International Capital and Economic Development

by

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Abstract

The paper presents a model of economic development and international capital flows. In the early stage of development, investments are complementary and production exhibits increasing returns. This creates strategic complementarities among investors, which make both low and high capital equilibria possible. Movements between two equilibria represent economic takeoff and capital flight. The model shows how expectations and risks determine the final equilibrium of the economy by changing the *structure* of multiple equilibria. Given the multiple equilibria, the role of government is to achieve the high equilibrium through policies that affect equilibrium switching factors in the right directions. As the economy take off successfully, it enters the stage of decreasing returns where multiple equilibria no longer exist. Thus the role of government must change.

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I. Introduction

An important development in the world economy during the last few decades has been the extended liberalization of capital markets. We now have a global capital market with free international capital flows. Facilitating an efficient allocation of capital, the global capital market has contributed to the remarkable transformation of many less developed countries into *emerging economies*. At the same time, however, we have witnessed a significant number of capital flights and economic crises. Asian developing countries are recent examples. Many Asian countries had gone through a stage of economic takeoff with large capital inflows, which was hailed as the "Asian miracle" in the early 1990s, and then suddenly faced capital flight and the turmoil of the "Asian crisis" in the late 1990s.[1]

What characterized the "Asian miracle" and the "Asian crisis" was the *sudden* inflows and outflows of *international capital*. For a developing country in the global capital market, the success and failure of economic development depend on international capital flows. Therefore, to understand the mechanism of modern economic development as well as crises in emerging economies, we need to understand why and how sudden inflows and outflows of international capital occur. Thus we ask the following questions: What is the mechanism of capital flows in and out of a developing country? What triggers sudden reversal of capital flows? Is the liberalization of capital markets good for developing countries? What is the role of government in promoting economic development and preventing capital flight?

This paper attempts to answer those questions with a model of economic development and international capital flows. The model emphasizes the importance of *strategic complementarities* between the *optimal portfolio* decisions of international investors. In the early stage of development, investments are *complementary* and therefore production exhibits *increasing returns* to capital. This characteristic creates strategic complementarities among the optimal portfolio decisions of international investors. The strategic complementarities give rise to *multiple equilibria*: that is, low and high capital equilibria. Movements between two equilibria represent *economic takeoff* and *capital flight*, which are associated with sudden inflows and outflows of international capital. Thus both economic takeoff and capital flight arise from the same mechanism of international capital flows. It turns out that capital flights are more likely to occur among those emerging economies that have been successful in achieving high growth.

Many papers in development economics have argued that investments are complementary and production exhibits increasing returns to capital in the early stage of development. Their theories are known as the "big push" models.[2] The "big push" models emphasize the importance of various "economies of scale," "linkages," and "balanced growth" for economic development. The essential element behind all of those concepts is the idea of *complementarity* between investments. Lewis (1955: p.249), for example, has stated as follows: "If a new undertaking is to be started, the productivity of this undertaking depends not only upon itself, but also upon the efficiency of all other industries whose services the new undertaking would need to use---especially general engineering services, suppliers of components, transport, and other public utilities. This in turn depends partly upon how highly capitalized these other services are. Hence the productivity of one investment depends upon other investments having been made before in many directions. At least up to a point, there are increasing rather than decreasing returns to capital investment."

In fact, the assumption of *decreasing returns* is not consistent with the growth data of developing countries, although it is consistent with those of developed countries. The main implication of the *conventional* production function with decreasing returns is that the growth rate declines as the economy develops or equivalently that the marginal product of capital declines as the economy accumulates more capital (Figure 1). This implication is consistent with the growth data of developed countries. As Figure 2A and 2B show, developed countries with higher income (capital) tend to have lower growth (marginal product) while developed countries with lower income (capital) tend to have higher growth (marginal product). As a result, *convergence* is observed among developed countries.

However, the implication of the conventional production function is not consistent with the growth data of developing countries. No convergence is observed among developing countries (Figure 3). Most developing countries are characterized by low income (capital) and low growth (marginal product), while *emerging economies* are characterized by medium income (capital) and high growth (marginal product). This is the opposite of what decreasing returns to capital imply. Thus the conventional production function with decreasing returns does not apply to developing countries. Furthermore, the lack of convergence suggests the existence of *multiple equilibria* for developing countries.

What kind of a production function is consistent with the growth data of both developed and developing countries? It is a production function with *increasing returns* in the early stage and *decreasing returns* in the later stage of development (Figure 4). This production function is consistent with the *inverted-U shaped growth pattern* that countries initially move from the stage of low income and low growth to the stage of medium income and high growth (takeoff), and then enter into the stage of high income and low growth (convergence). [3]

Given the new production function with increasing and decreasing returns along different developmental stages, the *optimal portfolio* decisions of international investors and their non-cooperative interactions give rise to two stable Nash equilibria: a *Pareto-inferior* low capital equilibrium and a *Pareto-superior* high capital equilibrium. Movements between two equilibria correspond to economic takeoff (sudden capital inflows) and capital flight (sudden capital outflows). They are triggered by changes in the following equilibrium switching factors: (i) expected exchange rate, (ii) expected productivity, (iii) world interest rate, (iv) exchange rate risk, (v) productivity risk, and (vi) the risk aversion of international investors.

