# Economic Takeoff and Capital Flight

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**Abstract**

This paper presents a model of economic takeoff and capital flight with free international capital flows. In the early stage of development, investments are complementary and production exhibits increasing returns to capital. The increasing returns give rise to strategic complementarity between the optimal portfolio decisions of international investors. It produces two stable Nash equilibria: a low and high capital equilibrium. Switches between two equilibria represent economic takeoff and capital flight. At the high capital equilibrium, the interest rate parity with risk premium holds and international capital allocation is efficient. The model identifies the return and risk factors that can trigger switches between two equilibria. The role of government is to achieve the high capital equilibrium through policies that affect the return and risk factors. The globalization of capital markets helps achieve economic takeoff through risk-sharing among the increasing number of investors. The development strategy of domestic capital accumulation and capital market liberalization can achieve economic takeoff. However, a developing country may be trapped in the low capital equilibrium if the liberalization is implemented before a sufficient accumulation of domestic capital.

# I. Introduction

One important development in the world economy during the last few decades has been the extended liberalization and globalization 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 growing 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*. In the global economy with an integrated capital market, sudden capital inflows and outflows correspond to the *economic takeoff* and *capital flight* of developing countries. To understand the mechanism of modern economic development, we need to understand why and how the sudden inflows and outflows of international capital occur. Thus, we ask the following questions: What is the mechanism of sudden capital inflows and outflows? What triggers such capital inflows and outflows? What are the conditions for economic takeoff and capital flight? What is the role of government in economic development?

This paper presents a model of economic takeoff and capital flight with free international capital flows. The model emphasizes the importance of *strategic complementarity* between the *optimal portfolio decisions* of international investors. In the early stage of economic development,

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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).

investments are complementary and the aggregate production exhibits *increasing returns* to capital. The complementarity between investments or the increasing returns to capital give rise to strategic complementarity between the actions of international investors. The strategic complementarity produces *two stable Nash equilibria*: a low and high capital equilibrium. Switches between two equilibria represent economic takeoff and capital flight. Thus, economic takeoff and capital flight emerge from the same mechanism of modern economic development, which is characterized by increasing returns and multiple equilibria. It is not a coincidence, therefore, that capital flights are observed among those countries that have recently achieved a successful takeoff into development.

Many papers in development economics have argued that basic investments are complementary and aggregate production exhibits increasing returns in the early stage of development. They 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

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[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 importance of complementarity between investments and discuss its implications for the role of government.

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* to capital is inconsistent with the growth data of developing countries, while 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 2 shows, 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, the phenomenon of *convergence* is observed among developed countries.

However, the implication of the conventional production function is incompatible with the growth data of developing countries. No phenomenon of 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 implies. Thus the conventional production function does not apply to developing countries. Furthermore, the lack of convergence suggests multiple equilibria.

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 (economic 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 to capital, the *optimal portfolio decisions* of international investors and their non-cooperative interaction give rise to two stable Nash equilibria: a *Pareto-inferior* low capital equilibrium and a *Pareto-superior* high capital equilibrium. Switches between two equilibria correspond to the economic takeoff and capital flight of developing countries. They are triggered by changes in the basic return and risk factors: (i) expected exchange rate, (ii) expected productivity, (iii) the world interest rate, (iv) exchange rate risk, (v) productivity risk, and (vi) the risk aversion of international investors.

Now, given the Pareto-ranked multiple equilibria and the basic factors for equilibrium selection, the *role of government* can be well defined. It is to achieve the high capital equilibrium through policies that can affect the return and risk factors. Those policies potentially include fixed exchange rate policy, government guarantee, and capital control. The *development strategy* of domestic capital accumulation and capital market liberalization can also help achieve the high capital equilibrium. However, the economy may be trapped in the low capital equilibrium if the liberalization is implemented before the sufficient accumulation of domestic capital.

I will elaborate on those points, using a formal model. The rest of the paper is organized as follows: Section II presents a model of optimal portfolio decisions of international investors and Nash equilibria. Section III presents the comparative static analyses with respect to the return and risk factors. Section IV analyzes the mechanism of economic takeoff and capital flight or switching between two equilibria. Section V studies the role of government and development strategy. Section VI concludes the paper.

