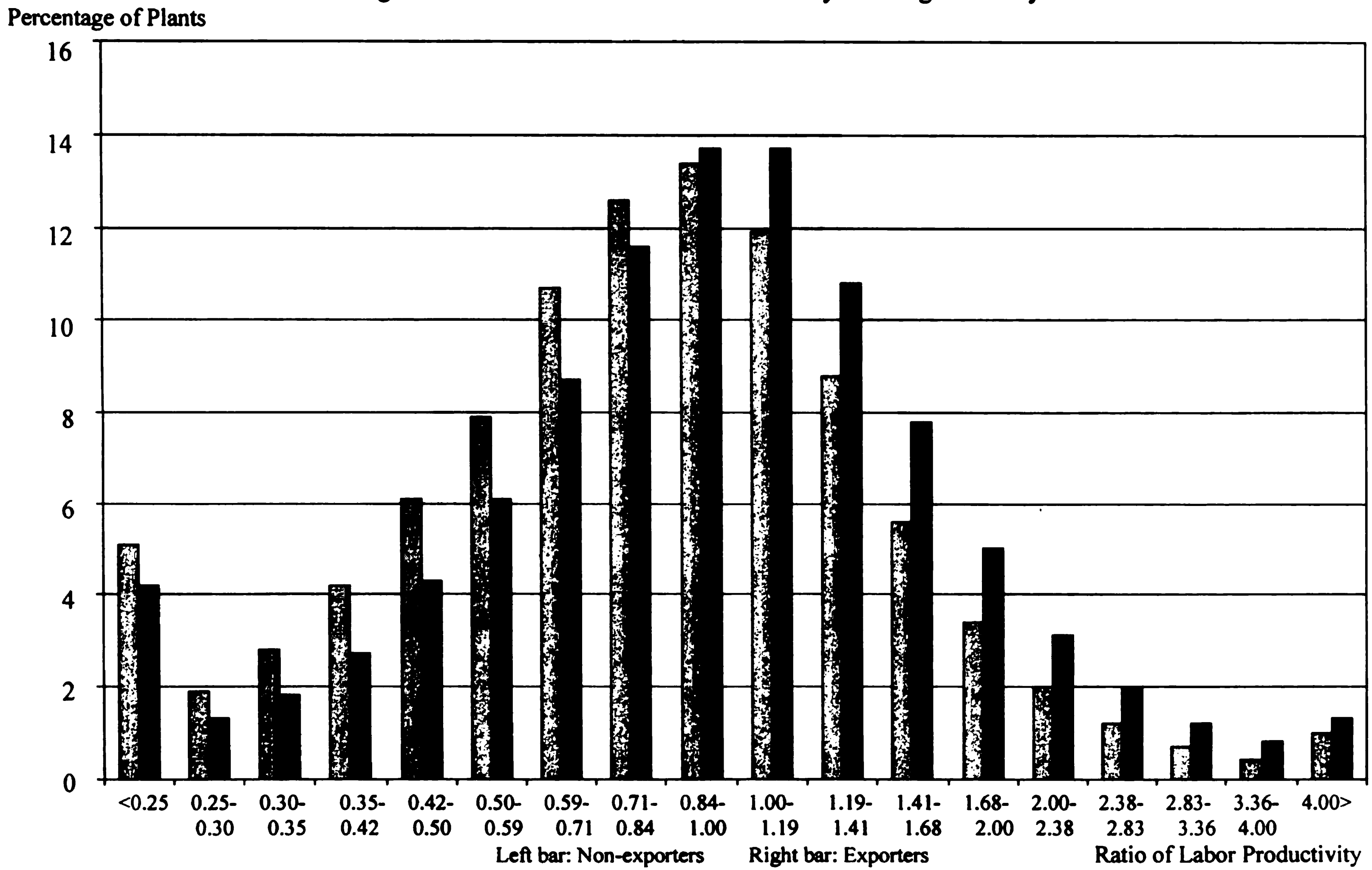


Figure 3-3: The ZCP condition in the Closed Economy

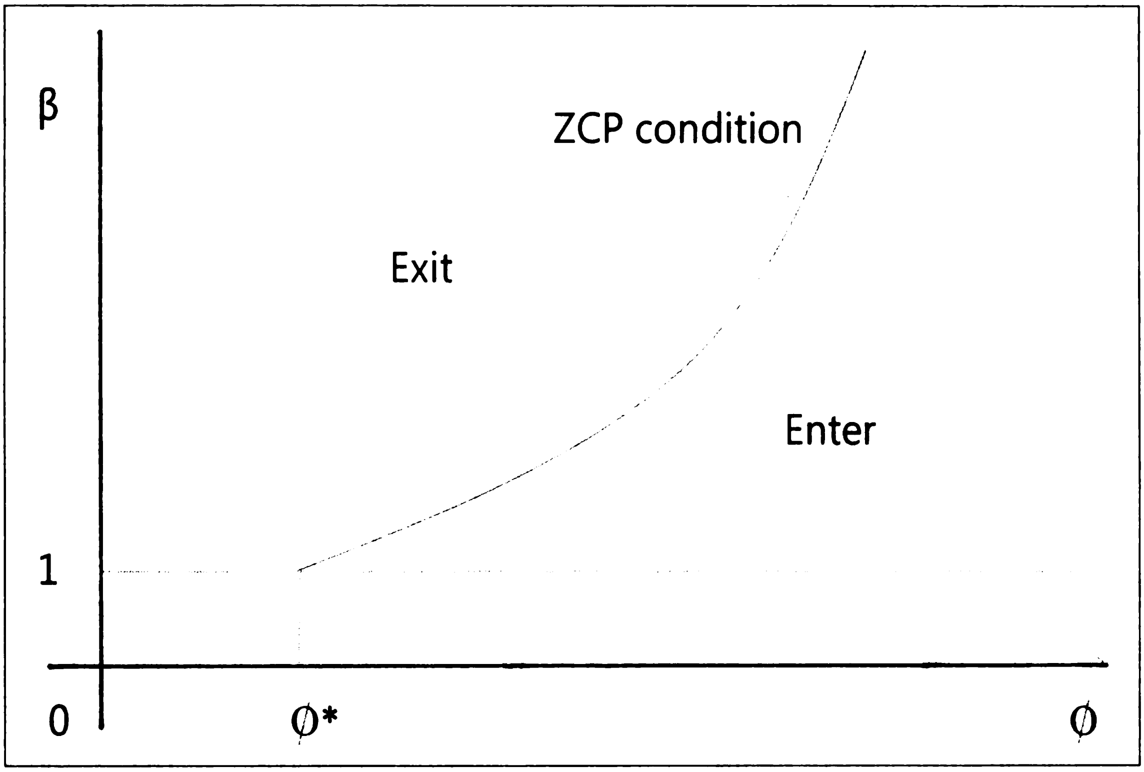


Figure 3-4: The ZCP condition in the Open Economy