The model shows how expectations and risks determine the final equilibrium of the economy, starting from a historically given initial equilibrium, by changing the *structure* of multiple equilibria. Expectations do not just pick a final equilibrium from a fixed set of multiple equilibria; they affect the entire structure of multiple equilibria. Given the initial equilibrium of the economy (history), a sufficient shift in the relative strength of expectations versus risks changes the equilibrium by *transforming* multiple equilibria into a single unique equilibrium. This provides a general solution to the equilibrium selection problem in the presence of multiple equilibria. Under uncertainty there exists an intrinsic conflict between expectations and risks. They determine the structure of multiple equilibria and the future course of the economy. The relative strength of expectations versus risks plays a fundamental role in triggering economic takeoff and capital flight.

The model shows that a *competitive* global capital market may suffer from a *coordination failure.* It suggests a potential role of government for economic development by means of exchange rate policy, government guarantee, capital control, and a two-stage development strategy, which combines domestic capital accumulation and capital market liberalization. The model also shows how the *globalization* of capital markets helps developing countries achieve economic takeoff and why emerging economies are susceptible to capital flight. It also shows why the role of government should depend on the stage of economic development.

The rest of the paper is organized as follows: Section II presents a model of optimal portfolio decisions of international investors and multiple Nash equilibria. Section III studies the comparative statics of the equilibria. Section IV analyzes the mechanism of economic takeoff and capital flight. Section V discusses policy implications. Section VI concludes the paper.

II. A Model of Optimal Portfolio and Multiple Equilibria

The model assumes the following situation: Capital markets are integrated and form a *competitive* global capital market. There are no obstacles to international capital flows. The economic growth of a developing country depends on capital inflows from the global capital market. The production function exhibits *increasing returns* to capital in the early stage and *decreasing returns* in the later stage of development. There are a large number of *international investors*. Their portfolios consist of risk free assets and risky investment in a developing country. Then the model shows that the optimal portfolio decisions and the non-cooperative interactions of international investors make both high and low capital equilibria possible.

A. Increasing and decreasing returns to capital

There are many reasons why increasing returns to capital arise in the early stage of development. The main argument is that many investments are *complementary* at the beginning of development.[4] Investments reinforce each other through positive feedback and build the infrastructure of the economy, which makes an efficient production possible. An investment may not be profitable by itself, but its effects on other investments and their feedback effects on itself can make the investment profitable. Consequently, investments are complementary in an aggregate production process. However, as the economy develops into a more advanced stage, there emerge various opportunities for investments associated with a wider variety of substitutable products. Consequently, investments for new products are more likely to be *substitutable* and they compete for limited resources. As a result, production exhibits *increasing returns* in the early stage and *decreasing returns* in the later stage of development.[5]

Thus we define the production function as follows: The production function is twice continuously differentiable with respect to capital k and is given by:

$$F(k) = f(k) + \varepsilon k \tag{1}$$

where ε is a marginal productivity shock or a rate-of-return shock. It is distributed as $\varepsilon \sim N(E(\varepsilon), \sigma_\varepsilon^2)$, which represents a normal distribution with mean $E(\varepsilon)$ and variance σ_ε^2. The production function satisfies that $f(0) = 0, f'(0) = 1, f'(k) > 1$ for $k > 0$ and also that

$$f''(k) > 0 \quad \text{for } k < \bar{k} \qquad \text{and} \qquad f''(k) < 0 \quad \text{for } k > \bar{k} \tag{2}$$

where $\bar{k}$ is the capital level at which the marginal product is maximal.

An important characteristic of this production function is that the expected marginal product of capital initially increases and then declines thereafter. It suggests that the marginal product of capital or the rate of return for capital exhibits an *inverted-U shaped growth pattern* with the accumulation of capital. The marginal product initially rises with economic development. Then, after reaching a maximum rate, the marginal product begins to decline with a further accumulation of capital. This implication is consistent with the stylized fact that an economy tends to develop from a low-income low-growth stage to a medium-income high growth stage (takeoff), and then to a high-income low-growth stage (convergence).

B. Optimal portfolio decision of international investors

There are a sufficiently large number of identical international investors (i = 1,2,3,…,n). Each investor has total wealth w available for investments. Their asset portfolios consist of risk free assets and risky foreign investment. The risk free assets yield the world interest rate R while the risky foreign investment yields the rate of return r. Investor i invests his wealth w either in risk free assets $(w - k_i)$ at the world interest rate R or in a risky foreign country (k_i) at the rate of return r.

I assume that the global capital market is *competitive* so that each investor takes the rate of return as *independent* of one's own action. I also assume that the rate of return on foreign investment (r) depends on the *average* investment of other investors (k) as follows:

$$r = r(k) + \varepsilon \tag{3}$$

where $r(k) = f'(k) - 1$ (Figure 4). Besides the average investment of other investors, the rate of return (r) depends on a marginal productivity shock (ε). International investors therefore face *productivity risk*.

In addition to the productivity risk, international investors face *foreign exchange rate risk*. The depreciation of foreign currency reduces the value of foreign investment. The rate of return for foreign investment is therefore reduced by the rate of foreign currency depreciation d. The rate of depreciation is assumed to be normally distributed as $d \sim N(E(d), \sigma_d^2)$.

To sum up, the return on the portfolio of international investor *i* can be written as follows:

$$\pi = (1 + r(k) + \varepsilon - d)k_i + (1 + R)(w - k_i) \tag{4}$$

where $\varepsilon \sim N(E(\varepsilon), \sigma_\varepsilon^2)$ and $d \sim N(E(d), \sigma_d^2)$. If $(w - k_i)$ is positive (negative), it indicates net lending (borrowing) at the world interest rate *R*, which is the *opportunity cost* for investors. Random variables ε and d are assumed to be independent for the sake of simplicity without affecting the conclusions of this paper.