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[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).

## II. The Model of Optimal Portfolio and Nash Equilibria

The model assumes the following situation: Capital markets are integrated and form *an efficient 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 aggregate 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. Their optimal portfolio decisions and their non-cooperative interactions produce *two stable Nash equilibria* with high and low capital stocks. Switches between two equilibria represent *economic takeoff* and *capital flight*.

## A. Production function with increasing and decreasing returns

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

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[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 diminishing returns from taking hold. Nevertheless, the number of workers is ultimately limited and resource constraints eventually set in. Therefore, diminishing returns will eventually dominate.

feedback effects on itself can make the investment profitable. Consequently, investments are complementary in the 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, the aggregate production function 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 takes the following form:

$$F(k) = f(k) + ek \qquad (1)$$

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

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

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[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.

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. 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 a takeoff into 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 many identical international investors ($i$ = 1,2,3,…,n). Each investor has total wealth $w$ available for investment. 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 $\tilde{r}$. 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 $\tilde{r}$.

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. The rate of return on foreign investment ($\tilde{r}$) depends on the *average* investment of other investors ($k$) as follows:

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

where $r(k) = f'(k) - 1$ (Figure 4). The rate of return ($\tilde{r}$) also depends on a

marginal productivity shock ( $e$ ).    International investors thus face *productivity risk*.

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

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

$$\tilde{p} = (1 + r(k) + e - \tilde{d})k_i + (1 + R)(w - k_i) \tag{4}$$

where

$$e \sim N(E(e), s_e^2) \quad \text{and} \quad \tilde{d} \sim N(E(d), s_d^2) \tag{5}$$

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.  Stochastic variables $e$ and $\tilde{d}$ are assumed to be independent for the sake of simplicity.

International investors maximize their expected utilities that depend on the return on their portfolio ($\tilde{p}$).  The utility function is given by the following form of constant absolute risk aversion (CARA):

$$u(\tilde{p}) = -\exp(-b\,\tilde{p}) \tag{6}$$

where $b$ is the parameter of constant absolute risk aversion ($b > 0$).

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

$$\max_{k_i} \quad E(u(\tilde{p})) = -\exp\{-b\,[\,E(\tilde{p}) - \tfrac{1}{2}\,b\,s_p^2\,]\} \tag{7}$$

where the equality is established by the calculation method that one uses to find the moment generating function for the normal distribution.

The above expected utility maximization problem is equivalent to the following maximization problem:

$$\max_{k_i} f(k_i, k) \; = \; (\,1 + r(k) + E\,(e) - E\,(d)\,)\,k_i \; + (1 + R)(w - k_i) - \tfrac{1}{2}\,b\,s^2 k_i^{\,2} \qquad (8)$$

where $s^2 \equiv s_e^2 + s_d^2$. This involves only the means and variances of stochastic variables.

The first order condition for maximization is obtained as follows:

$$k_i \;\; = \;\; \frac{r(k) + E\,(e) - E\,(d) - R}{b\,(s_e^2 + s_d^2)} \qquad (9)$$

This gives the *optimal* action ($k_i$) of investor *i* as a function of the *average* action ($k$) of other investors. It is the *best response function* of $k_i$ with respect to $k$. The second order condition is satisfied because $b(s_e^2 + s_d^2) > 0$.

The optimal portfolio solution clearly shows a tradeoff between *risk* and *return*. The numerator expresses the expected excess rate of return over the risk free assets while the denominator expresses the risk factors associated with investing in a foreign country. The optimal investment level $k_i$ is increasing with respect to the *return* in the numerator and decreasing with respect to the *risk* in the denominator. There is a clear tradeoff between risk and return in the optimal portfolio decision.

## C. Strategic complementarity and multiple Nash equilibria

We define strategic complementarity and strategic substitutability in terms of the function $f_{12}(k_i, k)$. International investors face the situation of

*strategic complementarity* if $f_{12}(k_i, k) > 0$. 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 $f_{12}(k_i, k) < 0$. It means that the optimal investment of an investor *decreases* if other investors increase their investment. [6] Therefore, strategic substitutability makes capital flows *stable* while strategic complementarity makes capital flows *unstable*.

