Globalization under Financial Imperfection

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Abstract

The paper investigates the effects of international trade in goods and capital movement on the productivity distribution and industry-wide productivity when countries are heterogeneous in the quality of their financial institutions. In autarky, firm heterogeneity in their productivities arises in countries with poor financial institutions, while all firms adopt a high-productivity technology in countries with better financial institutions. Trade in goods will not change the productivity distribution (nor the industry-wide productivity as a result) in any country, although it lowers equilibrium interest rates in countries with poor financial institutions while it raises them in countries with better financial institutions. Allowing international capital movement in addition to the trade, however, makes a large impact on the industry. Capital flight from countries with poor financial institutions occurs, leading to either (i) all firms in the world adopt the high-productivity technology under a relatively high interest rate, or (ii) some firms adopt the high-productivity technology while others adopt the low-productivity technology in every country in the world under a low interest rate. The latter occurs more likely if many countries with poor financial institutions carry out the capital account liberalization, reducing the world-wide efficiency of the industry.

Very preliminary and incomplete

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1 Introduction

Recent financial turmoil reminded us of the importance of the high-quality credit market on the economy and of the significance of the financial globalization as well as the globalization in trade in goods. This paper investigates the effects of globalization in trade and capital movement on a financially-dependent industry. Countries are different in their qualities of financial institutions, so the impacts of globalization may well be different across countries.

The quality of financial institution has long been recognized to be critical to the economic prosperity. McKinnon (1973, 1993), for example, emphasizes that less-developed countries and countries in transition from socialism to democracy should develop reliable financial institution in order to achieve economic growth. He argues that countries should first improve their internal financial institutions before opening to trade in goods. He also claims that allowing free international capital mobility should be the last stage of economic liberalization to avoid unwarranted capital flight or an accumulation of foreign debt. There is also a body of research on the effect of financial development on the economic growth. Rajan and Zingales (1998), for example, find empirical evidences that financial development contributes positively to the economic growth.

Recently, Matsuyama (2005), Wynne (2005), Ju and Wei (2008), Antràs and Caballero (2009), and others have explicitly considered financial frictions in their models to examine the impacts of financial frictions (or financial imperfection) on the models' trade policy implications. Matsuyama (2005), Wynne (2005), and Ju and Wei (2008) argue that the cross-country differences in the quality of financial institutions significantly affect the structure of countries' comparative advantage and trade patterns. Antràs and Caballero (2009) theoretically examine the complementarity between international trade in goods and capital movement under financial imperfection. They show among others that trade in goods induces international capital movement, which in turn stimulates international trade in goods. This result is in a stark contrast to a typical result in the traditional literature that trade in goods and international capital movement are substitutes (Mundell, 1957). Manova (2008) also develops a model with credit-constrained heterogeneous firms. In her model, firms are faced with credit constraint in financing trade costs. Efficient firms are less financially constrained, so efficient firms in financially developed countries are more likely to engage in the export. Furusawa and Yanagawa (2009) examine the role of wealth distributions and financial institutions of an economy on within-industry firm heterogeneity in productivity and on international trade in goods and capital movement.

In this paper, we extend the model of Furusawa and Yanagawa (2009) to investigate the effects of international trade in goods and capital movement on the productivity distribution and industry-wide productivity when there are many countries with different qualities of their financial institutions. In autarky, firm heterogeneity in their productivities arises in countries with poor financial institutions, while all firms adopt a high-productivity technology in countries with better financial institutions. Trade in goods will not change the productivity distribution and hence the industry-wide productivity in any country, although it lowers equilibrium interest rates in countries with poor financial institutions while it raises them in countries with better financial institutions. Allowing international capital movement in addition to the trade, however, makes a large impact on the industry. Capital flight from countries with poor financial institutions occurs, leading to either (i) all firms in the world adopt the high-productivity technology under a relatively high interest rate, or (ii) some firms adopt the high-productivity technology while others adopt the low-productivity technology in every country in the world under a low interest rate. The latter occurs more likely if many countries with poor financial institutions carry out the capital account liberalization, reducing the world-wide efficiency of the industry.

2 Model

There are n countries, each of which is populated by a mass m_k ($k = 1, \cdots, n$) of individuals. Every individual in any country owns one unit of labor and a wealth of ω that is uniformly distributed on $[0, \bar{\omega}]$; thus the density of individuals whose wealth is $\omega \in [0, \bar{\omega}]$ equals $m_k/\bar{\omega}$. All individuals share the same utility function over the two goods, a differentiated good X

and numeraire good Y, characterized by

$$u = \log u_x + y, \tag{1}$$

where

$$u_x = \left[\int_{\Omega_k} x(i)^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}} ; \ \sigma > 1 \tag{2}$$

denotes the subutility derived from the consumption of continuum varieties of good X, $\{x(i)\}_{i\in\Omega_k}$ (where Ω_k deontes the set of all varieties available in country k), and y denotes the consumption of good Y. The numeraire good is competitively produced such that one unit of labor produces one unit of the good, so the wage rate equals one.

Each individual chooses a consumption profile of good X to maximize u_x subject to $\int_{\Omega_k} p(i)x(i)di \leq E$, where $p(i)$ and E denote the price for variety i and the total expenditure on all varieties of good X, respectively. It is immediate to obtain $x(i) = p(i)^{-\sigma}E/P_k^{1-\sigma}$, where $P_k \equiv \left[\int_{\Omega_k} p(i)^{1-\sigma}di\right]^{\frac{1}{1-\sigma}}$ denotes the price index of good X. We substitute this result into (2) to obtain $u_x = E/P_k$. Therefore, an individual's utility function can be written as $u = \log E - \log P_k + y$. Maximizing this with the constraint $E + y \leq I$, where I denote the individual's income (which is the sum of her labor income and the investment return from her wealth), we obtain $E = 1$. That is, each individual spends $E = 1$ on good X, so the country k's aggregate expenditure on good X is m_k.