An international investor maximizes his expected utility that depends on the return on his portfolio (π). The utility function is assumed to be given by the following form of constant absolute risk aversion (CARA):

$$u(\pi) = -\exp(-\beta\,\pi) \tag{5}$$

where β is the parameter of constant absolute risk aversion ($\beta > 0$).

Then the expected utility maximization problem of investor *i* with respect to k_i is given as follows:

$$\max_{k_i} \quad E(u(\pi)) = -\exp\{-\beta\,[\,E(\pi) - \tfrac{1}{2}\,\beta\,\sigma_\pi^2\,]\} \tag{6}$$

where the right-hand side is obtained by application of the method of deriving a moment generating function of a random variable with the normal distribution.[6]

Because the exponential function is strictly increasing, the above maximization problem becomes equivalent to the following:

$$\max_{k_i} \ \phi(k_i, k) = (1 + r(k) + E(\varepsilon) - E(d))\,k_i + (1 + R)(w - k_i) - \tfrac{1}{2}\beta\,\sigma^2 k_i^{\,2} \tag{7}$$

where $\sigma^2 \equiv \sigma_\varepsilon^2 + \sigma_d^2$. This is a final form of the optimal portfolio decision of an investor, which involves only the means and variances of random variables.

The first order condition for the optimal portfolio decision of an investor is obtained as follows:

$$k_i = \frac{r(k)+E(\varepsilon)-E(d)-R}{\beta\,(\sigma_\varepsilon^2+\sigma_d^2)} \tag{8}$$

This may be interpreted as the *optimal* action (k_i) of investor *i* as a function of the *average* action (k) of other investors or the *best response function* of k_i with respect to k. The second order condition is satisfied because $\beta(\sigma_\varepsilon^2+\sigma_d^2)>0$ holds.

The optimal portfolio solution shows a tradeoff between *risk* and *return*. The numerator expresses an expected excess rate of return over the risk free assets while the denominator expresses various risk factors associated with investing in a foreign country. The optimal amount of investment (k_i) is increasing with respect to the expected excess *return* in the numerator and decreasing with respect to the *risks* in the denominator. There is a clear tradeoff between risk and return in the optimal portfolio decision.[7]

C. Strategic complementarity and multiple Nash equilibria

We define strategic complementarity and strategic substitutability in terms of the function $\phi_{12}(k_i,k)$. International investors face the situation of *strategic complementarity* if $\phi_{12}(k_i,k)>0$. It means that the optimal investment of an investor *increases* if other investors increase their investment. It induces *rational herd behavior* among international investors. Conversely, investors face the situation of *strategic substitutability* if $\phi_{12}(k_i,k)<0$. It means that the optimal investment of an investor *decreases* if other investors increase their investment.[8] Therefore, strategic substitutability makes capital flows *stable* while strategic complementarity makes capital flows *unstable*.

In the model, strategic complementarity exists $(\phi_{12}>0)$ *if and only if* the production function exhibits increasing returns to capital $(f''(k)>0)$. This proposition follows directly from the fact that

$$\phi_{12}(k_i, k) = r'(k) = f''(k) \tag{9}$$

Therefore, strategic complementarity exists in the early stage of development with increasing returns while strategic substitutability exists in the later stage of development with decreasing returns. It follows that capital flows are *unstable* in the early stage while they become *stable* in the later stage of development.

Strategic complementarities among the optimal portfolio decisions of international investors produce multiple Nash equilibria: that is, low and high capital equilibria. Figure 5 shows the response functions of investor i and j ($i \neq j$): that is, the response function of k_i with respect to k which includes k_j and the response function of k_j with respect to k which includes k_i. Nash equilibria are obtained at the intersection of those response functions. The Nash equilibria satisfy the condition that $k_i = k_j = k$ for all i and j.

There are generally two *stable* Nash equilibria at k_H and k_L as well as one *unstable* Nash equilibrium at k_T, which is located between the two stable Nash equilibria (Figure 5). The low and high capital equilibria (k_L and k_H) are *Nash* equilibria because an investor i has no incentive to deviate from $k_i = k_L$ ($k_i = k_H$) if other investors choose $k = k_L$ ($k = k_H$). The *stability* of both the low and high capital equilibria (k_L and k_H) can be confirmed by examining the characteristics of the response functions in Figure 5. Although there is another Nash equilibrium (k_T) between k_L and k_H, it turns out to be highly unstable. A small perturbation will trip the unstable Nash equilibrium (k_T), and the economy will move to either k_H or k_L (Figure 5). In other words, the unstable Nash equilibrium (k_T) represents the *threshold level* of capital.

The two stable Nash equilibria are *Pareto-ranked*. This follows directly from the relationship that

$$\phi(k_H, k_H) - \phi(k_L, k_L) \;=\; \tfrac{1}{2}\,\beta\,\sigma^2\,\{\,(k_H)^2 - (k_L)^2\,\}\; > 0 \tag{10}$$

It shows that the high capital equilibrium (k_H) is a *Pareto-superior* Nash equilibrium while the low capital equilibrium (k_L) is a *Pareto-inferior* Nash equilibrium. All investors prefer the high capital equilibrium to the low capital equilibrium.[9] The Pareto-ranked multiple equilibria suggest a possibility of *coordination failure* that the economy gets stuck at a Pareto-inferior equilibrium.