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

$$f_{12}(k_i, k) = r'(k) = f''(k) \tag{10}$$

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 of development while they become *stable* in the later stage of development.

Strategic complementarity among the optimal portfolio decisions of international investors produces multiple Nash equilibria: a low capital equilibrium and a high capital equilibrium. 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 $j$.

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[6] 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.

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). Both high and low capital equilibria are stable Nash equilibria because an investor *i* has no incentive to deviate from $k_i = k_H$ if other investors choose $k = k_H$ and also from $k_i = k_L$ if other investors choose $k = k_L$. Although there is another equilibrium ($k_T$) between $k_L$ and $k_H$, it turns out to be unstable. A small perturbation will trip the unstable Nash equilibrium ($k_T$), and the economy will move to either $k_H$ or $k_L$.[7] 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

$$f(k_H, k_H) - f(k_L, k_L) = \tfrac{1}{2} b s^2 \{ (k_H)^2 - (k_L)^2 \} > 0 \qquad (11)$$

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. 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 ($E(e) - E(d) - R$) are sufficiently large or the risk factors ($b(s_e^2 + s_d^2)$) 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).

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[7] A similar dynamic process may be obtained from a modified neoclassical growth model. For example, equation (9) suggest the following capital flow equation: $(dk/dt)/k = r(k) + E(e) - E(d) - R - bs^2 k$. It produces a dynamic process with multiple equilibria, which is analogous to the adjustment process of my model. I owe this point to Delano Villanueva.

Therefore the high capital equilibrium will prevail if the risk factors dominate the return factors. In this sense, the high capital equilibrium may be called a *Return-dominant* equilibrium while the low capital equilibrium may be called a *Risk-dominant* equilibrium. There exists a tradeoff between risk and return for the equilibrium selection.

## D. Interest rate parity with risk premium

Substituting $k$ into $k_i$ in equation (9), we find that the Nash equilibria satisfy the following form of the *interest rate parity with risk premium*:

$$\{\, r(k) + E(e) - E(d)\,\} - R \;=\; b\,(s_e^2 + s_d^2)\,k \qquad (12)$$

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 (12) represents the expected excess return (ER) of risky investment in a foreign county 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 markets* and *non-emerging markets* among developing countries. Emerging markets may be defined as developing countries with the capital stock greater than $k_T$. Non-emerging markets may be defined as developing

countries with the capital stock less than $k_T$. Emerging markets are those countries that converge to the high capital equilibrium ($k_H$) while non-emerging markets are those that converge to the low capital equilibrium ($k_L$). *Developed countries* may be defined as those countries that have already achieved a high level of capital accumulation ($k_{HH} \gg \bar{k}$) where diminishing returns dominate.

## III. Comparative Statics of Return and Risk Factors

This section studies the comparative static properties of the high and low capital equilibrium with respect to the return and risk 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 ($E(e)$), and the world interest rate ($R$). Expected currency depreciation shifts the excess return curve downward by its magnitude (Figure 8). Expected currency depreciation therefore reduces the equilibrium capital stock, inducing capital outflows. Conversely, expected currency appreciation shifts the excess return curve upward by its magnitude. Expected currency appreciation therefore increases the equilibrium capital stock, inducing capital inflows.

Those results are confirmed by the following derivative at $k = k_H, k_L$:

$$\frac{dk}{dE(d)} = \frac{1}{f''(k) - b\,(s_e^2 + s_d^2)} < 0 \qquad (13)$$

At $k = k_H, k_L$, the slope of the risk premium line is larger than the slope of

the excess return curve: that is, $b \, (s_e^2 + s_d^2) > f''(k)$. 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 capital stock, inducing capital inflows. Expected productivity decline, on the other hand, reduces the equilibrium capital stock, inducing capital outflows. A fall in the world interest rate shifts the excess return curve upward by its magnitude. It increases the equilibrium capital stock, inducing capital inflows. A rise in the world interest rate, on the other hand, reduces the equilibrium capital stock, inducing capital outflows.

These results are confirmed by the following derivatives at $k = k_H, \, k_L$:

$$\frac{dk}{dE(e)} = \frac{-1}{f''(k) - b \, (s_e^2 + s_d^2)} > 0 \qquad (14)$$

$$\frac{dk}{dR} = \frac{1}{f''(k) - b \, (s_e^2 + s_d^2)} < 0 \qquad (15)$$

Again the sign of the denominator is strictly negative.