The differentiated-good industry is characterized by the monopolistic competition with free-entry and free-exit. When a firm enters, however, it incurs an R&D (or setup) cost. There are two types of production technology (or facility). The higher the investment, the lower is the marginal cost of production. More specifically, if a firm invests g_h (g_l) units of the numeraire good, its marginal cost becomes $1/\varphi_h$ ($1/\varphi_l$). We assume that $g_l < g_h < \bar{\omega}$, $\varphi_l \equiv \varphi$, and $\varphi_l < \varphi_h \equiv \beta\varphi$, where $\beta > 1$ represents the productivity gap. To obtain the profits for firm i in country k (in autarky), we define the competition index

$$\tilde{\varphi}_k \equiv \left[\int_{i\in\Omega_k} \varphi(i)^{\sigma-1}di\right]^{\frac{1}{\sigma-1}}. \tag{3}$$

Since there is a continuum of varieties, each firm naturally ignores the impact of its pricing on the price index, so that firms select prices that are $\sigma/(\sigma-1)$ times their individual marginal costs. It is easy to see that the profits for firm i in country k equal

$$\pi_k(\varphi(i), \tilde{\varphi}_k) = \frac{m_k}{\sigma} \left(\frac{\varphi(i)}{\tilde{\varphi}_k} \right)^{\sigma-1}. \tag{4}$$

Individuals in country k decide whether or not they become entrepreneurs who can borrow money at a gross interest rate of R_k to finance their investments if necessary. If an individual decides to become an entrepreneur, she will choose the high-productivity technology or the low-productivity technology with which her firm operates. If she decides not to be an entrepreneur or if part of her wealth is left after the investment for her firm, she will lend out her (remaining) wealth.

The critical feature of the model is that entrepreneurs are faced with a financial constraint: entrepreneur i can borrow up to the amount such that the repayment does not exceed $\theta_k \pi_k(\varphi(i), \tilde{\varphi}_k)$, the fraction $\theta_k \in (0, 1]$ of the profits that her firm will earn. The fraction θ_k represents the quality of the financial institution of country k. A financial institution is perfect if $\theta_k = 1$; any entrepreneur with any amount of wealth can finance the investment for either high-productivity technology or low-productivity techonogy, effectively without any constraint. A financial institution is imperfect if $\theta_k < 1$; individuals with small amounts of wealth may not be able to finance the investment costs in this case. Countries vary in the quality of their financial institutions.

In the economy that we consider, there are two types of the constraints, the profitability constraints and borrowing constraints, which must be satisfied. The profitability constraints

$$\pi_k(\varphi_h, \tilde{\varphi}_k) - R_k g_h \geq 0, \tag{5}$$

$$\pi_k(\varphi_l, \tilde{\varphi}_k) - R_k g_l \geq 0, \tag{6}$$

for the high-productivity firm and the low-productivity firm, respectively, simply mean that the net profits must be non-negative if firms of the respective type operate at all. The borrowing constraints, on the other hand, can be written as

$$\theta_k \pi_k(\varphi_h, \tilde{\varphi}_k) \geq R_k(g_h - \omega), \tag{7}$$

$$\theta_k \pi_k(\varphi_l, \tilde{\varphi}_k) \geq R_k(g_l - \omega), \tag{8}$$

which mean that entrepreneurs can borrow money only up to the amount such that the repayment does not exceed the fraction θ_k of the profits. It is easy to see that for each type of firm, the profitability constraint is tighter than the borrowing constraint if θ_k is large, whereas the borrowing constraint is tighter than the profitability constraint if θ_k is small.

Suppose for the time being that there is a country whose financial institution is perfect, so that $\theta_k = 1$, and consider a decision made by an individual with the wealth ω in the country k. If she invests g_h on the high-productivity technology, she would obtain $\pi_k(\varphi_h, \tilde{\varphi}_k) - R_k(g_h - \omega)$. If $\omega < g_h$, she borrows $g_h - \omega$ to earn $\pi_k(\varphi_h, \tilde{\varphi}_k)$ and pay $R_k(g_h - \omega)$ back to the lenders. If $\omega \geq g_h$, on the other hand, she obtains $\pi_k(\varphi_h, \tilde{\varphi}_k)$ from the production of good X (from the investment of g_h) and $-R_k(g_h - \omega)$ from lending out. Similarly, if she invests g_l, she would obtain $\pi_k(\varphi_l) - R(g_l - \omega)$. Finally, if she lends out the entire wealth of hers, she would get $R_k\omega$.

An entrepreneur chooses the high-productivity technology rather than the low-productivity technology if

$$\pi_k(\varphi_h, \tilde{\varphi}_k) - R_k(g_h - \omega) > \pi_k(\varphi_l, \tilde{\varphi}_k) - R_k(g_l - \omega),$$

which can be written as

$$\pi_k(\varphi_h, \tilde{\varphi}_k)(1 - \beta^{1-\sigma}) > R_k(g_h - g_l). \tag{9}$$

Note that this inequality does not depend on ω, so all entrepreneurs choose the same technology.

Whether or not the inequality (9) holds depends on the productivity and investment-cost parameters. In this paper, we focus on the natural case in which entrepreneurs choose the high-productivity technology if they are not financially constrained, so the inequality (9) holds. In equilibrium, some individuals become entrepreneurs while some others must be lending money to entrepreneurs, and hence the net benefit of being an entrepreneur and that of lending money must be the same. That is,

$$\pi_k(\varphi_h, \tilde{\varphi}_k) - R_k(g_h - \omega) = R_k\omega,$$

which is reduced to

$$\pi_k(\varphi_h, \tilde{\varphi}_k) = R_k g_h. \tag{10}$$

Note that this equality simply shows that profits for high-tech firms are zero: running a business does not yield extra-benefits to individuals. Now, substituting this equality into (9) and rearranging terms, we obtain $\beta^{\sigma-1} > g_h/g_l$, which we assume for the rest of our analysis.