If the return factors ($E(\varepsilon) - E(d) - R$) are sufficiently large or the risk factors ($\beta(\sigma_\varepsilon^2 + \sigma_d^2)$) are sufficiently small, the high capital equilibrium will exist. However, if the return factors are sufficiently small or the risk factors are sufficiently large, the high capital equilibrium does not exist and the low capital equilibrium becomes a *unique* equilibrium (Figure 6). Therefore the high equilibrium will prevail if the risk factors dominate the return factors. In this sense, the high equilibrium may be called a *return-dominant* equilibrium while the low equilibrium may be called a *risk-dominant* equilibrium. There exists a tradeoff between risk and return for the equilibrium determination.

D. Interest rate parity with risk premium

Substituting k into k_i in equation (8), we find that the Nash equilibria satisfy the following form of the *interest rate parity* condition *with* a *risk premium*:

$$\{\, r(k) + E(\varepsilon) - E(d)\,\} - R \;=\; \beta\,(\sigma_\varepsilon^2 + \sigma_d^2)\,k \tag{11}$$

This interest rate parity equation is derived from the utility maximization of individual investors and the condition of the Nash equilibrium.

The left-hand side of equation (11) represents the expected excess return (ER) of risky foreign investment over risk free assets. The right-hand side represents the risk premium (RP), which is increasing with respect to *k*. Let us call the left-hand equation the *excess return curve* (ERC) and the right-hand equation the *risk premium line* (RPL). The Nash equilibria correspond to the intersections of the excess return curve and the risk premium line (Figure 7). The representation of Figure 7 corresponds to that of Figure 5. Figure 5 describes the Nash equilibria in terms of the game-theoretic response functions while Figure 7 describes the same Nash equilibria in terms of the excess return curve and the risk premium line.

Figure 7 suggests a natural way to distinguish between *emerging economies* and *underdeveloped economies* among developing countries. Emerging economies may be defined as developing countries with capital greater than k_T. Underdeveloped economies may be defined as developing countries with capital less than k_T. In other words, emerging economies are those countries that converge to the high capital equilibrium (k_H) while underdeveloped economies are those that converge to the low capital equilibrium (k_L). Similarly, *developed economies* may be defined as those countries that have already achieved a sufficiently high level of capital accumulation ($k_{HH} >> \bar{k}$) where decreasing returns dominate.

III. Comparative Statics of Multiple Equilibria

This section studies the comparative static properties of the high and low capital equilibria with respect to changes in the risk and return factors.

A. Expected exchange rate, expected productivity, and the world interest rate

The return factors in the model are expected exchange rate ($E(d)$), expected productivity ($E(\varepsilon)$), and the world interest rate (R). Expected currency appreciation shifts the excess return curve upward by its magnitude (Figure 8). Expected currency appreciation therefore increases the equilibrium level of capital, inducing capital inflows. Conversely, expected currency depreciation shifts the excess return curve downward by its magnitude. Expected currency depreciation therefore reduces the equilibrium level of capital, inducing capital outflows. These results are confirmed by the following derivative at $k = k_H, k_L$:

$$\frac{dk}{dE(d)} = \frac{1}{f''(k) - \beta(\sigma_\varepsilon^2 + \sigma_d^2)} < 0 \tag{12}$$

At k_L and k_H, the slope of the risk premium line is greater than the slope of the excess return curve: that is, $\beta(\sigma_\varepsilon^2 + \sigma_d^2) > f''(k)$. This makes the sign of the denominator strictly negative.

Similarly, expected productivity increase shifts the excess return curve upward by its magnitude. It increases the equilibrium level of capital, inducing capital inflows. Expected productivity decline, on the other hand, reduces the equilibrium level of capital, inducing capital outflows. Similarly, a fall in the world interest rate shifts the excess return curve upward by its magnitude. It increases the equilibrium level of capital, inducing capital inflows. A rise in the world interest rate, on the other hand, reduces the equilibrium level of capital, inducing capital outflows. These results are confirmed by the following derivatives at $k = k_H, k_L$:

$$\frac{dk}{dE(\varepsilon)} = \frac{-1}{f''(k) - \beta(\sigma_\varepsilon^2 + \sigma_d^2)} > 0 \tag{13}$$

$$\frac{dk}{dR} = \frac{1}{f''(k) - \beta(\sigma_\varepsilon^2 + \sigma_d^2)} < 0 \tag{14}$$

Again, $\beta(\sigma_\varepsilon^2 + \sigma_d^2) > f''(k)$ holds at both high and low equilibria and therefore the sign of the denominator becomes strictly negative.

B. Exchange rate risk, productivity risk, and risk aversion

The risk factors are the exchange rate risk (σ_d^2), the productivity risk (σ_ε^2), and the risk aversion (β) of international investors. Increases in those risk factors rotate the risk premium line counter-clockwise. They reduce the equilibrium level of capital, inducing capital outflows (Figure 9). Decreases in the risk factors rotate the risk premium line clockwise. They increase the equilibrium level of capital, inducing capital inflows. These results are confirmed by the following derivative at $k = k_H,\ k_L$:

$$\frac{dk}{d[\beta(\sigma_\varepsilon^2+\sigma_d^2)]} = \frac{k}{f''(k)-\beta(\sigma_\varepsilon^2+\sigma_d^2)} < 0 \qquad (15)$$

Again, $\beta(\sigma_\varepsilon^2+\sigma_d^2) > f''(k)$ holds at both equilibria and therefore the sign of the denominator becomes strictly negative.