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

The risk factors in the model are the exchange rate risk $(s_d^2)$, the productivity risk $(s_e^2)$, and the risk aversion $(b)$ of international investors. Increases in those risk factors rotate the risk premium line counter-clockwise. They reduce the equilibrium capital stock, inducing capital outflows (Figure 9). Decreases in the risk factors, on the other hand, rotate the risk premium line clockwise. They increase the equilibrium capital stock, inducing capital inflows. In short, increased risks reduce the equilibrium capital stock, inducing capital outflows while reduced risks increase the equilibrium capital

stock, inducing capital inflows.

These results are confirmed by the following derivative at $k = k_H$, $k_L$:

$$\frac{dk}{d[b(s_e^2 + s_d^2)]} = \frac{k}{f''(k) - b(s_e^2 + s_d^2)} < 0 \qquad (16)$$

Again the sign of the denominator is strictly negative.

## IV.  Mechanism of Economic Takeoff and Capital Flight

This section studies the mechanism of switching between two equilibria or the mechanism of economic takeoff and capital flight in modern economic development.

## 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 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 down 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 onto the high critical level ($k_{CH}$). This corresponds to the moment of *capital flight*.

Likewise, 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 $f''(k)$

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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.*

The high capital equilibrium will suddenly disappear if the risk factors overtake the return factors, bringing the economy below the high critical level ($k_{CH}$). If the risk premium line and the excess return curve no longer intersect at $k_H$, capital outflows will suddenly occur. Conversely, the low capital equilibrium will suddenly disappear if the return factors overtake the risk factors, bringing the economy above the low critical level ($k_{CL}$). If the excess return curve and the risk premium line no longer intersect at $k_L$, capital inflows will suddenly emerge.

Suppose the economy is initially at $k = k_H > k_{CH}$. Then expected currency depreciation will reduce the equilibrium level of capital and trigger capital flight when the excess return curve falls below ER(CH) (Figure 8). Then the economy will move from $k_H = k_{CH}$ to $k_L$, inducing capital outflows. This represents capital flight. A similar situation will arise with expected productivity decline and a fall in the world interest rate.

In addition, a rise in productivity risk and exchange rate risk as well as the risk aversion of international investors reduces the equilibrium level of capital. They will trigger capital flight when the risk premium line rotates counter-clockwise beyond RP(CH) (Figure 9). The economy will move from $k_H = k_{CH}$ to $k_L$ with sudden capital outflows.

In contrast, expected currency appreciation, expected productivity increase, a fall in the world interest rate, as well as decreases in productivity risk, exchange rate risk, and the risk aversion of investors create an environment conducive to achieving economic takeoff with large capital inflows. They shift the excess return curve upward and rotate the risk

premium line clockwise (Figure 8 and 9). The economy will move from $k_L = k_{CL}$ to $k_H$ with the disappearance of the low capital equilibrium. This represents a takeoff with large capital inflows.

## B. Emerging economies and capital flight

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 a viewpoint of international investors (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 helps trigger a takeoff into development. Thus the globalization of capital markets helps achieve the transformation of developing countries into emerging economies.

Emerging economies ($k > k_{CH}$) are more likely to face capital flight than developed countries ($k \gg \bar{k}$). The minimum shift in the risk premium line or the excess return curve that can trigger capital flight in a developing country cannot cause capital flight in a developed country (Figure 7). Only larger shifts can trigger capital flight in developed countries. This is because developed countries are operating their production at the level of diminishing returns and are located further away from the high critical level of capital ($k_{CH}$).

The emerging economies that are located near the high critical level are susceptible to capital flight. Those *marginal emerging economies* ($k_H \approx k_{CH}$) exist if international capital markets are efficient and the number of emerging economies is large. To see this point, suppose there is an increasing number of emerging economies in the efficient global capital market. Then, their increasing demand for international capital will induce the world interest rate to go up until some of the emerging economies are

attacked by capital flight. A rise in the world interest rate shifts the excess return curve down until the supply and demand for international capital in developing countries are balanced. Therefore there are many emerging economies near the high critical level of capital ($k_{CH}$). In short, a combination of an efficient global capital market and a large number of emerging economies make capital flight more likely to occur. A slight perturbation of the basic factors can trigger capital flight in marginal emerging economies.