Assumption 1

$$\beta^{\sigma-1} > g_h/g_l.$$

This assumption indicates that the productivity gap is so large that the more-costly high-productivity technology is effectively more economical than the low-productivity technology. Consequently, all entrepreneurs choose the high-productivity technology while some individuals lend their wealth to those entrepreneurs. Moreover, it is easy to check that under this assumption, there does not exist equilibrium in which entrepreneurs choose the low-productivity technology.

Let n_k denote the mass of firms (or equivalently the mass of entrepreneurs) in country k. Then, the total investment demands equal $n_k g_h$, while the total loan supply equals

$$\frac{m_k}{\bar{\omega}} \int_0^{\bar{\omega}} \omega d\omega = \frac{m_k \bar{\omega}}{2}.$$

By equating the asset demands and supplies, we find that the mass of firms is given by

$$n_k = \frac{m_k \bar{\omega}}{2 g_h}. \tag{11}$$

We need the following assumptin to ensure that $n_k < m_k$.

Assumption 2

$$\bar{\omega} < 2 g_h.$$

Recall that the decision as to whether or not an individual becomes an entrepreneur does not depend on her wealth. This means that despite that the number of entrepreneurs is unambiguously determined, who become entrepreneurs is indeterminate under perfect financial institution. But if we suppose that only the wealthiest individuals become entrepreneurs, the wealth level of the poorest entrepreneur ω_h^* must satisfy

$$\frac{m_k}{\bar{\omega}}(\bar{\omega} - \omega_h^*) = \frac{m_k\bar{\omega}}{2g_h},$$

which gives us

$$\omega_h^* = \bar{\omega} - \frac{\bar{\omega}^2}{2g_h}. \tag{12}$$

In this case, individuals become entrepreneurs if and only if their wealth levels lie in the interval $[\omega_h^*, \bar{\omega}]$.

Under imperfect financial institution, however, some entrepreneurs choose the low-productivity technology due to the borrowing constraint. If θ_k is small enough that the borrowing constraint is binding for both high-productivity and low-productivity technologies, wealthiest individuals become entrepreneurs with the high-productivity technology, those who own intermediate levels of wealth become entrepreneurs with the low-productivity technology, and the poorest individuals lend out their wealth. We define critical levels of wealth, $\omega_{h,k}$ and $\omega_{l,k}$, such that all individuals with $\omega \in [\omega_{h,k}, \bar{\omega}]$ become entrepreneurs choosing the high-productivity technology while all individuals with $\omega \in [\omega_{l,k}, \omega_{h,k}]$ become entrepreneurs choosing the low-productivity technology.

The condition that $\omega_{h,k}$ and $\omega_{l,k}$ must satisfy is the credit-market clearing condition. In autarky, it is written as

$$\frac{m_k}{\bar{\omega}}(\bar{\omega} - \omega_{h,k})g_h + \frac{m_k}{\bar{\omega}}(\omega_{h,k} - \omega_{l,k})g_l = \frac{m_k\bar{\omega}}{2}, \tag{13}$$

which can be solved for $\omega_{l,k}$ to define the function $\hat{\omega}_l$:

$$\hat{\omega}_l(\omega_{h,k}) = \frac{2g_h\bar{\omega} - \bar{\omega}^2}{2g_l} - \frac{g_h - g_l}{g_l}\omega_{h,k}. \tag{14}$$

This function represents the relation between $\omega_{l,k}$ and $\omega_{h,k}$ under the credit-market clearing condition. We can easily see that $\hat{\omega}_l$ is decreasing and that $\omega_{h,k} - \hat{\omega}_l(\omega_{h,k})$ increases with $\omega_{h,k}$. An increase in $\omega_{h,k}$ releases part of capital used for the high-tech firms, which is absorbed by the low-tech entrants whose mass exceeds that of the exiting high-tech firms.

3 Autarkic Equilibrium

We use the relation (14) to write profits for firms as functions of $\omega_{h,k}$. The competition index defined by (3) can be written as

$$\begin{aligned}\tilde{\varphi}_k(\omega_{h,k}) &= \left\{(\beta\varphi)^{\sigma-1}\frac{m_k}{\bar{\omega}}(\bar{\omega}-\omega_{h,k})+\varphi^{\sigma-1}\frac{m_k}{\bar{\omega}}[\omega_{h,k}-\hat{\omega}_l(\omega_{h,k})]\right\}^{\frac{1}{\sigma-1}} \\ &= \varphi m_k^{\frac{1}{\sigma-1}}\phi(\omega_{h,k})^{\frac{1}{\sigma-1}}, \qquad (15)\end{aligned}$$

where

$$\phi(\omega_{h,k}) = \beta^{\sigma-1}\frac{\bar{\omega}-\omega_{h,k}}{\bar{\omega}}+\frac{\omega_{h,k}-\hat{\omega}_l(\omega_{h,k})}{\bar{\omega}}.$$

The competition index $\tilde{\varphi}_k(\omega_{h,k})$ is decreasing in $\omega_{h,k}$ as the derivative of the normalized average productivity $\phi(\omega_{h,k})$ with respect to $\omega_{h,k}$ equals $[(g_h/g_l)-\beta^{\sigma-1}]\,\bar{\omega}$, which is negative under Assumption 1; the effect of the contraction of the high-tech group outweighs the effect of the expansion of the entire mass of firms. The profits for the firms can be written as

$$\begin{aligned}\pi(\varphi_h,\tilde{\varphi}_k(\omega_{h,k})) &= \frac{m_k}{\sigma}\left(\frac{\beta\varphi}{\tilde{\varphi}_k(\omega_{h,k})}\right)^{\sigma-1} = \frac{\beta^{\sigma-1}}{\sigma\phi(\omega_{h,k})}, \qquad (16)\\ \pi(\varphi_l,\tilde{\varphi}_k(\omega_{h,k})) &= \frac{1}{\sigma\phi(\omega_{h,k})}, \qquad (17)\end{aligned}$$

for the high-tech and low-tech firms, respectively. Since $\phi(\omega_{h,k})$ decreases with $\omega_{h,k}$, both $\pi(\varphi_h,\tilde{\varphi}_k(\omega_{h,k}))$ and $\pi(\varphi_l,\tilde{\varphi}_k(\omega_{h,k}))$ increase with $\omega_{h,k}$.