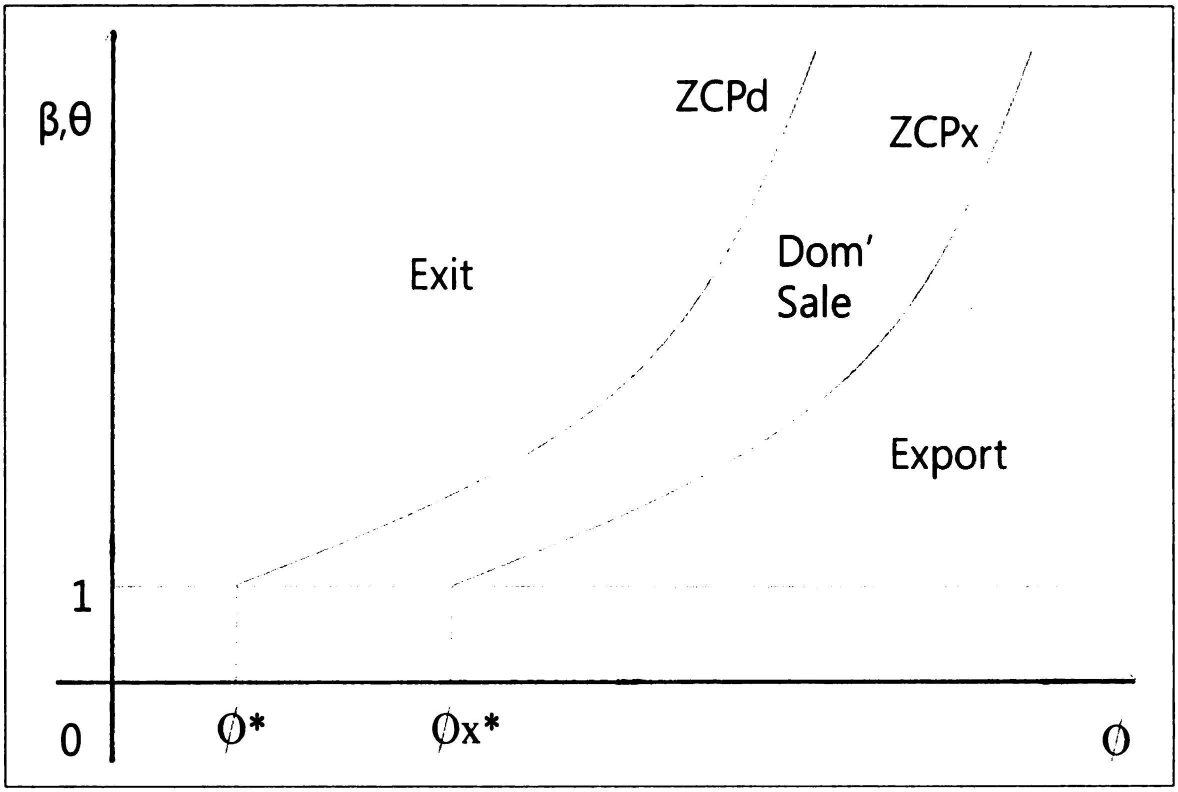


Figure 3-5: The Distribution of Productivity and Financial Constraints

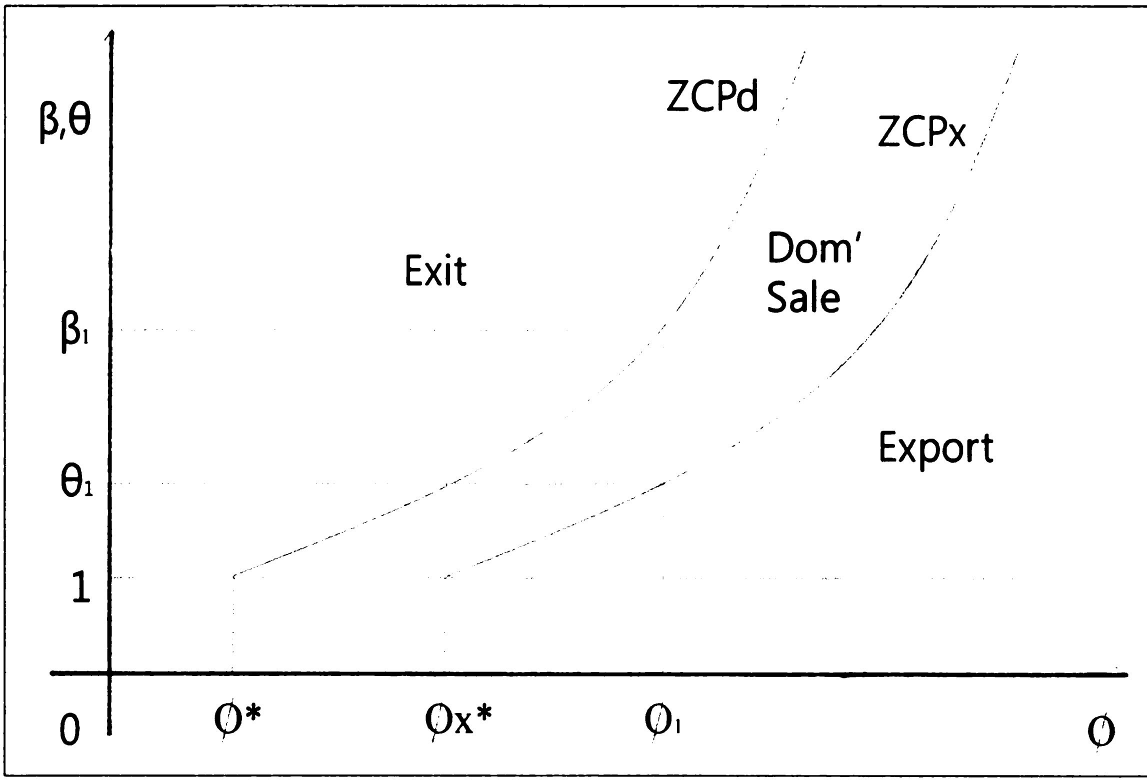
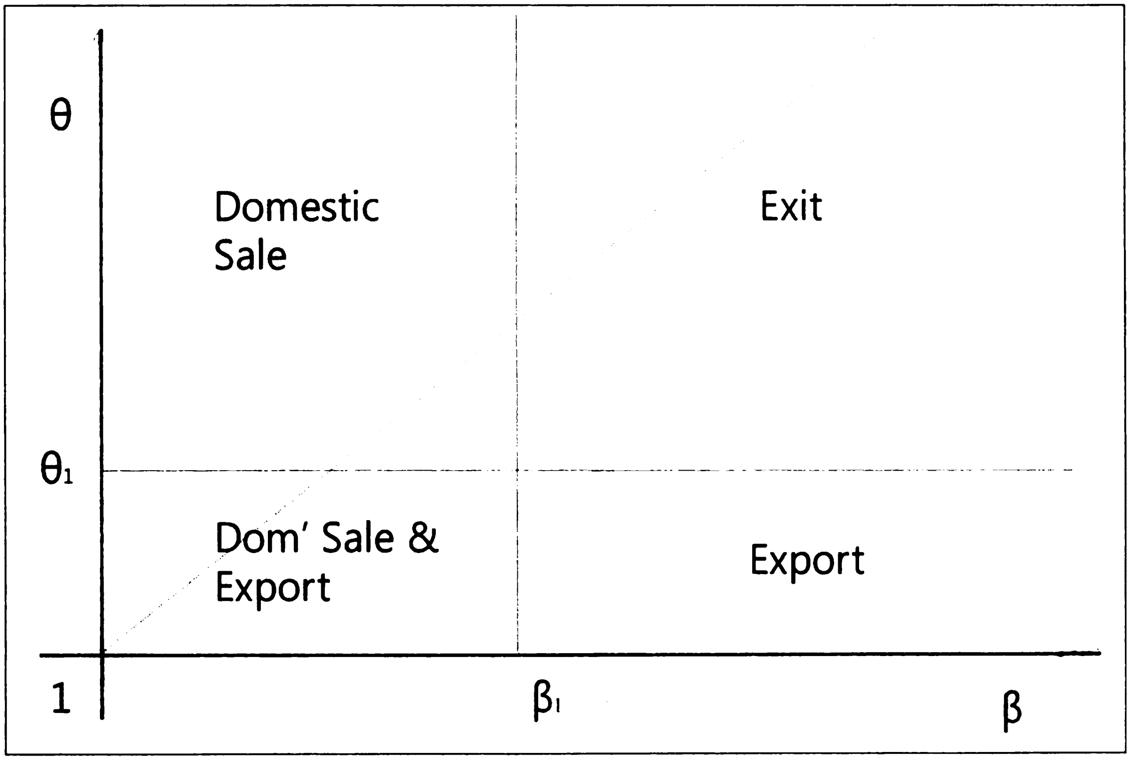