IV. Mechanism of Economic Takeoff and Capital Flight

This section studies the mechanism of dynamic adjustment processes between two equilibria or the mechanism of economic takeoff (sudden capital inflows) and capital flight (sudden capital outflows).

A. Sudden capital inflows and outflows

The comparative static analyses in the previous section have revealed that the absolute values of derivatives become greater as the level of capital (k) moves closer to the low critical level (k_{CL}) from below (Figure 8 and 9). This is because the slope of the excess return curve $f''(k)$ increases as k moves up to k_{CL} from below, decreasing the absolute value of the denominator and therefore increasing the absolute values of derivatives. In other words, the effect of a change in the basic factors is greater for the economy that is located closer to the low critical level of capital (k_{CL}). It goes to infinity as the economy moves up to the low critical level (k_{CL}). This corresponds to the moment of *economic takeoff*.

Similarly, the absolute values of derivatives become greater as the level of capital (k) moves closer to the high critical level (k_{CH}) from above (Figure 8 and 9). This is because the slope of the excess return curve $f''(k)$ increases as k moves to k_{CH} from above, decreasing the absolute value of the denominator and therefore increasing the absolute values of derivatives. In other words, the effect of a change in the basic factors is greater for the economy that is located closer to the high critical level of capital (k_{CH}). It goes to infinity as the economy moves down to the high critical level (k_{CH}). This corresponds to the moment of *capital flight*.

Economic takeoff and capital flight are associated with disappearance of one of the multiple equilibria. If the excess return becomes dominant over the risk, the excess return curve and the risk premium line will no longer intersect at k_L. Then the low capital equilibrium disappears and it triggers a takeoff with sudden capital inflows (Figure 8). Conversely, if the risk becomes dominant over the excess return, the risk premium line and the excess return curve will no longer intersect at k_H. Then the high capital equilibrium disappears and it triggers capital flight (Figure 9).

Suppose the economy is initially in the state of underdevelopment at $k = k_L < k_{CL}$. Then a rise in expected productivity will increase the equilibrium level of capital and it will trigger a takeoff if the excess return curve shifts upward above ER(CL) (Figure 8). A similar situation will arise with expected currency appreciation and a fall in the world interest rate. In addition, a fall in productivity risk and exchange rate risk as well as the risk aversion of investors increase the equilibrium level of capital and they will trigger a takeoff if the risk premium line rotates clockwise beyond RP(CL) (Figure 9). Thus the economy will move from $k_L = k_{CL}$ to k_H with the disappearance of the low capital equilibrium.

In contrast, expected currency depreciation, a fall in expected productivity, and a rise in the world interest rate will reduce the equilibrium level of capital and they will trigger capital flight if the excess return curve shifts downward below ER(CH) (Figure 8). In addition, an increase in productivity risk and exchange rate risk as well as the risk aversion of investors reduce the equilibrium level of capital and they will trigger capital flight if the risk premium line rotates counter-clockwise above RP(CH) (Figure 9). Thus the economy will move from $k_H = k_{CH}$ to k_L with the disappearance of the high capital equilibrium.

Those dynamic adjustment processes between two equilibria are naturally described by the following capital flow equation:

$$\frac{dk/dt}{k} = \{r(k) + E(\varepsilon) - E(d) - R - \beta\sigma^2 k\}/\lambda \qquad (16)$$

which is based on the optimal response function (8) and the equilibrium condition (11) (Figure 5 and 7). The speed of adjustment or the amount of capital flows depends on the *costs of adjustment* $(\lambda > 0)$. It also depends on the gap between the excess return curve and the risk premium line. This implies the following: First, the interest rate parity condition with a risk premium (11) will *not* be satisfied during the adjustment period. Therefore the interest parity condition is likely to hold better for developed countries than developing countries because the former are moving along the high equilibrium while the latter are moving between two equilibria. Second, when one of the multiple equilibria disappears, the speed of adjustment initially increases and then declines during the transition period (Figure 8 and 9). That is, the capital inflows and outflows associated with economic takeoff and capital flight will initially rise at an *accelerating* pace and reach their maxima and then slow down to zero as the economy converges to a new equilibrium.

B. Economic takeoff and coordination failure

The existence of the high capital equilibrium is a *necessary* but not a *sufficient* condition for economic takeoff. When there are multiple equilibria, the high equilibrium is not necessarily selected over the low equilibrium. In other words, a *coordination failure* can arise in a *competitive* global capital market. The reasons for coordination failure are the *stability* of two equilibria and the *costs of adjustment* between two equilibria. Because of these two reasons, *history* (initial conditions) matters and *hysteresis* characterizes the dynamic process of economic development.

Suppose that the economy is initially located at a unique low capital equilibrium k_{LL} (Figure 7). Now suppose that changes in the return and risk factors bring the excess return curve and the risk premium line into intersecting three times at k_L, k_T and k_H. Will the economy move from the low to the high capital equilibrium? No, it will not as long as the low capital equilibrium continues to exist because it is *stable* and the *costs of adjustment* exist. The economy will stay at the low equilibrium even if the high equilibrium is brought into existence. In other words, coordination failures will prevent the economy from taking off. For a takeoff to actually occur, it becomes necessary for the expected excess return to continue to rise and/or the risks to continue to fall so that the excess return curve and the risk premium line intersect at the unique high capital equilibrium k_{HH} (Figures 7-9).