We are now ready for determining equilibrium levels of $\omega_{h,k}$, $\omega_{l,k}$, and R_k. The four constraints that must be satisfied if a firm of the corresponding productivity operates can be written as follows. The profitability constraints for the high-tech and low-tech firms can be written respectively as

$$(\mathrm{PC}_h)\quad R_k \leq \frac{\beta^{\sigma-1}}{\sigma\phi(\omega_{h,k})g_h}, \qquad (18)$$

$$(\mathrm{PC}_l)\quad R_k \leq \frac{1}{\sigma\phi(\omega_{h,k})g_l}. \qquad (19)$$

The borrowing constraints for the high-tech and low-tech firms can be written respectively as

$$(\mathrm{BC}_h)\quad R_k \leq \frac{\theta_k\beta^{\sigma-1}}{\sigma\phi(\omega_{h,k})(g_h-\omega_{h,k})}, \qquad (20)$$

$$(\mathrm{BC}_l) \quad R_k \le \frac{\theta_k}{\sigma\phi(\omega_{h,k})(g_l - \hat{\omega}_l(\omega_{h,k}))}. \tag{21}$$

If θ_k is very small, it is the borrowing constraint that binds for either type of technology, i.e., both (BC_h) and (BC_l) are binding. In this case, (PC_h) and (PC_l) are satisfied with strict inequalities. As θ_k rises, (PC_l) becomes binding and hence (BC_l) becomes slack, while (BC_h) remains binding for the high-tech firms. As θ_k rises further, (PC_l) become violated so that low-tech firms cease to exists. The only constraint that is binding in this case is (BC_h). Finally, if θ_k is sufficiently large, (PC_h) is the only constraint that is binding while (BC_h) is slack.

Figure 1 depicts the curves that represents these constraints when they are binding. The locations of the curves for the profitability constraints do not depend on θ_k, so they are common across all countries. Whereas those for the borrowing constraints depend on θ_k, and hence they are different across countries. The area on and below each curve is the set of $(\omega_{h,k}, R_k)$ that satisfies the corresponding constraint.

It follows immediately from (20) and (21) that the autarky threshold for the high-tech entrepreneurs must satisfy

$$\beta^{\sigma-1} = \frac{g_h - \omega_{h,k}}{g_l - \hat{\omega}_l(\omega_{h,k})}. \tag{22}$$

The threshold does not depend on θ_k, so countries with low levels of θ_ks have the same threshold, which we call ω_h^A. For the solution of (22) to make sense, $\hat{\omega}_l(\omega_h^A) < \omega_h^A$ must hold. We substitute (14) into this inequality to find that $\hat{\omega}_l(\omega_h^A) < \omega_h^A$ is equivalent to $\omega_{h,k} > \omega_h^*$, where ω_h^* is given by (12). Recalling that $\hat{\omega}_l$ is a decreasing function, therefore, we need the following assumption to ensure $\hat{\omega}_l(\omega_h^A) < \omega_h^A$.

Assumption 3

$$\beta^{\sigma-1} < \frac{g_h - \omega_h^*}{g_l - \hat{\omega}_l(\omega_h^*)}.$$

If θ_k is so small that the intersection between the BC_h curve and the BC_l curve lies below the PC_l curve, the autarkic equilibrium $(\omega_{h,k}, R_k)$ is given by the intersection of the BC_h curve and the BC_l curve. As θ_k rises, the intersection moves up vertically toward the PC_l

curve. With the market structure given by (22), the interest rate R_k^A is determied by the borrowing constraint (for high-tech firms, for example):

$$R_k^A = \frac{\theta_k \beta^{\sigma-1}}{\sigma \phi_k(\omega_h^A)(g_h - \omega_h^A)}. \tag{23}$$

As (23) indicates, any change in θ_k will induce offsetting change in R_k. In partial equilibrium analyses, the development of financial institution generally increases the number of firms because it becomes easier for entrepreneurs to finance the investment costs. But this seemingly obvious causality breaks down in this general equilibrium model. The production side of the market structure hinges critically on the total credit supply that is fixed in the autarkic economy. That is why the financial development, for example, will increase the interest rate to offset an induced increase in credit demands. If θ_k is sufficiently small, a rise in θ_k does not change the threshold $\omega_{h,k}$ from ω_h^A and hence $\omega_{l,k} = \hat{\omega}_l(\omega_{h,k})$, but increases R_k. This movement is also depicted in Region I of Figure 2.

If θ_k is relatively large so that the intersection between the BC$_h$ curve and the BC$_l$ curve lies above the PC$_l$ curve, the constraint that is binding for low-tech firms will be (PC$_l$) instead of (BC$_l$). That is, $(\omega_{h,k}, R_k)$ is given by the intersection between the BC$_h$ curve and the PC$_l$ curve. Since PC$_l$ curve is upward-sloping, both $\omega_{h,k}$ and R_k fall as θ_k increases. As θ_k rises, more high-tech firms enter the market (i.e., $\omega_{h,k}$ decreases), which pushes low-tech firms out of the market (i.e., $\omega_{l,k}$ increases). Some low-tech firms survive, nevertheless, despite that the market becomes more competitive; the interest rate R_k falls so that they can survive. This phenomenon is shown in Region II of Figure 2.

To make the above argument more precise, we derive

$$\theta_k \beta^{\sigma-1} = \frac{g_h - \omega_{h,k}}{g_l} \tag{24}$$

from the binding conditions of (BC$_h$) and (PC$_l$):

$$R_k = \frac{\theta_k \beta^{\sigma-1}}{\sigma \phi(\omega_{h,k})(g_h - \omega_{h,k})},$$
$$R_k = \frac{1}{\sigma \phi(\omega_{h,k}) g_l}.$$

It immediately follows from (24) that $\omega_{h,k}$ falls as θ_k increases. As a result, $\phi(\omega_{h,k})$ increases which lowers R_k as we see from the binding constraint of (PC_l).