Figure 3-6: The Distribution of Financial Constraints at the Given Productivity



APPENDICES

<Appendix A: Nash Bargaining solution>

In the case of the Nash Bargaining situation, the problem of profit-maximizing firms in domestic sales and export will change as follows. I assume that contracts include a portion of profits, which goes to investors at the end of the period. θ_d and θ_x represent those portions in the domestic sector and the export sector respectively.

$$\max_{p_d, p_x, F_d(\varphi), F_x(\varphi)} \Pi(\varphi) = p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - \lambda_d F_d(\varphi) - (1-\lambda_d)t_d k_d - \theta_d \Pi_d(\varphi)$$
$$+n[p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - \lambda_x F_x(\varphi) - (1-\lambda_x)t_x k_x - \theta_x \Pi_x(\varphi)] \qquad \text{(A.1)}$$

subject to

1) $q_d(\varphi) = \frac{p_d(\varphi)^{-\sigma} R}{P^{1-\sigma}}$

2) $q_x(\varphi) = \frac{p_x(\varphi)^{-\sigma} R}{P^{1-\sigma}}$

3) $A_d(\varphi) \equiv (1-\theta_d)\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - F_d'(\varphi)\} \geq 0$

4) $A_x(\varphi) \equiv (1-\theta_x)\{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - F_x'(\varphi)\} \geq 0$

5) $B_d(\varphi) \equiv -k_d + \lambda_d F_d'(\varphi) + (1-\lambda_d)t_d k_d + \theta_d\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - F_d'(\varphi)\} \geq 0$

6) $B_x(\varphi) \equiv -k_x + \lambda_x F_x'(\varphi) + (1-\lambda_x)t_x k_x + \theta_x\{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - F_x'(\varphi)\} \geq 0.$

Due to competitive financial markets, constraints (5) and (6) are binding. Thus, I can obtain

$$F_d'(\varphi) = \frac{k_d\{1-(1-\lambda_d)t_d\}}{\lambda_d - \theta_d} - \frac{\theta_d\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi\}}{\lambda_d - \theta_d}, \qquad \text{(A.2)}$$
$$F_x'(\varphi) = \frac{k_x\{1-(1-\lambda_x)t_x\}}{\lambda_x - \theta_x} - \frac{\theta_x\{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi\}}{\lambda_x - \theta_x}.$$

Solutions for optimal prices in (A.1), p_d and p_x, are the same as those in the maximization problem (12). Constraints (3) and (4) also are binding if the firm has the cut-off productivity level. Then,

$$A_d(\varphi) \equiv (1-\theta_d)\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - F_d'(\varphi)\} \qquad \text{(A.3)}$$
$$\equiv (1-\theta_d)\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi - \frac{k_d\{1-(1-\lambda_d)t_d\}}{\lambda_d - \theta_d} + \frac{\theta_d\{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi\}}{\lambda_d - \theta_d}\} = 0.$$
$$F_d'(\varphi) = \{p_d(\varphi)q_d(\varphi) - q_d(\varphi)/\varphi\}$$

$$= \{\frac{\lambda_d-\theta_d}{\lambda_d}\}\frac{k_d\{1-(1-\lambda_d)t_d\}}{\lambda_d-\theta_d} = \frac{k_d\{1-(1-\lambda_d)t_d\}}{\lambda_d} = F_d(\varphi).$$

$$A_x(\varphi) \equiv (1-\theta_x)\{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - F_x'(\varphi)\}$$

$$\equiv (1-\theta_x)\{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi - \frac{k_x\{1-(1-\lambda_x)t_x\}}{\lambda_x-\theta_x} + \frac{\theta_x\{p_x(\varphi)q_x(\varphi)-\tau q_x(\varphi)/\varphi\}}{\lambda_x-\theta_x}\} = 0.$$

$$F_x'(\varphi) = \{p_x(\varphi)q_x(\varphi) - \tau q_x(\varphi)/\varphi\}$$

$$= \{\frac{\lambda_x-\theta_x}{\lambda_x}\}\frac{k_x\{1-(1-\lambda_x)t_x\}}{\lambda_x-\theta_x} = \frac{k_x\{1-(1-\lambda_x)t_x\}}{\lambda_x} = F_x(\varphi).$$

Constraints (3) and (4) in the Nash Bargaining situation are the same as those in the take-it-or-leave-it offer. This implies that there are no changes in critical productivity levels for domestic sellers and exporters in the Nash Bargaining case. The only difference is the way of repayments. In the Nash Bargaining case, repayments are diversified into two ways, ordinary repayments and specific portions of profits. If investors can have certain portions of profits, there is an incentive for them to decrease ordinary repayments. As a consequence, total repayments to investors will be the same, and cut-off productivity levels do not change due to different methods of repayments.

<Appendix B: Comparative Statics>

Equilibrium cut-off productivity levels can be derived from the ZCP and the FE conditions as in equation (13).

$$\frac{\delta k_e}{[1-G(\varphi')]} = F_d f(\varphi') + F_x p_x n f(\varphi'_x), \tag{B.1}$$

where $F_d(\varphi) = \frac{[1-(1-\lambda_d)t_d]k_d}{\lambda_d}$, $F_x(\varphi) = \frac{[1-(1-\lambda_x)t_x]k_x}{\lambda_x}$, $\varphi'_x = \tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$, $f(\varphi') = [\widetilde{\varphi}/\varphi']^{\sigma-1} - 1$, and $p_x = \frac{[1-G(\varphi'_x)]}{[1-G(\varphi')]}$.

From (B.1),

$$\delta k_e = [1-G(\varphi')]F_d f(\varphi') + [1-G(\varphi'_x)]F_x n f(\varphi'_x).$$

$$\delta k_e \varphi'^{\sigma-1} = [1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1} - [1-G(\varphi')]F_d\varphi'^{\sigma-1} + \tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}$$
$$-\varphi'^{\sigma-1}[1-G(\varphi'_x)]F_x n \tag{B.2}$$

$$\delta k_e {\varphi'_x}^{\sigma-1} = \tau^{\sigma-1}[1-G(\varphi')]F_x[\widetilde{\varphi}]^{\sigma-1} - {\varphi'_x}^{\sigma-1}[1-G(\varphi')]F_d + [1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}$$
$$-{\varphi'_x}^{\sigma-1}[1-G(\varphi'_x)]F_x n \tag{B.3}$$

1) Effects of the relaxation of financial constraints for domestic sellers

a) Effects on the φ'