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

## C. Economic takeoff and coordination failure

The existence of the high capital equilibrium is a *necessary* condition for capital inflows and economic development. Is it also a *sufficient* condition? The answer is no. When there exist multiple equilibria, the high capital equilibrium is not necessarily selected over the low capital equilibrium. In other words, *coordination failures* can arise. The reason for coordination failures in the model is the *stability* of both high and low capital equilibria. *History* matters and the phenomenon of *hysteresis* can arise.

Suppose that the economy is initially located at the 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 capital equilibrium to the high capital equilibrium? In general, it will not move so long as the low capital equilibrium continues to exist. This is because the low capital equilibrium is stable. The economy will stay at the low capital equilibrium even if the high capital equilibrium exists.

There are two ways in which a developing country can achieve economic takeoff in this situation. First, the simplest case is that the expected excess return increases and the risks decline so that the excess return curve and the risk premium line intersect at the unique high capital equilibrium $k_{HH}$ (Figure 7). If this happens, the economy will start economic takeoff with large capital inflows until it converges to the high capital equilibrium ($k_{HH}$). Second, if international investors can coordinate their investments so that they invest in a developing country at the same time above the threshold level ($k_T$). This possibility seems, however, to be small because of difficulties and costs associated with coordinating a large number of international investors in a decentralized global capital market in a way that is compatible with their individual incentives.[8]

## V.  Policy Implications

This section studies the policy implications of the model. We have seen in the previous sections how autonomous changes in the return and risk factors can bring about economic takeoff and capital flight. To the extent that the government can control those return and risk factors, it can influence the equilibrium selection of the economy. Therefore the developmental role of government can be well defined: It is to help achieve

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[8] In the above argument, I am assuming that adjustment costs are large so that history dominates expectations in the selection of the final equilibrium. In the presence of large adjustment costs, *history* determines the equilibrium. *Expectations* can be important if adjustment costs are small. See Krugman (1991) for the discussion of history versus expectations in the presence of multiple equilibria.

the high capital equilibrium through policies that can affect the return and risk factors in the right directions. What are those policies?

With respect to exchange rate policy, a *fixed exchange rate* creates an economic environment conducive to large capital inflows and therefore economic development. It reduces the exchange rate risk ($s_d^2$) and thus helps achieve the high capital equilibrium with capital inflows (Figure 9). This seems to be the main reason why many developing countries have pegged their local currencies to the 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.[9]

Suppose that 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, restoring the high capital equilibrium.

As long as the initial fall in capital is small and capital remains close enough to the high critical level ($k_{CH}$), an immediate and sufficient

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[9] The importance of a stable exchange rate for development suggests an answer to the open economy "policy trilemma." It is well known that the government cannot simultaneously maintain 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.

devaluation will bring the economy back to the high capital equilibrium even though the new equilibrium 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.[10]

When combined with the immediate and sufficient devaluation, *capital controls* can play an important role in stopping capital flight. If capital controls can limit capital outflows to a minimum amount, the economy will return to the high capital equilibrium as soon as the devaluation brings the equilibrium back into existence. This is because the high capital equilibrium is stable (Figure 7). Capital controls can also prevent the economy from moving to the low capital equilibrium by increasing the costs of capital movements for international investors.[11] 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 the only equilibrium. Therefore, the appropriate policy response to capital flight is firstly to limit the amount of capital outflows, and secondly to bring the high capital equilibrium back into existence. Capital controls can accomplish the first objective while the immediate and sufficient devaluation can accomplish the second objective.

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[10] 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*. Devaluation, however, has a negative side-effect that it weakens the balance-sheet of firms with dollar-denominated debts (cf., Krugman (1999)).

[11] In the presence of large adjustment costs, history dominates expectations in the selection of the final equilibrium (cf., Krugman (1991)). Therefore, capital controls make it less likely for the economy to shift to the low capital equilibrium as long as the high capital equilibrium exists.