As θ_k continues to rise, the equilibrium $\omega_{h,k}$ will reach ω_h^*. That is, low-tech firms are completely eliminated. As θ_k further rises, (BC_h) will be the only constraint that is binding, and R_k rises while $\omega_{h,k}$ is constant at ω_h^*. This movement is depicted in Region III of Figure 2.

Finally, if θ_k is so large, R_k that satisfies (BC_h) with equality at $\omega_{h,k} = \omega_h^*$ is so large that (PC_h) is satisfied with equality. For θ_k that is greater than this critical level, it is (PC_h) that is satified with equality; (BC_h) is slack in this region. In this region, entrepreneurs are not financially constraint even though θ_k is in general less than one. Since we are interested in the case where at least some entrepreneurs are financially constraint, we assume that θ_k is less than this critical level for any k.

We summarize our findings for the autarkic equilibrium in the following proposition.

Proposition 1 *In autarky, firms with different productivity levels operate in countries whose financial institution is relatively poor, while firms are homogeneous in countries with better financial institution. The equilibrium interest rate increases with the quality of financial institution for countries that have either poor financial institutions or rather developed institutions. The interest rate decreases with the quality of financial institution, however, for countries whose financial institutions are in the intermediate levels.*

4 Free Trade Equilibrium

This section considers the case in which all countries are completely open to international trade in goods. We show among others that trade in goods will not affect the productivity distribution of the industry in any country in the world.

To derive the equilibrium conditions, we first derive the profits for firms in free trade. Since all firms in the world compete in a level field in every country, the competition index is the same for every country and it is written as

$$\tilde{\varphi}_w = \varphi \left(\sum_{k=1}^{n} m_k \right)^{\frac{1}{\sigma-1}} \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right)^{\frac{1}{\sigma-1}},$$

where

$$\begin{aligned} \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right) &= \beta^{\sigma-1} \sum_{k=1}^{n} \frac{m_k}{\sum_{j=1}^{n} m_j} \frac{\bar{\omega} - \omega_{h,k}}{\bar{\omega}} + \sum_{k=1}^{n} \frac{m_k}{\sum_{j=1}^{n} m_j} \frac{\omega_{h,k} - \hat{\omega}_l(\omega_{h,k})}{\bar{\omega}} \\ &= \sum_{k=1}^{n} \frac{m_k}{\sum_{j=1}^{n} m_j} \phi_k(\omega_{h,k}). \end{aligned}$$

Then, the profits for high-tech firms and low-tech firms can be written as

$$\begin{aligned} \pi(\varphi_h, \tilde{\varphi}_w) &= \frac{\sum_{k=1}^{n} m_k}{\sigma} \left(\frac{\beta\varphi}{\tilde{\varphi}_w} \right)^{\sigma-1} = \frac{\beta^{\sigma-1}}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right)}, \\ \pi(\varphi_l, \tilde{\varphi}_w) &= \frac{1}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right)}, \end{aligned}$$

respectively.

In region I, where (BC_h) and (BC_l) are binding, the equilibrium conditions are

$$\begin{aligned} R_k &= \frac{\theta_k \beta^{\sigma-1}}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right) (g_h - \omega_{h,k})}, \\ R_k &= \frac{\theta_k}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right) (g_l - \hat{\omega}_l(\omega_{h,k}))}. \end{aligned}$$

It immediately follow from them that $\omega_{h,k}$ is determined by (22), which is the same as in autarky. Thus, the productivity distribution of the industry will not change with opening to trade for those countries in this region. Opening to trade, however, changes the interest rates. For financially-undeveloped countries, $\phi_k(\omega_{h,k}^A)$ is lower than those of any other countries. So we have $\phi_k(\omega_{h,k}^A) < \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right)$. Therefore, R_k falls as a result of trade liberalization.

In region II, where (BC_h) and (PC_l) are binding, the equilibrium conditions are

$$\begin{aligned} R_k &= \frac{\theta_k \beta^{\sigma-1}}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right) (g_h - \omega_{h,k})}, \\ R_k &= \frac{1}{\sigma \phi_w \left(\{\omega_{h,k}\}_{k=1}^{n} \right) g_l}. \end{aligned}$$

Again, the equilibrium condition for $\omega_{h,k}$ is the same as in autarky, which is given by (24). Trade liberalization will also not affect the productivity distribution of the industry. The interest rate decreases for countries that have relatively poor financial institutions so that $\phi_k(\omega_{h,k}(\theta_k)) < \phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right)$, while it increases for other countries with relatively better financial institutions.

Finally in region III, where (BC_h) is the only binding constraint, the equilibrium condition can be written as

$$R_k = \frac{\theta_k \beta^{\sigma-1}}{\sigma\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right)(g_h - \omega_{h,k})}.$$

Since only high-tech firms operate in these countries, $\omega_{h,k}$ equals ω_h^* as in autarky. The interest rate increases as opening to trade is beneficial to firms in these countries.

Figure 3 shows the equilibrium productivity distribution and interest rate, and compare them with those in autarky.

Proposition 2 *Opening to trade will not change the productivity distribution of the industry for any country. The interest rate decreases, however, for countries with poor financial institutions, while it increases for countries with better financial institutions.*

5 Free Trade and Capital Movement

We have seen that opening to trade will not affect the productivity distribution of the industry. If countries liberalize capital movement as well as trade in goods, the story will be quite different as we will see shortly.

To make the equilibrium conditions more transparent, we write the relevant (binding) constraints, (PC_l), (BC_h), and (BC_l), as

$$R_w\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right) = \frac{1}{\sigma g_l}, \tag{25}$$

$$R_w\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right) = \frac{\theta_k\beta^{\sigma-1}}{\sigma(g_h - \omega_{h,k})}, \tag{26}$$

$$R_w\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right) = \frac{\theta_k}{\sigma(g_l - \omega_{l,k})}, \tag{27}$$

where R_w denotes the equilibrium interest rate that prevails worldwide.