From (B.2),

$$\delta k_e \varphi'^{\sigma-1} = [1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1} - [1-G(\varphi')]F_d\varphi'^{\sigma-1} + \tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}$$
$$-\varphi'^{\sigma-1}[1-G(\varphi'_x)]F_x n,$$

where $\varphi'_x = \tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$, $F_d(\varphi) = \frac{[1-t_d+\lambda_d t_d]k_d}{\lambda_d}$, and $F_x(\varphi) = \frac{[1-t_x-\lambda_x t_x]k_x}{\lambda_x}$.

$$\frac{d\varphi'}{d\lambda_d} = \frac{d\varphi'}{dF_d}\frac{dF_d}{d\lambda_d}.$$
$$\frac{dF_d}{d\lambda_d} = \frac{\lambda_d t_d k_d - [1-t_d+\lambda_d t_d]k_d}{\lambda_d^2} = \frac{-[1-t_d]k_d}{\lambda_d^2} < 0.$$

Differentiate (B.2) in terms of F_d.

$$(\sigma-1)\delta k_e \varphi'^{\sigma-2}\frac{d\varphi'}{dF_d} = -g(\varphi')F_d[\widetilde{\varphi}]^{\sigma-1}\frac{d\varphi'}{dF_d} + [1-G(\varphi')][\widetilde{\varphi}]^{\sigma-1}$$
$$+(\sigma-1)[1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-2}\frac{d\widetilde{\varphi}}{d\varphi'}\frac{d\varphi'}{dF_d} + g(\varphi')F_d\varphi'^{\sigma-1}\frac{d\varphi'}{dF_d} - [1-G(\varphi')]\varphi'^{\sigma-1}$$
$$-(\sigma-1)[1-G(\varphi')]F_d\varphi'^{\sigma-2}\frac{d\varphi'}{dF_d} - \tau^{1-\sigma}g(\varphi'_x)F_d n[\widetilde{\varphi_x}]^{\sigma-1}\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_d}$$

$+\tau^{1-\sigma}[1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}+(\sigma-1)\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-2}\frac{d\widetilde{\varphi_x}}{d\varphi'_x}\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_d}$
$-(\sigma-1)\varphi'^{\sigma-2}[1-G(\varphi'_x)]F_x n+\varphi'^{\sigma-1}g(\varphi'_x)F_x n\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_d}$.

Apply (B.2) in LHS and using $\varphi'_x=\tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$,
$\frac{\varphi'}{\varphi'_x}\frac{d\varphi'_x}{d\varphi'}=\tau^{-1}\{\frac{F_x}{F_d}\}^{-1/(\sigma-1)}\tau\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}=1$, and $\frac{d\widetilde{\varphi}}{d\varphi'}\frac{\varphi'}{\widetilde{\varphi}}=\frac{\varphi'}{\sigma-1}\frac{g(\varphi')}{1-G(\varphi')}\{1-[\frac{\varphi'}{\widetilde{\varphi}}]^{\sigma-1}\}$.

The proof of $\frac{d\widetilde{\varphi}}{d\varphi'}\frac{\varphi'}{\widetilde{\varphi}}$:
$\widetilde{\varphi}(\varphi')^{(\sigma-1)}=\frac{1}{1-G(\varphi')}\int_{\varphi'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi$
$(\sigma-1)\widetilde{\varphi}^{\sigma-2}\frac{d\widetilde{\varphi}}{d\varphi'}=\frac{g(\varphi')}{[1-G(\varphi')]^2}\int_{\varphi'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi+\frac{1}{1-G(\varphi')}[\int_{\varphi'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi]'$.

Apply Leibniz Intergral Rule.
$[\int_{\varphi'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi]'=\varphi_h^{\sigma-1}g(\varphi_h)\frac{d\varphi_h}{d\varphi'}-\varphi'^{\sigma-1}g(\varphi')\frac{d\varphi'}{d\varphi'}+\int_{\varphi'}^{\infty}\frac{d\{\varphi^{\sigma-1}g(\varphi)\}}{d\varphi'}d\varphi$,
where φ_h is the upper limit of productivity.

$(\sigma-1)\widetilde{\varphi}^{\sigma-2}\frac{d\widetilde{\varphi}}{d\varphi'}=\frac{g(\varphi')}{[1-G(\varphi')]^2}\int_{\varphi'}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi+\frac{1}{1-G(\varphi')}\{-\varphi'^{\sigma-1}g(\varphi')\}$
$(\sigma-1)\widetilde{\varphi}^{\sigma-2}\frac{d\widetilde{\varphi}}{d\varphi'}=\frac{g(\varphi')}{1-G(\varphi')}\{\widetilde{\varphi}^{\sigma-1}-\varphi'^{\sigma-1}\}$

$\frac{d\widetilde{\varphi}}{d\varphi'}=\frac{1}{\sigma-1}\widetilde{\varphi}\frac{g(\varphi')}{1-G(\varphi')}\{1-[\frac{\varphi'}{\widetilde{\varphi}}]^{\sigma-1}\}$, and $\frac{d\widetilde{\varphi}}{d\varphi'}\frac{\varphi'}{\widetilde{\varphi}}=\frac{\varphi'}{\sigma-1}\frac{g(\varphi')}{1-G(\varphi')}\{1-[\frac{\varphi'}{\widetilde{\varphi}}]^{\sigma-1}\}$.

Then, $[1-G(\varphi')]\{[\widetilde{\varphi}]^{\sigma-1}-\varphi'^{\sigma-1}\}+\tau^{1-\sigma}[1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}=$
$[1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1}\frac{d\varphi'}{dF_d}\{\frac{(\sigma-1)}{\varphi'}\}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}\frac{d\varphi'}{dF_d}\{\frac{(\sigma-1)}{\varphi'}\}$.

$\frac{d\varphi'}{dF_d}=\{\frac{\varphi'}{\sigma-1}\}\frac{[1-G(\varphi')]\{[\widetilde{\varphi}]^{\sigma-1}-\varphi'^{\sigma-1}\}+\tau^{1-\sigma}[1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}}{[1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}}>0$,
Thus, $\frac{d\varphi'}{d\lambda_d}=\frac{d\varphi'}{dF_d}\frac{dF_d}{d\lambda_d}<0$.

Examples: Pareto distribution with $\alpha>(\sigma-1),\widetilde{\varphi}=[\frac{\alpha}{\alpha-\sigma+1}]^{1/(\sigma-1)}\varphi'$.
Therefore, $\frac{\varphi'}{\widetilde{\varphi}}\frac{d\widetilde{\varphi}}{d\varphi'}=1$, and $[\frac{\varphi'}{\widetilde{\varphi}}]^{\sigma-1}=\frac{\alpha-(\sigma-1)}{\alpha}$.[32]
$\frac{[1-G(\varphi'_x)]}{[1-G(\varphi')]}=(\frac{\varphi'}{\varphi'_x})^{\alpha}=\tau^{-\alpha}\{\frac{F_x}{F_d}\}^{-\alpha/(\sigma-1)},\varphi'_x=\tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$
$\frac{d\varphi'}{dF_d}=\frac{\varphi'}{\sigma-1}\{\frac{\sigma-1}{\alpha-\sigma+1}+(\frac{\varphi'}{\varphi'_x})^{\alpha}n\frac{\alpha}{\alpha-\sigma+1}(\frac{F_x}{F_d})\}/\{\frac{\alpha}{\alpha-\sigma+1}+(\frac{\varphi'}{\varphi'_x})^{\alpha}n\frac{\alpha}{\alpha-\sigma+1}F_x\}>0$.
$\frac{d\varphi'}{d\lambda_d}=\frac{d\varphi'}{dF_d}\frac{dF_d}{d\lambda_d}<0$.