One may imagine another possible way in which a developing country could take off. A takeoff would be achieved if international investors could coordinate themselves so that they would invest in a developing country at the same time beyond the threshold level of capital (k_T). This possibility is, however, remote because of difficulties associated with coordinating a large number of investors in a decentralized global capital market in a way that is compatible with their individual incentives. Otherwise, economic development would be easy to achieve. Just let international investors coordinate themselves. Economic growth would naturally follow, and it would be the end of the story. But, that is definitely not the case in reality.

That is why I have modeled a *competitive* global capital market with many investors, under which a *coordination failure* will arise and a developing country can take off only if the low capital equilibrium disappears and the high capital equilibrium becomes a unique equilibrium. The structure of multiple equilibria depends on the relative strength of expectations and risks. Thereby the model shows how expectations and risks determine the final equilibrium of the economy, starting from a historically given initial equilibrium, by changing the *structure* of multiple equilibria.[10] In this way, the model offers deeper insights into the mechanism and problems of modern economic development and international capital flows.

C. Emerging economies and capital flight

Figure 7 shows that a developed country ($k >> \bar{k}$) is much less likely to face capital flight than an emerging economy. A minimum shift in the risk premium line or the excess return curve that triggers capital flight in an emerging economy cannot cause capital flight in a developed country. Only an extremely large shift can trigger capital flight in a developed country because its capital is at the level of decreasing returns and it is located further away from the high critical level of capital (k_{CH}). In short, only the high capital equilibrium exists for a developed country.

On the other hand, an emerging economy that is located near the high critical level is susceptible to capital flight. Such emerging economy ($k_H \approx k_{CH}$) exist if the global capital market is efficient and the number of emerging economies is rising. To see this, suppose there is an increasing number of emerging economies in the global capital market. Then, their increasing demand for capital will induce the world interest rate to go up until some of emerging economies are forced to face capital flight. A rise in the world interest rate shifts the excess return curve down until the supply and demand for international capital are balanced. As a result, there will be an increasing number of emerging economies located near the high critical level (k_{CH}). A slight perturbation of the risk and return factors can trigger capital flight. In short, a combination of an efficient global capital market and an increasing number of emerging economies make capital flight more likely to occur.

The event of capital flight in one developing country will increase the perceived risks (σ^2) for investing in other developing countries. The increased risks can thus trigger capital flight in other emerging economies (Figure 9). Moreover, an increasing number of crises will have adverse effects on the risk aversion of investors (β). Like increased risks, increased risk aversion can trigger capital flight. Therefore the *crisis contagion* of capital flights can spread among emerging economies through the increased risks as well as the increased risk aversion of investors.

V. Policy Implications

Next we discuss the policy implications of the model and, in particular, the role of government in economic development. The previous sections have shown how autonomous changes in the return and risk factors bring about economic takeoff and capital flight. To the extent that the government can control those return and risk factors, it can influence the determination of the final equilibrium. Therefore the role of government is well defined: it is to help the economy achieve and maintain the high capital equilibrium through policies that affect the equilibrium switching factors in the right directions. What are those policies?

With respect to exchange rate policy, a *stable exchange rate* creates an economic environment conducive to large capital inflows and therefore economic development. In normal times, it reduces the exchange rate risk (σ_d^2) and thus helps achieve the high equilibrium with capital inflows (Figure 9). This explains why many developing countries have pegged their local currencies to the dollar, which is the main currency of international investors. In contrast, a flexible exchange rate increases the exchange rate risk, and makes it difficult for a developing country to attract international capital. As the economy matures into a more advanced stage that is located away from the critical level (k_{CH}) and thus faces less risk of capital flight, the government can adopt a more flexible exchange rate.

The importance of a stable exchange rate for economic development suggests an answer to the so-called "open economy policy trilemma." It is well known that the government cannot simultaneously achieve the following three policy goals: (1) free international capital flows, (2) an exchange rate target, and (3) a monetary target. The above discussion about the exchange rate policy suggests that developing countries should seek the (1) and (2) policy goals, while developed countries should seek the (1) and (3) policy goals. The reason is that exchange rate stability is more important for developing countries because they are located closer to the high critical level of capital and therefore susceptible to capital flight, while developed countries are unlikely to experience capital flight because they are located further away from the critical level of capital.

Now suppose that a fixed exchange rate policy lost credibility and expected currency depreciation has triggered capital flight. In other words, the excess return curve has shifted from ER to below ER(CH) in Figure 8. In this case, the role of government is to bring the high capital equilibrium back into existence. This goal can be achieved, for example, if the government devalues the currency *immediately and sufficiently* so that investors expect future *appreciation* instead of *depreciation*. It will shift the excess return curve back to ER and beyond, thereby restoring the high capital equilibrium.

As long as the initial fall in capital is small and the capital remains close enough to the high critical level (k_{CH}), an immediate and sufficient devaluation will bring the economy back to the high capital equilibrium, even though the new equilibrium level may be less than the previous level. It will stop capital flight because the high capital equilibrium is *stable*. The economy will move back to the high capital equilibrium so long as it stays near the equilibrium or above the threshold level of capital (k_T).[11]

When combined with the immediate and sufficient devaluation, *capital controls* can play a useful role in stopping capital flight. If capital controls can limit capital outflows to a minimum amount so that the economy stays above the threshold level (k_T), the economy will return to the high capital equilibrium as soon as the devaluation brings back the high capital equilibrium into existence (figure 8). The reason is of course that the high capital equilibrium is stable. Capital controls can also prevent the economy from moving to the low capital equilibrium by increasing the costs of adjustment, that is, λ in the capital flow equation (16). It will enable the government to earn more time for implementing appropriate policies that bring back the high capital equilibrium into existence again.