We find immediately that the left-hand sides of (25)-(27), respectively, are the same for all countries, and that either $R_w\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right) > 1/(\sigma g_l)$ or $R_w\phi_w\left(\{\omega_{h,k}\}_{k=1}^n\right) < 1/(\sigma g_l)$

holds generically in equilibrium. Indeed, there are two types of equilibrium, which have very different implications from each other on the impact of capital movement.

The first case is likely to appear in equilibrium if there are many countries with high quality of financial institutions. In such a case, inequality $R_w \phi_w \left(\{\omega_{h,k}\}_{k=1}^n \right) > 1/(\sigma g_l)$ holds in equilibrium and R_w will be large as indicated in the lower panel of Figure 4, so that (BC_h) is binding in every country. Since (PC_l) is violated, only high-tech firms exist in the entire world; capital movement completely eliminates low-tech firms enhancing the worldwide efficiency. Capital moves from southern countries with poor financial institutuions to northern countries with better financial institutions, so the industry in southern countries shrink while that in northern countries expands as indicated in the upper panel of Figure 4.

If there are many countries with low quality of financial institutions, on the other hand, inequality $R_w \phi_w \left(\{\omega_{h,k}\}_{k=1}^n \right) < 1/(\sigma g_l)$ in equilibrium, and R_w will be small as the financial friction supresses the worldwide credit demands. In such a case, (PC_l) holds with strict inequality and (BC_h) and (BC_l) are binding in every country in equilibrium. As indicated in the upper panel of Figure 5, low-tech firms emerge in every country in the world. Again, capital moves out of southern countries, and it moves out significantly in total so that capital becomes so much abundant in northern countries allowing even low-tech firms to survive also in northern countries. Capital movement in this case decreases worldwide efficiency.

Proposition 3 *Capital movement in addition to trade in goods will either enhance worldwide efficiency eliminating all low-tech firms, or reduce worldwide efficiency allowing low-tech firms to survive in every country. The former is likely to appear if there are many countries with high quality of financial institutions, while the latter is more likely if there are many countries with low quality of financial institutions.*

Corollary 1 *Worldwide efficiency of production may be enhanced by restricting international capital movement in southern countries.*

6 Concluding Remarks

We have investigated the impact of globalization, i.e., opening to trade in goods and capital movement, on a monopolistically-competitive industry under financial imperfection. We have found that trade in goods alone will not affect the productivity distribution of the industry, but capital movement (in addition to trade) will drastically change the the productivity distribution. Trade in goods and international capital movement affect the economy very differently in the presence of financial imperfection.

We have considered the case in which entrepreneurs can choose either a high-productivity technology or low-productivity technology. The impact of financial imperfection on the choice of technology and the resulting firm heterogeneity in an industry can be examined more thoroughly when there are many possible production technologies that are available for entrepreneurs. Extending the model to the one with an infinite number of technologies is left for future research.

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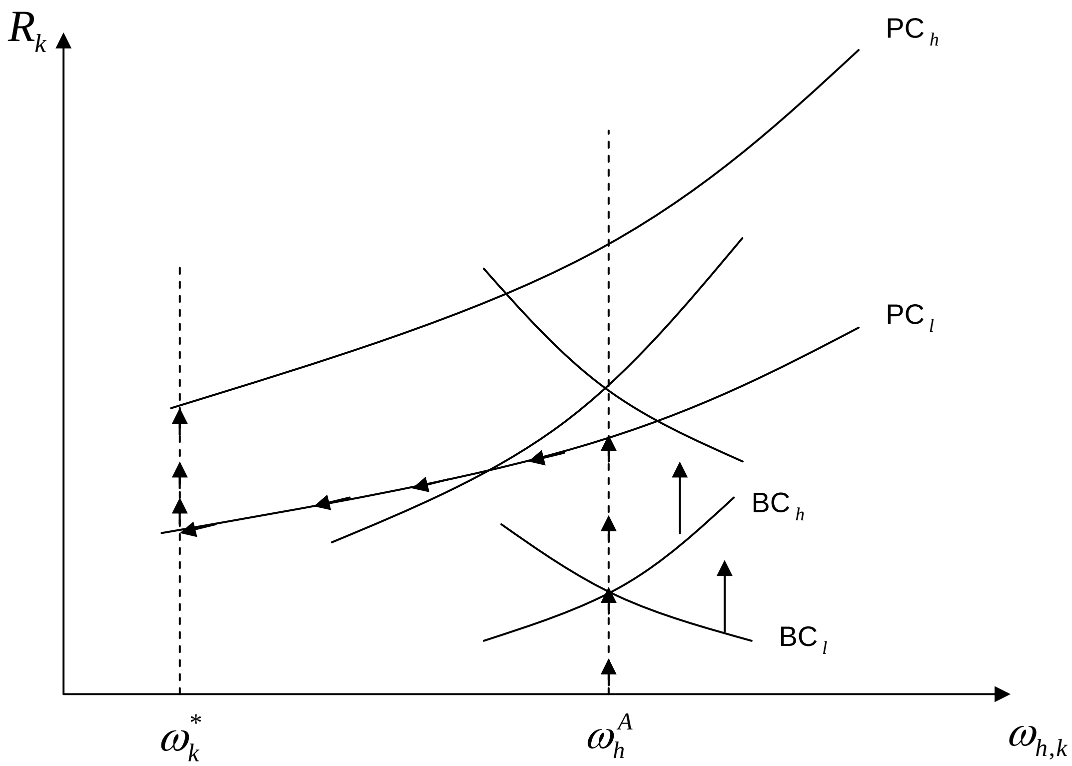