[32]For $\widetilde{\varphi}$ to have the finite value in Pareto distribution, α should be greater than $(\sigma-1)$.

b) Effects on the φ_x'

From (B.3),

$\delta k_e {\varphi_x'}^{\sigma-1} = \tau^{\sigma-1}[1-G(\varphi')]F_x[\widetilde{\varphi}]^{\sigma-1} - {\varphi_x'}^{\sigma-1}[1-G(\varphi')]F_d + [1-G(\varphi_x')]F_x n[\widetilde{\varphi_x}]^{\sigma-1}$
$-{\varphi_x'}^{\sigma-1}[1-G(\varphi_x')]F_x n$

Differentiate (B.3) in terms of F_d.

$(\sigma-1)\delta k_e {\varphi_x'}^{\sigma-2}\frac{d\varphi_x'}{dF_d} = -\tau^{\sigma-1}g(\varphi')F_x[\widetilde{\varphi}]^{\sigma-1}\frac{d\varphi'}{d\varphi_x'}\frac{d\varphi_x'}{dF_d}$
$+(\sigma-1)\tau^{\sigma-1}[1-G(\varphi')]F_x[\widetilde{\varphi}]^{\sigma-2}\frac{d\widetilde{\varphi}}{d\varphi'}\frac{d\varphi'}{d\varphi_x'}\frac{d\varphi_x'}{dF_d} - (\sigma-1){\varphi_x'}^{\sigma-2}[1-G(\varphi')]F_d\frac{d\varphi_x'}{dF_d}$
$+{\varphi_x'}^{\sigma-1}g(\varphi')F_d\frac{d\varphi'}{d\varphi_x'}\frac{d\varphi_x'}{dF_d} - {\varphi_x'}^{\sigma-1}[1-G(\varphi')] - g(\varphi_x')F_x n[\widetilde{\varphi_x}]^{\sigma-1}\frac{d\varphi_x'}{dF_d}$
$+(\sigma-1)[1-G(\varphi_x')]F_x n[\widetilde{\varphi_x}]^{\sigma-2}\frac{d\widetilde{\varphi_x}}{d\varphi_x'}\frac{d\varphi_x'}{dF_d} - (\sigma-1){\varphi_x'}^{\sigma-2}[1-G(\varphi_x')]F_x n\frac{d\varphi_x'}{dF_d}$
$+{\varphi_x'}^{\sigma-1}g(\varphi_x')F_x n\frac{d\varphi_x'}{dF_d}$.

Apply (B.3) in LHS and using ${\varphi_x'}^{\sigma-1}g(\varphi')F_d\frac{d\varphi'}{d\varphi_x'}\frac{d\varphi_x'}{dF_d} = \varphi'^{\sigma-1}\tau^{\sigma-1}g(\varphi')F_x\frac{d\varphi'}{d\varphi_x'}\frac{d\varphi_x'}{dF_d}$,
$\frac{\varphi'}{\varphi_x'}\frac{d\varphi_x'}{d\varphi'} = \tau^{-1}\{\frac{F_x}{F_d}\}^{-1/(\sigma-1)}\tau\{\frac{F_x}{F_d}\}^{1/(\sigma-1)} = 1$, and $\frac{d\widetilde{\varphi}}{d\varphi'}\frac{\varphi'}{\widetilde{\varphi}} = \frac{\varphi'}{\sigma-1}\frac{g(\varphi')}{1-G(\varphi')}\{1-[\frac{\varphi'}{\widetilde{\varphi}}]^{\sigma-1}\}$.

$\frac{d\varphi_x'}{dF_d} = -\{\frac{\varphi_x'}{\sigma-1}\}\frac{{\varphi_x'}^{\sigma-1}[1-G(\varphi')]}{\tau^{\sigma-1}[1-G(\varphi')]F_x[\widetilde{\varphi}]^{\sigma-1}+[1-G(\varphi_x')]F_x n[\widetilde{\varphi_x}]^{\sigma-1}} < 0$,
Thus, $\frac{d\varphi_x'}{d\lambda_d} = \frac{d\varphi_x'}{dF_d}\frac{dF_d}{d\lambda_d} > 0$.

Examples: Pareto distribution with $\alpha > (\sigma-1)$,
$\frac{[1-G(\varphi_x')]}{[1-G(\varphi')]} = (\frac{\varphi'}{\varphi_x'})^{\alpha} = \tau^{-\alpha}\{\frac{F_x}{F_d}\}^{-\alpha/(\sigma-1)}, \varphi_x' = \tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$
$\frac{d\varphi_x'}{dF_d} = -\frac{\varphi_x'}{F_x(\sigma-1)}/\{\tau^{\sigma-1}\frac{\alpha}{\alpha-\sigma+1}[\frac{\varphi'}{\varphi_x'}]^{\sigma-1} + \frac{\alpha}{\alpha-\sigma+1}(\frac{\varphi'}{\varphi_x'})^{\alpha}n\} < 0.$
$\frac{d\varphi_x'}{d\lambda_d} = \frac{d\varphi_x'}{dF_d}\frac{dF_d}{d\lambda_d} > 0.$

$\frac{d\varphi'}{dt_d}$ => Same process with the case of $\frac{d\varphi'}{d\lambda_d}$ except $\frac{dF_d}{dt_d} = \frac{-[1-\lambda_d]k_d}{\lambda_d} < 0$.

2) Effects of the relaxation of financial constraints for exporters

a) Effects on the φ'

From (B.2),

$\delta k_e \varphi'^{\sigma-1} = [1-G(\varphi')]F_d[\widetilde{\varphi}]^{\sigma-1} - [1-G(\varphi')]F_d\varphi'^{\sigma-1} + \tau^{1-\sigma}[1-G(\varphi_x')]F_d n[\widetilde{\varphi_x}]^{\sigma-1}$
$-\varphi'^{\sigma-1}[1-G(\varphi_x')]F_x n$

$\frac{d\varphi'}{d\lambda_x} = \frac{d\varphi'}{dF_x}\frac{dF_x}{d\lambda_x}$.
$\frac{dF_x}{d\lambda_x} = \frac{\lambda_x t_x k_x - [1-t_x+\lambda_x t_x]k_x}{\lambda_x^2} = \frac{-[1-t_x]k_x}{\lambda_x^2} < 0.$

Differentiate (B.2) in terms of F_x.

$(\sigma-1)\delta k_e \varphi'^{\sigma-2}\frac{d\varphi'}{dF_x} = -g(\varphi')F_d[\tilde{\varphi}]^{\sigma-1}\frac{d\varphi'}{dF_x} + (\sigma-1)[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-2}\frac{d\tilde{\varphi}}{d\varphi'}\frac{d\varphi'}{dF_x}$
$+g(\varphi')F_d\varphi'^{\sigma-1}\frac{d\varphi'}{dF_x} - (\sigma-1)[1-G(\varphi')]F_d\varphi'^{\sigma-2}\frac{d\varphi'}{dF_x} - \tau^{1-\sigma}g(\varphi'_x)F_d n[\widetilde{\varphi_x}]^{\sigma-1}\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_x}$
$+(\sigma-1)\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-2}\frac{d\widetilde{\varphi_x}}{d\varphi'_x}\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_x} - (\sigma-1)\varphi'^{\sigma-2}[1-G(\varphi'_x)]F_x n\frac{d\varphi'}{dF_x}$
$+\varphi'^{\sigma-1}g(\varphi'_x)F_x n\frac{d\varphi'_x}{d\varphi'}\frac{d\varphi'}{dF_x} - \varphi'^{\sigma-1}[1-G(\varphi'_x)]n.$