However, capital controls can be effective only if they are combined with other policies that help bring the high capital equilibrium back into existence. Without the re-emergence of the high capital equilibrium, capital controls will not be able to stop capital flight because the low capital equilibrium becomes a unique equilibrium. Therefore the appropriate policy response to capital flight is firstly to limit the amount of capital outflows, and secondly to bring back the high capital equilibrium into existence. Capital controls can accomplish the first objective while the immediate and sufficient devaluation can accomplish the second objective.

Government guarantee for foreign debts can be an effective means to achieve the high capital equilibrium. From the viewpoint of international investors, government guarantee is equivalent to purchasing a put option with the option fee paid by taxpayers. A put option transforms the payoff function for investors into a convex shape. It has the same effect as an increase in the expected marginal product $E(\varepsilon)$ and a reduction in the productivity risk σ_{ε}^{2}. It shifts the excess return curve upward and rotates the risk premium line clockwise. Therefore government guarantee increases the likelihood that the country will move from the low to the high capital equilibrium with large capital inflows (Figure 8 and 9).[12]

The model suggests a *two-stage development strategy* that consists of domestic capital accumulation and capital market liberalization. The accumulation of domestic capital has the effect of shifting the risk premium line to the right by that amount (Figure 11). Therefore the following development strategy becomes effective for economic development: In the first stage, domestic capital (k_D) is accumulated sufficiently above the level of k_{DC}. In the second stage, capital market liberalization is implemented. Then, as Figure 11 shows, the high capital equilibrium (k_H) becomes a unique equilibrium and the optimal response of international investors is to increase their investment in the developing country. The economy will therefore take off through *autonomous* inflows of international capital ($k_H - k_D$).

The *capital market liberalization* should be implemented only after domestic capital is sufficiently accumulated. There are two reasons: First, capital market liberalization will not help the economy to achieve the high capital equilibrium if domestic capital is less than k_{DC}. Second, capital market liberalization may bring about some outflows of domestic capital. Therefore, it is necessary for the success of the strategy that domestic capital (k_D) remains above the critical level (k_{DC}) after some outflows of domestic capital due to the capital market liberalization. Otherwise the economy will be trapped in the low capital equilibrium.

The *globalization* of capital markets is associated with growth in the number of international investors. An increase in the number of investors implies an *equi-proportionate* shift of the excess return curve to the left from the viewpoint of an international investor (Figure 10). In other words, the amount of foreign investment per investor declines to finance a given amount of total investment in a developing country. It means enhanced risk-sharing among investors and reduced risk for each investor. It can trigger a takeoff. Thus the globalization of capital markets helps achieve the transformation of less developed countries into emerging economies.

Last but not least, the *role of government* must change with different stages of economic development. During the early stage of development characterized by increasing returns (complementarity), the role of government is to achieve the high equilibrium through policies that affect the equilibrium switching factors (that is, the risk and return factors) in the right directions. However, after the high equilibrium is achieved and the risk of capital flight is reduced, the role of government must change. Those interventional policies that have been helpful in achieving the high equilibrium in the early stage of development become distortionary as the economy enters into the late stage of development, which is characterized by decreasing returns (substitutability). Therefore they must be abolished after the economy has achieved sustainable development.

VI. Conclusion

In line with large literature in development economics, I have argued that in the early stage of development, investments are *complementary* and therefore production exhibits *increasing returns* to capital. Then increasing returns create *strategic complementarities* among the optimal portfolio decisions of international investors. The strategic complementarities give rise to two stable *multiple equilibria*: the low and high capital equilibria. These equilibria satisfy the *interest rate parity* condition with a *risk premium*, which however does not hold during the transition from one equilibrium to another.

The model has shown how expectations and risks determine the final equilibrium of the economy, starting from a historically given initial equilibrium, by changing the *structure* of multiple equilibria. In particular, it has shown how changes in the expected excess return and risks trigger sudden capital inflows and outflows. If the expected excess return dominates the risks, the low equilibrium will disappear. Then capital inflows will bring about *economic takeoff*. Conversely, if the risks dominate the expected excess return, the high equilibrium will disappear. Then *capital flight* will happen. The same mechanism generates both economic takeoff and capital flight. An *emerging* economy is susceptible to capital flight because its capital is near the high critical level. A small increase in the world interest rate, for example, can trigger and spread capital flights among emerging economies.

A *competitive* global capital market is prone to a *coordination failure* due to the stability of the low capital equilibrium, To the extent that the government can influence the risk and return factors, it can affect the determination of the final equilibrium. Given the multiple equilibria, the *role of government* is to achieve and maintain the high capital equilibrium through policies that affect the risk and return factors in the right directions. Those policies may include exchange rate policy, government guarantee, and capital controls. However, after capital is sufficiently accumulated so that *decreasing returns* become dominant, those interventional policies must be abolished. The reason is that multiple equilibria no longer exist and the justification for the government policies ceases to exist. Therefore the role of government must change in accordance with the different stages of development.

The *globalization* of capital markets helps developing countries achieve the high equilibrium through risk-sharing among the increasing number of international investors. Developing countries, for their part, can implement a *two-stage development strategy* that consists of domestic capital accumulation in the first stage and capital market liberalization in the second stage. This strategy provides a developing country with an opportunity to take off with *autonomous* capital inflows from the global capital market. However, if capital market liberalization is implemented before a sufficient accumulation of domestic capital, the developing country may be trapped in the low equilibrium. Therefore the *order* of policy implementation becomes crucial for its success.