Figure 1: Effect of an increase in θ_k

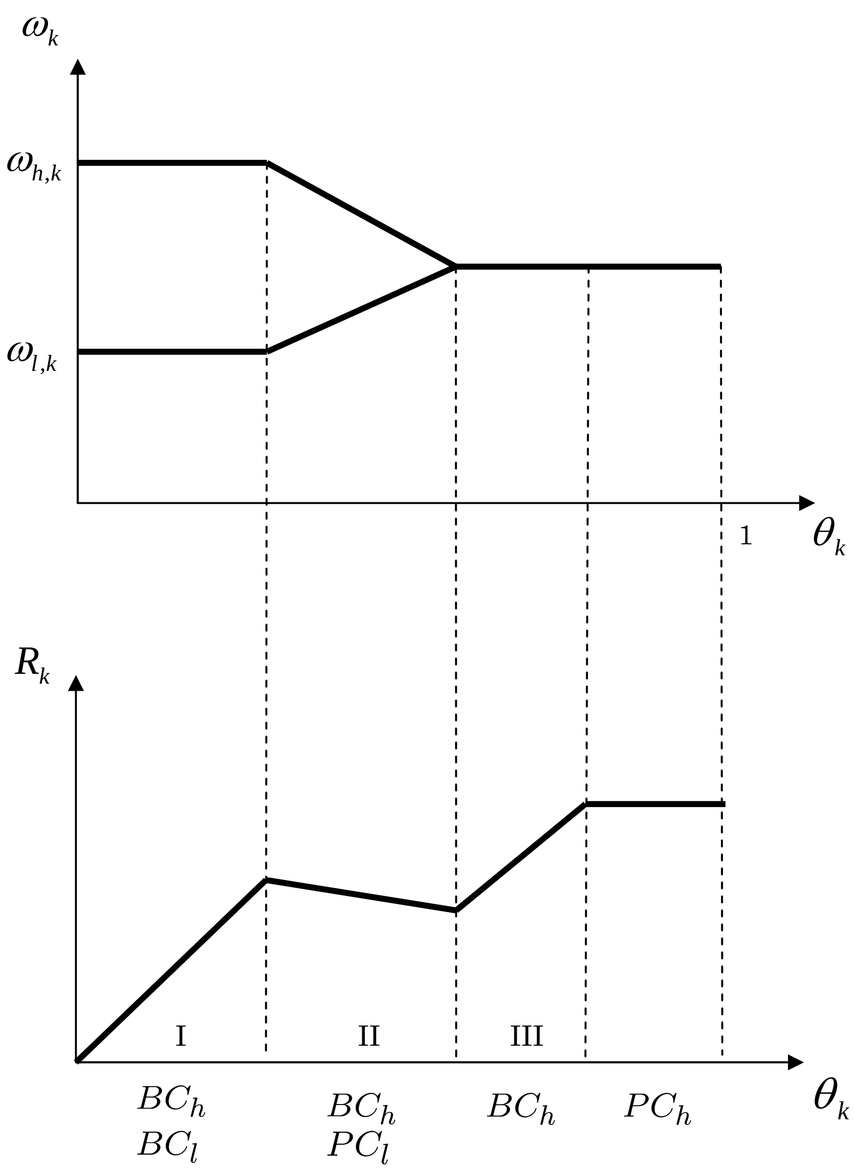

Figure 2. Productivity Distribution and Interest Rate

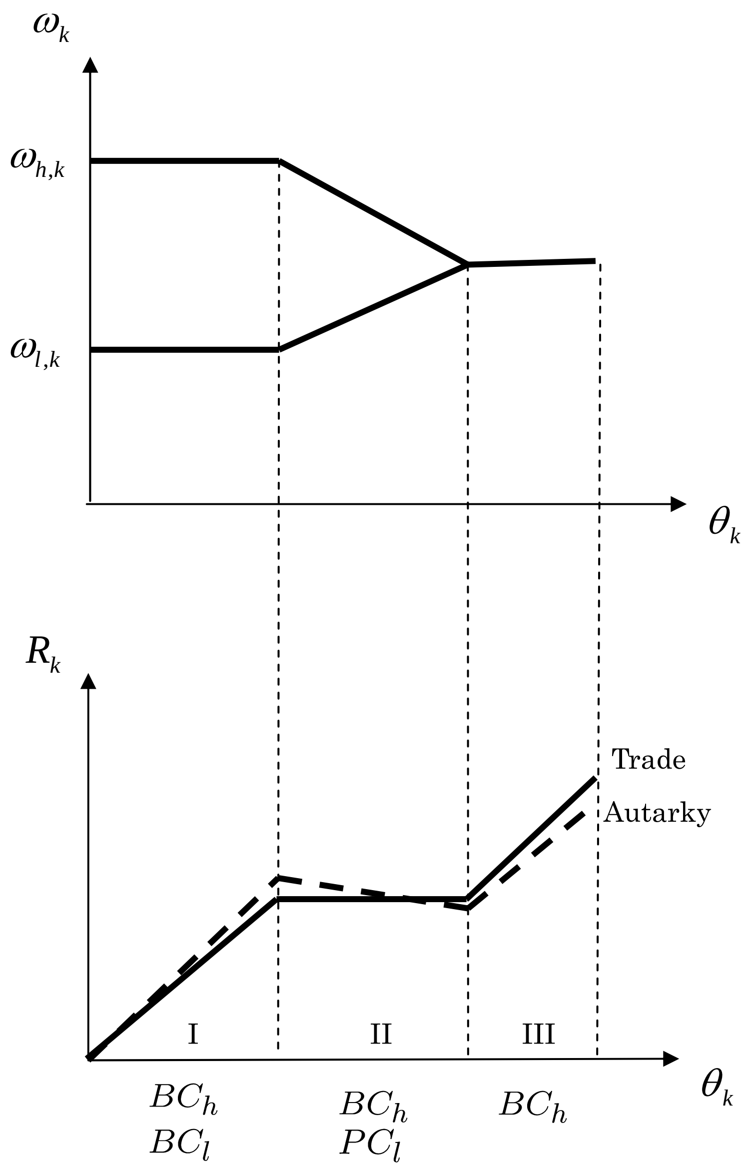