Apply (B.2) in LHS and using $\frac{\varphi'}{\varphi'_x}\frac{d\varphi'_x}{d\varphi'} = \tau^{-1}\{\frac{F_x}{F_d}\}^{-1/(\sigma-1)}\tau\{\frac{F_x}{F_d}\}^{1/(\sigma-1)} = 1,$
and $\frac{d\tilde{\varphi}}{d\varphi'}\frac{\varphi'}{\tilde{\varphi}} = \frac{\varphi'}{\sigma-1}\frac{g(\varphi')}{1-G(\varphi')}\{1-[\frac{\varphi'}{\tilde{\varphi}}]^{\sigma-1}\}.$

$\frac{d\varphi'}{dF_x} = -\{\frac{\varphi'}{\sigma-1}\}\frac{\varphi'^{\sigma-1}[1-G(\varphi'_x)]n}{[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}} < 0,$
Thus, $\frac{d\varphi'}{d\lambda_x} = \frac{d\varphi'}{dF_x}\frac{dF_x}{d\lambda_x} > 0.$

Examples: Pareto distribution with $\alpha > (\sigma-1)$,
$\frac{[1-G(\varphi'_x)]}{[1-G(\varphi')]} = (\frac{\varphi'}{\varphi'_x})^{\alpha} = \tau^{-\alpha}\{\frac{F_x}{F_d}\}^{-\alpha/(\sigma-1)}, \varphi'_x = \tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$
$\frac{d\varphi'}{dF_x} = -\{\frac{n\varphi'}{\sigma-1}\}/\frac{\alpha}{(\alpha-\sigma+1)}\{(\frac{\varphi'_x}{\varphi'})^{\alpha}F_d + nF_x\} < 0.$
$\frac{d\varphi'}{d\lambda_x} = \frac{d\varphi'}{dF_x}\frac{dF_x}{d\lambda_x} > 0.$

b) Effects on the φ'_x

From (B.3),

$\delta k_e \varphi_x'^{\sigma-1} = \tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1} - \varphi_x'^{\sigma-1}[1-G(\varphi')]F_d + [1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}$
$-\varphi_x'^{\sigma-1}[1-G(\varphi'_x)]F_x n$

Differentiate (B.3) in terms of F_d.

$(\sigma-1)\delta k_e \varphi_x'^{\sigma-2}\frac{d\varphi'_x}{dF_x} = -\tau^{\sigma-1}g(\varphi')F_x[\tilde{\varphi}]^{\sigma-1}\frac{d\varphi'}{d\varphi'_x}\frac{d\varphi'_x}{dF_x} + \tau^{\sigma-1}[1-G(\varphi')][\tilde{\varphi}]^{\sigma-1}+$
$(\sigma-1)\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-2}\frac{d\tilde{\varphi}}{d\varphi'}\frac{d\varphi'}{d\varphi'_x}\frac{d\varphi'_x}{dF_x} - (\sigma-1)\varphi_x'^{\sigma-2}[1-G(\varphi')]F_d\frac{d\varphi'_x}{dF_x}$
$+\varphi_x'^{\sigma-1}g(\varphi')F_d\frac{d\varphi'}{d\varphi'_x}\frac{d\varphi'_x}{dF_x} - g(\varphi'_x)F_x n[\widetilde{\varphi_x}]^{\sigma-1}\frac{d\varphi'_x}{dF_x} + [1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}$
$+(\sigma-1)[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-2}\frac{d\widetilde{\varphi_x}}{d\varphi'_x}\frac{d\varphi'_x}{dF_x} - (\sigma-1)\varphi_x'^{\sigma-2}[1-G(\varphi'_x)]F_x n\frac{d\varphi'_x}{dF_x}$
$+\varphi_x'^{\sigma-1}g(\varphi'_x)F_x n\frac{d\varphi'_x}{dF_x} - \varphi_x'^{\sigma-1}[1-G(\varphi'_x)]n$

Apply (B.3) in the LHS and using $\frac{\varphi'}{\varphi'_x}\frac{d\varphi'_x}{d\varphi'} = \tau^{-1}\{\frac{F_x}{F_d}\}^{-1/(\sigma-1)}\tau\{\frac{F_x}{F_d}\}^{1/(\sigma-1)} = 1$,
and $\frac{d\tilde{\varphi}}{d\varphi'}\frac{\varphi'}{\tilde{\varphi}} = \frac{\varphi'}{\sigma-1}\frac{g(\varphi')}{1-G(\varphi')}\{1 - [\frac{\varphi'}{\tilde{\varphi}}]^{\sigma-1}\}$.

$\frac{d\varphi'_x}{dF_x} = \{\frac{\varphi'_x}{\sigma-1}\}\frac{[1-G(\varphi'_x)]n\{[\widetilde{\varphi_x}]^{\sigma-1}-\varphi_x'^{\sigma-1}\}+\tau^{\sigma-1}[1-G(\varphi')][\tilde{\varphi}]^{\sigma-1}}{[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}+\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1}} > 0$,
Thus, $\frac{d\varphi'_x}{d\lambda_x} = \frac{d\varphi'_x}{dF_x}\frac{dF_x}{d\lambda_x} < 0$.

Examples: Pareto distribution with $\alpha > (\sigma - 1)$,
$\frac{[1-G(\varphi'_x)]}{[1-G(\varphi')]} = (\frac{\varphi'}{\varphi'_x})^\alpha = \tau^{-\alpha}\{\frac{F_x}{F_d}\}^{-\alpha/(\sigma-1)}, \varphi'_x = \tau\varphi'\{\frac{F_x}{F_d}\}^{1/(\sigma-1)}$.
$\frac{d\varphi'_x}{dF_x} = \frac{\varphi'_x}{\sigma-1}\frac{\alpha-\sigma+1}{\alpha}\{(\frac{\varphi'}{\varphi'_x})^\alpha\{\frac{\sigma-1}{\alpha-\sigma+1}\}n + \frac{\alpha}{\alpha-\sigma+1}\frac{F_d}{F_x}\}/\{F_d + (\frac{\varphi'}{\varphi'_x})^\alpha F_x n\} > 0$.
$\frac{d\varphi'_x}{d\lambda_x} = \frac{d\varphi'_x}{dF_x}\frac{dF_x}{d\lambda_x} < 0$.

$\frac{d\varphi'_x}{dt_x}$ => Same process with the case of $\frac{d\varphi'_x}{d\lambda_x}$ except $\frac{dF_x}{dt_x} = \frac{-[1-\lambda_x]k_x}{\lambda_x} < 0$.