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Footnotes

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[1] Economic developments leading up to the Asian crisis are surveyed and discussed in Corsetti, Pesenti, and Roubini (1998), Radelet and Sachs (1998), Furman and Stiglitz (1998), World Bank (1998a, 1998b), and Ito (1999).

[2] Early examples include Young (1928), Rosenstein-Rodan (1943), Singer (1949), Nurkse (1953), Scitovsky (1954), Fleming (1955), Lewis (1955), and Hirschman (1958). Murphy, Shleifer, and Vishny (1989) present a modern formulation of the "big push" model. Matsuyama (1991, 1992) extends their model into a dynamic model. Kremer (1993) presents a model that emphasizes complementarity between different components and inputs in a production process. Aoki, Kim, and Okuno-Fujiwara (1996) also emphasize the complementarity between investments.

[3] The inverted-U shaped growth pattern is discussed in Baumol et al. (1989), Dollar

(1992), King and Rebelo (1993), Easterly (1994), and Ito et al. (2000).

[4] Other arguments are as follows: First, because technology is embodied in capital, the accumulation of a certain amount of capital is a prerequisite for fully taking advantage of existing technology. It is not possible to scale down the size of production without causing inefficiency in the use of technology and capital. This gives rise to increasing returns to capital in the small scale of production. Second, there is a large pool of potential workers who can contribute to production only if they are equipped with capital. This prevents the force of decreasing returns from taking hold. Nevertheless, the number of workers is ultimately limited and resource constraints eventually set in. Therefore, decreasing returns will eventually dominate.

[5] In addition to the growth data of developed and developing countries that are discussed earlier, there exists empirical evidence for increasing and decreasing returns in the course of economic development. Okazaki (1996) has found a high correlation of investments across industries (electricity, steel, textiles, chemicals, machinery, transportation) in 1953-62 when Japan first took off after the war. The correlation, however, dropped and in some cases became negative in 1963-73 when Japan kept high growth but entered into a more advanced stage of development. Using world data and U.S. nineteenth century data, Ades and Glaeser (1999) have found that the division of labor is important for development, but too much specialization is bad for growth. The division of labor exploits complementarity between specialized tasks. As the division of labor is closely associated with the division of capital, it suggests that investments are initially complementary, but

eventually become substitutable.

[6] The moment generating function of a random variable with the normal distribution is given by $M_x(t) := E(e^{tx}) = \exp(\mu t + \frac{1}{2}\sigma^2 t^2)$ where $x \sim N(\mu, \sigma^2)$. Equation (6) follows from an application of this formula.

[7] We can extend the static optimal portfolio model to a dynamic optimal portfolio model, using a stochastic control method with *Brownian* motions However, the dynamic optimal portfolio solution has the same structure as the static one with expected excess return in the numerator and risk factors in the denominator (see Merton (1990) and Duffie (2001)). Therefore, the conclusions of this paper continue to hold in the dynamic optimal portfolio model without any substantial modifications.

[8] Cooper and John (1988) and Cooper (1999) discuss the concept of strategic complementarity and strategic substitutability. Strategic complementarity is often associated with multiple equilibria and multiplier effects.

[9] One may argue that the Pareto-ranking should be based on people in a developing country, not on international investors. However, there is always a Pareto-improving income distribution that can make everyone in a developing country better off with a *larger* pie. The simplest way to improve the lives of people in a developing country is by economic growth. Therefore the high equilibrium will be preferred by both people in a developing country and international investors.

[10] Using a *complex* dynamic mechanism and starting from a *non-equilibrium* point, Krugman (1991) has argued that if adjustment costs are small, *expectations* rather

than *history* can be decisive in the determination of the final equilibrium. However, the question of "history versus expectations" for equilibrium selection is misleading because the *structure* of multiple equilibria generally depends on expectations. In a fully specified model, expectations do not just pick a final equilibrium from a fixed set of multiple equilibria; they affect the entire structure of multiple equilibria. Moreover, starting from a non-equilibrium point leaves a nagging question unanswered---how did it get there in the first place? The present model shows how expectations as well as risks determine the final equilibrium of the economy, starting from a historically given initial *equilibrium* point, by changing the *structure* of multiple equilibria. There is no intrinsic conflict between history and expectations. Instead the conflict exists between expectations and risks, which compete in the determination of the final equilibrium.

[11] In fact, the Asian countries hit by currency crises in 1997 began to recover with the *sufficient* devaluation that occurred after they gave up their initial attempts to defend currencies. The model suggests that the Asian crisis could have been stopped much earlier and therefore would have been less severe if they had devalued currencies *immediately*. One must take it into consideration, however, that devaluation has a negative side-effect of weakening the balance-sheet of firms with dollar-denominated debts (cf., Krugman (1999)).

[12] Moral hazard models argue that government guarantee causes crises because it brings *excessively large* capital inflows that are to be followed by capital flight (See, for example, Dooley (2000)). However, a developing country trapped in the low capital equilibrium is suffering from *excessively small* capital inflows. The purpose

of government guarantee is to help the economy move from the low to the high capital equilibrium by encouraging capital inflows. Government guarantee may result in *excessively large* capital inflows if it continues to exist even after the economy has achieved successful economic development.