Figure 3. Trade Equilibrium

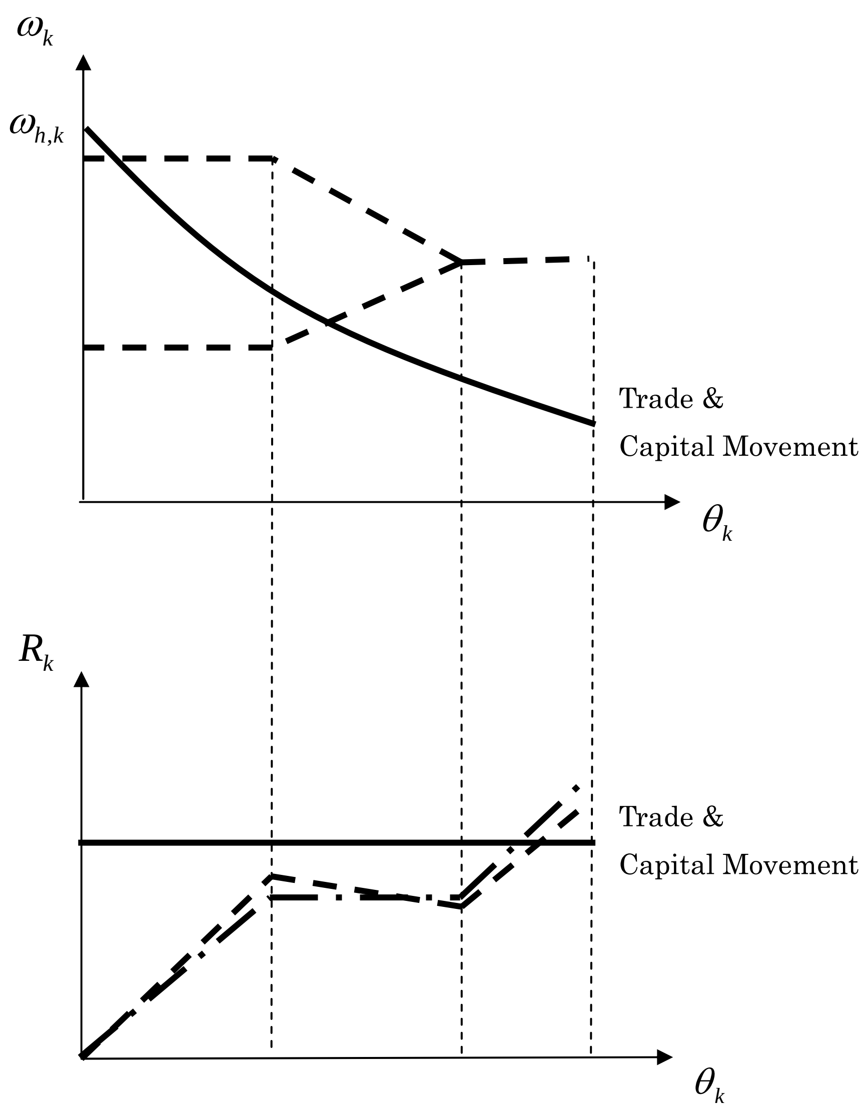

Figure 4. Trade and Capital Movement (Case 1)

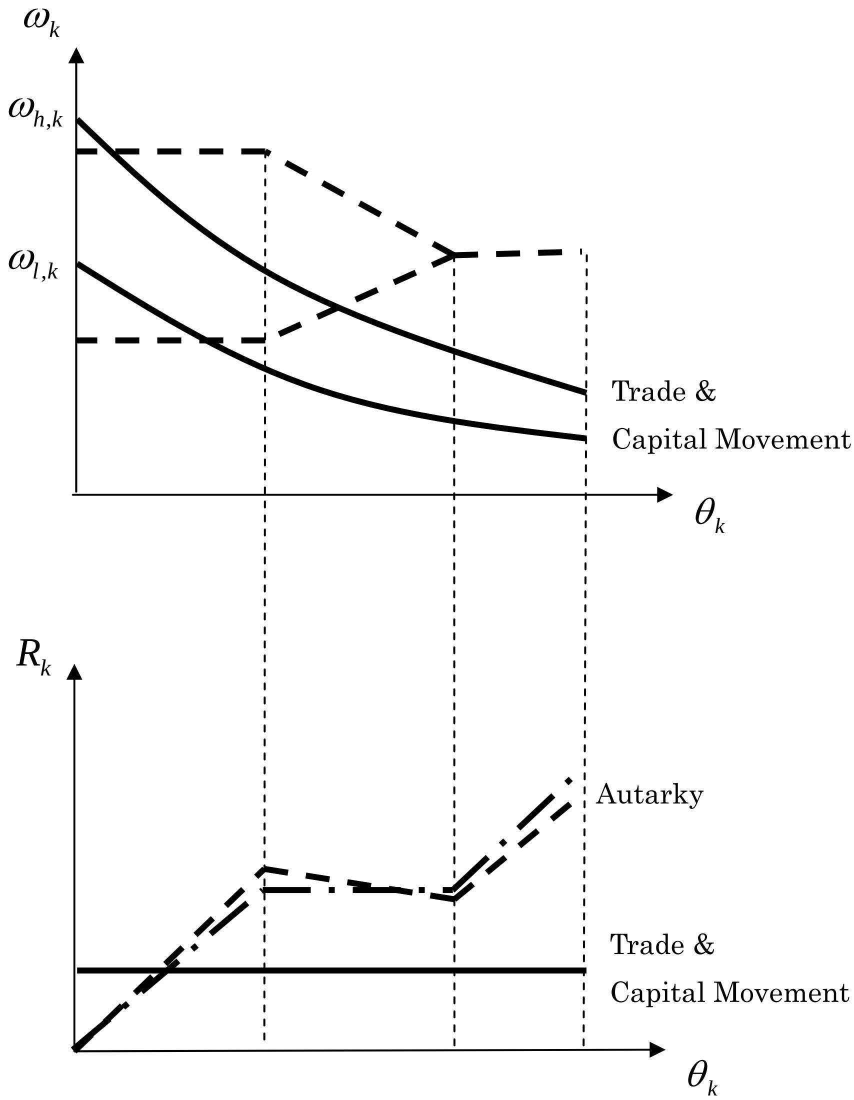

Figure 5. Trade and Capital Movement (Case 2)