3) Proof of Proposition (4)

$F_d(\varphi) = [1 - (1 - \lambda_d)t_d + r]k_d/\lambda_d$, and $F_x(\varphi) = [1 - (1 - \lambda_x)t_x + r]k_x/\lambda_x$.
Then, $\frac{dF_d}{dr} = k_d/\lambda_d > 0$, and $\frac{dF_x}{dr} = k_x/\lambda_x > 0$.
Also $\frac{F_x}{F_d} = \frac{[1-(1-\lambda_x)t_x+r]k_x\lambda_d}{[1-(1-\lambda_d)t_d+r]k_d\lambda_x}$.

a) $\frac{d\varphi'}{dr} = \frac{d\varphi'}{dF_d}\frac{dF_d}{dr_d} + \frac{d\varphi'}{dF_x}\frac{dF_x}{dr_x}$
$= \{\frac{\varphi'}{\sigma-1}\}\frac{[1-G(\varphi')]\{[\tilde{\varphi}]^{\sigma-1}-\varphi'^{\sigma-1}\}+\tau^{1-\sigma}[1-G(\varphi'_x)]n[\widetilde{\varphi_x}]^{\sigma-1}}{[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}}\frac{k_d}{\lambda_d}$
$-\{\frac{\varphi'}{\sigma-1}\}\frac{\varphi'^{\sigma-1}[1-G(\varphi'_x)]n}{[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}}\frac{k_x}{\lambda_x}$
$= \{\frac{\varphi'}{\sigma-1}\}\frac{\lambda_x k_d\{[1-G(\varphi')]\{[\tilde{\varphi}]^{\sigma-1}-\varphi'^{\sigma-1}\}+[1-G(\varphi'_x)]n\varphi'^{\sigma-1}k_x\lambda_d\{[\frac{\widetilde{\varphi_x}}{\varphi'_x}]^{\sigma-1}\frac{[1-(1-\lambda_x)t_x+r]}{[1-(1-\lambda_d)t_d+r]}-1\}}{\lambda_d\lambda_x\{[1-G(\varphi')]F_d[\tilde{\varphi}]^{\sigma-1}+\tau^{1-\sigma}[1-G(\varphi'_x)]F_d n[\widetilde{\varphi_x}]^{\sigma-1}\}}$,
which is positive when λ_x and t_x are not much different from λ_d and t_d.

b) $\frac{d\varphi'_x}{dr} = \frac{d\varphi'_x}{dF_d}\frac{dF_d}{dr_d} + \frac{d\varphi'_x}{dF_x}\frac{dF_x}{dr_x}$
$= \{\frac{\varphi'_x}{\sigma-1}\}\frac{-\varphi_x'^{\sigma-1}[1-G(\varphi')]}{\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1}+[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}}\frac{k_d}{\lambda_d}$
$+\{\frac{\varphi'_x}{\sigma-1}\}\frac{[1-G(\varphi'_x)]n\{[\widetilde{\varphi_x}]^{\sigma-1}-\varphi_x'^{\sigma-1}\}+\tau^{\sigma-1}[1-G(\varphi')][\tilde{\varphi}]^{\sigma-1}}{[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}+\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1}}\frac{k_x}{\lambda_x}$
$= \{\frac{\varphi'_x}{\sigma-1}\}\frac{k_x\lambda_d[1-G(\varphi'_x)]n\{[\widetilde{\varphi_x}]^{\sigma-1}-\varphi_x'^{\sigma-1}\}+\varphi_x'^{\sigma-1}[1-G(\varphi')]k_d\lambda_x\{[\frac{\tilde{\varphi}}{\varphi'}]^{\sigma-1}\frac{[1-(1-\lambda_d)t_d+r]}{[1-(1-\lambda_x)t_x+r]}-1\}}{\lambda_d\lambda_x\{\tau^{\sigma-1}[1-G(\varphi')]F_x[\tilde{\varphi}]^{\sigma-1}+[1-G(\varphi'_x)]F_x n[\widetilde{\varphi_x}]^{\sigma-1}\}}$,
which is positive when λ_x and t_x are not much different from λ_d and t_d.

c) Let $ratio = \frac{\varphi_x^{'}}{\varphi^{'}} = \tau^{\sigma-1}\{\frac{F_x}{F_d}\}$.

$\frac{d}{dr}ratio = \tau^{\sigma-1}\frac{F_x' F_d - F_x F_d'}{F_d^2}$.

$F_x' F_d - F_x F_d' = \frac{k_x}{\lambda_x} F_d - \frac{k_d}{\lambda_d} F_x = F_d \frac{k_x}{\lambda_x}\{1 - \frac{[1-(1-\lambda_x)t_x+r]}{[1-(1-\lambda_d)t_d+r]}\} = F_d \frac{k_x}{\lambda_x}\frac{(1-\lambda_x)t_x-(1-\lambda_d)t_d}{[1-(1-\lambda_d)t_d+r]}$.

When λ_x is smaller than λ_d, which means that exporters have higher probability of default, $\frac{d}{dr}ratio > 0$, which implies that the decrease of overall interest rates will decrease the cut-off productivity level of exporters more.

When t_x is bigger than t_d, which means that exporters can offer more collaterals, $\frac{d}{dr}ratio > 0$, which implies that the decrease of overall interest rates will decrease the cut-off productivity level of exporters more.

<Appendix C: Partial External Financing>

I assume that a firm finances a fraction α of its fixed costs by internal financing and $(1-\alpha)$ by external financing, where $0<\alpha<1$. The firm's profit maximization problem is changed as

$$\max_{p,F_d(\varphi)} \Pi(\varphi,\beta) = p(\varphi,\beta)q(\varphi,\beta) - q(\varphi,\beta)/\varphi - \alpha k_d - \frac{F_d(\varphi,\beta)}{\beta},$$

subject to 1) $q(\varphi,\beta) = \frac{p(\varphi,\beta)^{-\sigma}R}{P^{1-\sigma}}$

2) $A(\varphi,\beta) \equiv p(\varphi,\beta)q(\varphi,\beta) - q(\varphi,\beta)/\varphi - \alpha k_d \geq F_d(\varphi,\beta)$

3) $B(\varphi,\beta) \equiv -(1-\alpha)k_d + \frac{F_d(\varphi,\beta)}{\beta} \geq 0$, where $0<\alpha<1$.

In competitive financial markets, $F_d(\varphi,\beta) = \beta(1-\alpha)k_d$. The total amount of fixed costs that the firm has to pay is $\alpha k_d + \beta(1-\alpha)k_d \equiv F'_d(\varphi,\beta)$. Define $\beta' \equiv \alpha + \beta(1-\alpha)$; $F'_d(\varphi,\beta) = \beta' k_d$. The firm's problem is the same as that of no internal finance with contractibility of β'. Therefore, it is enough to analyze the case that all fixed costs are covered by external finance.

<Appendix D: Collaterals>

If there is a fraction t_d of collateral which goes to investors when a firm defaults, the maximization problem should be changed as

$$\max_{p, F_d(\varphi)} \Pi(\varphi, \beta) = p(\varphi, \beta)q(\varphi, \beta) - q(\varphi, \beta)/\varphi - \tfrac{1}{\beta}F_d(\varphi) - (1 - \tfrac{1}{\beta})t_d k_d,$$

$$\text{subject to} \quad 1)\ q(\varphi, \beta) = \tfrac{p(\varphi, \beta)^{-\sigma} R}{P^{1-\sigma}}$$

$$2)\ A(\varphi, \beta) \equiv p(\varphi, \beta)q(\varphi, \beta) - q(\varphi, \beta)/\varphi \geq F_d(\varphi, \beta)$$

$$3)\ B(\varphi, \beta) \equiv -k_d + \tfrac{1}{\beta}F_d(\varphi) + (1 - \tfrac{1}{\beta})t_d k_d \geq 0.$$

In competitive financial markets, $F_d(\varphi, \beta) = \beta[1 - (1 - \frac{1}{\beta})t_d]k_d = [\beta - (\beta - 1)t_d]k_d$. The firm's problem is the same as that of no collaterals with contractibility of $\beta' \equiv [\beta - (\beta - 1)t_d]$. Hence, it is enough to analyze only the case of contractibility without collaterals.

<Appendix E: Existence and Uniqueness of the Equilibrium Solution>

I prove them in the case of the closed economy.