*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 into a convex shape. It has the same effect as an increase in the expected marginal product $E(e)$ and a reduction in the productivity risk $s_e^2$. It shifts the excess return curve upward and rotates the risk premium line clockwise. Therefore, government guarantee increases the probability that the economy will achieve economic takeoff (Figure 8 and 9).[12]

The model suggests the *two-stage development strategy* 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 two-stage development strategy becomes an effective means of achieving the high capital equilibrium: In the first stage, domestic capital ($k_D$) should be accumulated sufficiently above the level of $k_{DC}$. In the second stage, capital market liberalization should be implemented. Then, as Figure 11 shows, the high capital equilibrium ($k_H$) becomes a unique Nash equilibrium and the optimal response of international investors is to increase their investment in the developing country. The country will thus achieve economic takeoff through the *autonomous* inflows of international capital ($k_H - k_D$).

The capital market liberalization should be implemented only after a sufficient accumulation of domestic capital is achieved. There are two

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[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 (cf., 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 shift 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 the high capital equilibrium.

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 will bring about some outflows of domestic capital. Therefore, it becomes necessary for achieving the high capital equilibrium that domestic capital ($k_D$) remains above the critical level ($k_{DC}$) after some outflows of domestic capital due to the liberalization. Otherwise the country will be trapped in the low capital equilibrium.

The *role of government* must change with the stages of economic development. During the stage of *increasing returns* and *complementarity*, the government can help achieve the high capital equilibrium through policies that affect the return and risk factors in the right directions. However, after the high capital equilibrium is achieved and the risk of capital flight is reduced, the role of government must change. Those interventional policies become distortionary for the economy that is characterized by *decreasing returns* and *substitutability*. Therefore, they must be abolished after the economy has achieved a successful takeoff.

## VI. Conclusion

I have presented a model of economic takeoff and capital flight with free international capital flows. In the early stage of development, investments are complementary and aggregate production exhibits *increasing returns* to capital. The increasing returns lead to *strategic complementarity* between the *optimal portfolio decisions* of international investors. The result is *multiple Nash equilibria*: a high capital equilibrium and a low capital equilibrium. The model has shown how changes in the return and risk factors can trigger switches between two equilibria. Switches between two equilibria correspond to the economic takeoff and capital flight of a developing country.

At the high capital equilibrium, the *interest rate parity with risk*

*premium* holds and international capital allocation is efficient. If the risk factors dominate the return factors, the high capital equilibrium will disappear. Then, *capital flight* becomes inevitable. Conversely, if the return factors dominate the risk factors, the low capital equilibrium will disappear. Then, autonomous capital inflows will bring about the *economic takeoff* of the developing country.

To the extent that the government can influence the return and risk factors, it can affect the selection of the equilibrium in the economy. Therefore the *role of government* is to help achieve the high capital equilibrium through policies that affect the return and risk factors. Fixed exchange rate policy, government guarantee, and capital control potentially help achieve the high capital equilibrium. However, after the economy is sufficiently developed to the level of *decreasing returns*, those policies become distortionary and therefore should be abolished.

The *globalization* of capital markets helps achieve the high capital equilibrium through risk-sharing among the increasing number of investors. The *two-stage development strategy* of domestic capital accumulation and capital market liberalization can also help achieve the high capital equilibrium. It enables the economy to achieve economic takeoff with *autonomous* capital inflows from the global capital market. However, the economy may be trapped in the low capital equilibrium if the liberalization is implemented before the sufficient accumulation of domestic capital.