∘ Variations of the ZCP conditions

$\beta^*(\varphi^*,\varphi') = \frac{1}{\sigma k_d}R[P\rho\varphi^*]^{\sigma-1}$

$= \frac{1}{\sigma k_d}R[\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} p(\varphi^*,\beta)^{1-\sigma}M\mu(\varphi^*,\beta)d\beta d\varphi^*]^{-1}\rho^{\sigma-1}[\varphi^*]^{\sigma-1}$

$= \frac{R}{\sigma k_d M}[\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} \varphi^{*\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^*]^{-1}[\varphi^*]^{\sigma-1}$

because $P = [\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} p(\varphi^*,\beta)^{1-\sigma}M\mu(\varphi^*,\beta)d\beta d\varphi^*]^{1/(1-\sigma)}$.

$\beta^*(\varphi^*,\varphi') = \frac{R}{\sigma k_d M}f(\varphi')[\varphi^*]^{\sigma-1}$,

where $f(\varphi') \equiv [\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} \varphi^{*\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^*]^{-1}$.

By dividing both side of equation (6), I obtain $\beta^*(\varphi^*,\varphi') = [\frac{\varphi^*}{\varphi'}]^{\sigma-1}$.

∘ Considering the average profit

$\pi(\varphi^*,\beta) = \frac{1}{\sigma}r(\varphi^*) - \beta k_d = \frac{1}{\sigma}R[P\rho\varphi^*]^{\sigma-1} - \beta k_d$

$= \frac{1}{\sigma}R[\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} p(\varphi^*,\beta)^{1-\sigma}M\mu(\varphi^*,\beta)d\beta d\varphi^*]^{-1}[\rho\varphi^*]^{\sigma-1} - \beta k_d$

$= \frac{R}{\sigma M}f(\varphi')[\varphi^*]^{\sigma-1} - \beta k_d$, where $f(\varphi') \equiv [\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} \varphi^{*\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^*]^{-1}$.

$\widetilde{\pi}(\varphi,\beta) = \int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}\{\frac{R}{\sigma M}f(\varphi')[\varphi^*]^{\sigma-1} - \beta k_d\}\mu(\varphi^*,\beta)d\beta d\varphi^* =$

$\frac{R}{\sigma M}\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} f(\varphi')[\varphi^*]^{\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^* - k_d\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}\beta\mu(\varphi^*,\beta)d\beta d\varphi^*$.

From the ZCP and the FE conditions,

ZCP : $\widetilde{\pi}(\varphi,\beta) = \int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} \pi(\varphi^*,\beta)\mu(\varphi^*,\beta)d\beta d\varphi^* =$

$\frac{R}{\sigma M}\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} f(\varphi')[\varphi^*]^{\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^* - k_d\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')}\beta\mu(\varphi^*,\beta)d\beta d\varphi^*$.

FE : $\widetilde{\pi}(\varphi,\beta) = \frac{\delta k_e}{pr_{in}}$.

The equilibrium solutions can be obtained from

$$\frac{\delta k_e}{pr_{in}} = \frac{R}{\sigma M}\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} f(\varphi')[\varphi^*]^{\sigma-1}\mu(\varphi^*,\beta)d\beta d\varphi^*$$
$$-k_d\int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} \beta\mu(\varphi^*,\beta)d\beta d\varphi^*.$$

Using $\beta^*(\varphi^*) = \frac{R}{\sigma k_d M} f(\varphi')[\varphi^*]^{\sigma-1}$, $\frac{\delta k_e}{k_d} = \int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^*.$

Define $I(\varphi') = \int_{\varphi'}^{\infty}\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^*.$

Apply Leibniz Integral Rule.

$$\frac{dI(\varphi')}{d\varphi'} = \int_{1}^{\beta^*(\varphi^*,\varphi^U)} (\beta^*-\beta)g(\varphi^*,\beta)d\beta\frac{d\varphi^U}{d\varphi'} - \int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta$$
$$+\int_{\varphi'}^{\infty}\frac{d}{d\varphi'}\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^*$$

$$\frac{d}{d\varphi'}\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta =$$
$$(\beta^*-\beta^*)g(\varphi^*,\beta^*)\frac{d\beta^*}{d\varphi'} - (\beta^*-1)g(\varphi^*,1)\frac{d1}{d\varphi'} + \int_{1}^{\beta^*(\varphi^*,\varphi')} \frac{d}{d\varphi'}(\beta^*-\beta)g(\varphi^*,\beta)d\beta$$
$$= \int_{1}^{\beta^*(\varphi^*,\varphi')} (1-\sigma)\varphi^{*\sigma-1}\varphi'^{-\sigma}g(\varphi^*,\beta)d\beta = (1-\sigma)\varphi^{*\sigma-1}\varphi'^{-\sigma}\int_{1}^{\beta^*(\varphi^*,\varphi')} g(\varphi^*,\beta)d\beta.$$

$$\frac{dI(\varphi')}{d\varphi'} =$$
$$= -\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta + \int_{\varphi'}^{\infty}(1-\sigma)\varphi^{*\sigma-1}\varphi'^{-\sigma}\int_{1}^{\beta^*(\varphi^*,\varphi')} g(\varphi^*,\beta)d\beta d\varphi^*$$
$$= -\int_{1}^{\beta^*(\varphi^*,\varphi')} (\beta^*-\beta)g(\varphi^*,\beta)d\beta - \frac{(\sigma-1)}{\varphi'^{\sigma}}\int_{\varphi'}^{\infty}\varphi^{*\sigma-1}\int_{1}^{\beta^*(\varphi^*,\varphi')} g(\varphi^*,\beta)d\beta d\varphi^*$$
$$< 0.$$

Therefore, $I(\varphi')$ is a monotonic decreasing function.

When $\varphi' => \varphi^U => \infty$,

$lim_{\varphi'->\varphi^U}\ I(\varphi') = \int_{\varphi^U}^{\varphi^U}\int_{1}^{\beta^*(\varphi^U,\varphi^U)} (\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^* = 0,$

where φ^U is the highest productivity level. Thus, the lower limit is zero.

When $\varphi' => 0$,

$lim_{\varphi'->0}\ I(\varphi') = \int_{0}^{\varphi^U}\int_{1}^{\beta^*(\varphi^*,0)} (\beta^*-\beta)g(\varphi^*,\beta)d\beta d\varphi^* =$

$$= \int_0^\infty \int_1^{\beta^U} (\beta^U - \beta) g(\varphi^*, \beta) d\beta d\varphi^*$$

$$= \int_0^\infty \int_1^{\beta^U} \beta^U g(\varphi^*, \beta) d\beta d\varphi^* - \int_0^\infty \int_1^{\beta^U} \beta g(\varphi^*, \beta) d\beta d\varphi^* = \beta^U - \widetilde{\beta} = \infty$$

because $\int_0^\infty \int_1^{\beta^U} g(\varphi^*, \beta) d\beta d\varphi^* = 1$. $\widetilde{\beta}$ is the average of financial constraints. Hence, the upper limit is infinity.

Therefore, the sufficient condition for the existence of equilibrium solutions is $\beta^U - \widetilde{\beta} > \frac{\delta k_e}{k_d}$. In the case of extremely high $\frac{\delta k_e}{k_d}$, there may be no solutions. However, it is not plausible because of very high value of β^U when there are firms with severe financial constraints. For instance, $\beta^U = \infty$ for the firm that cannot make contracts with any investor. Moreover, if there is a solution, the solution is unique because of the property of monotonic decreasing functions.

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