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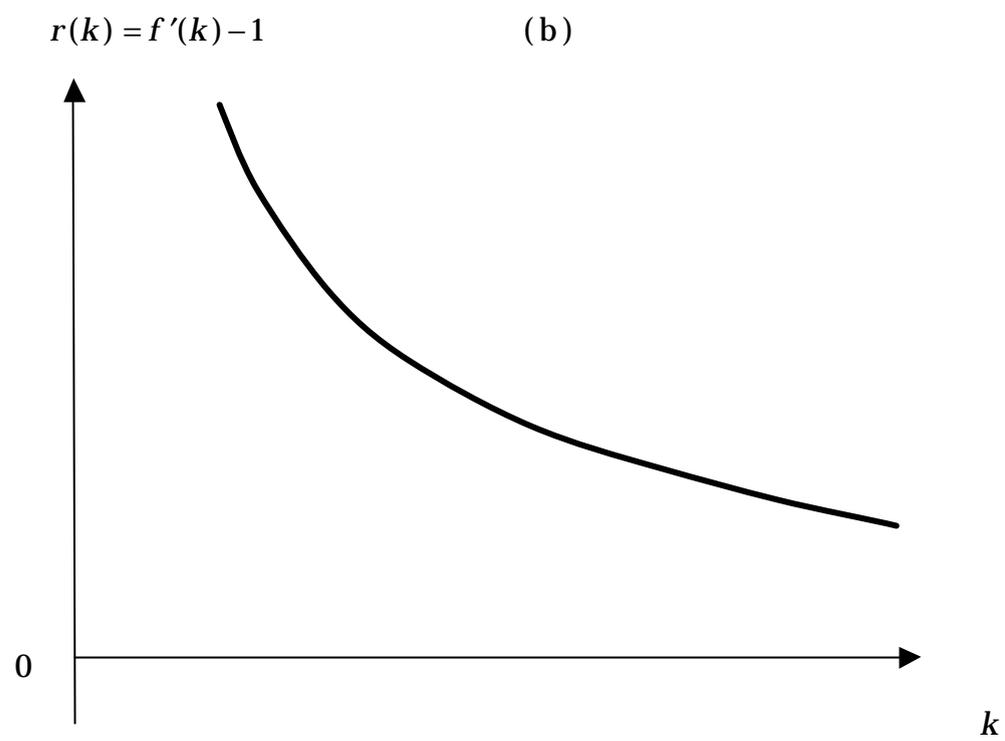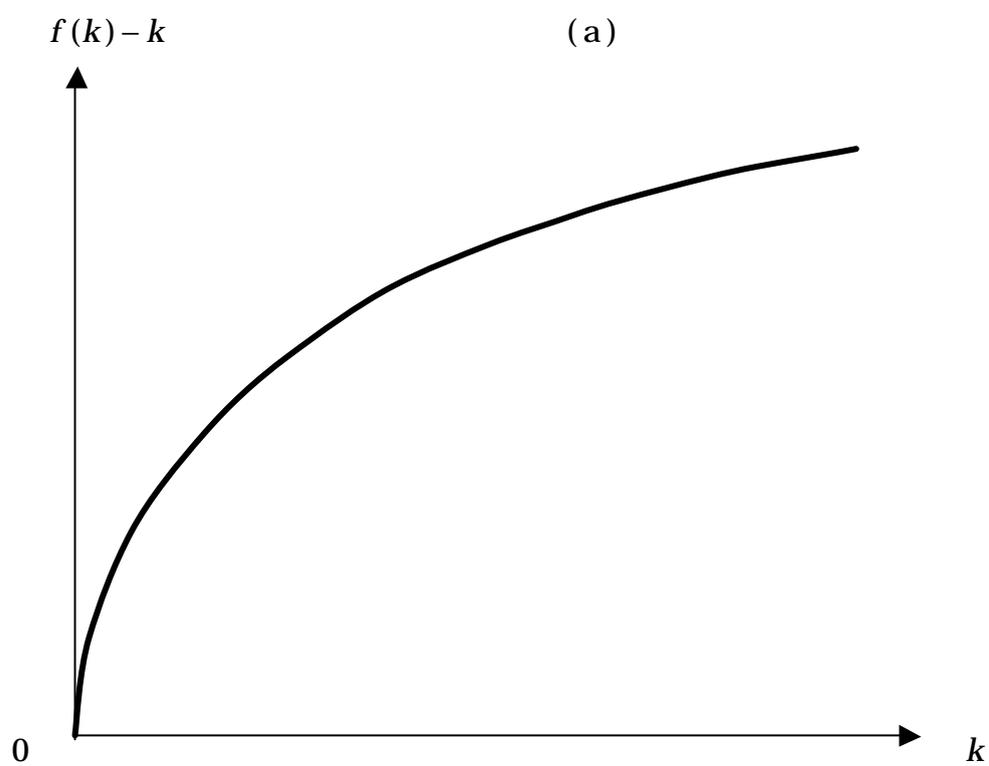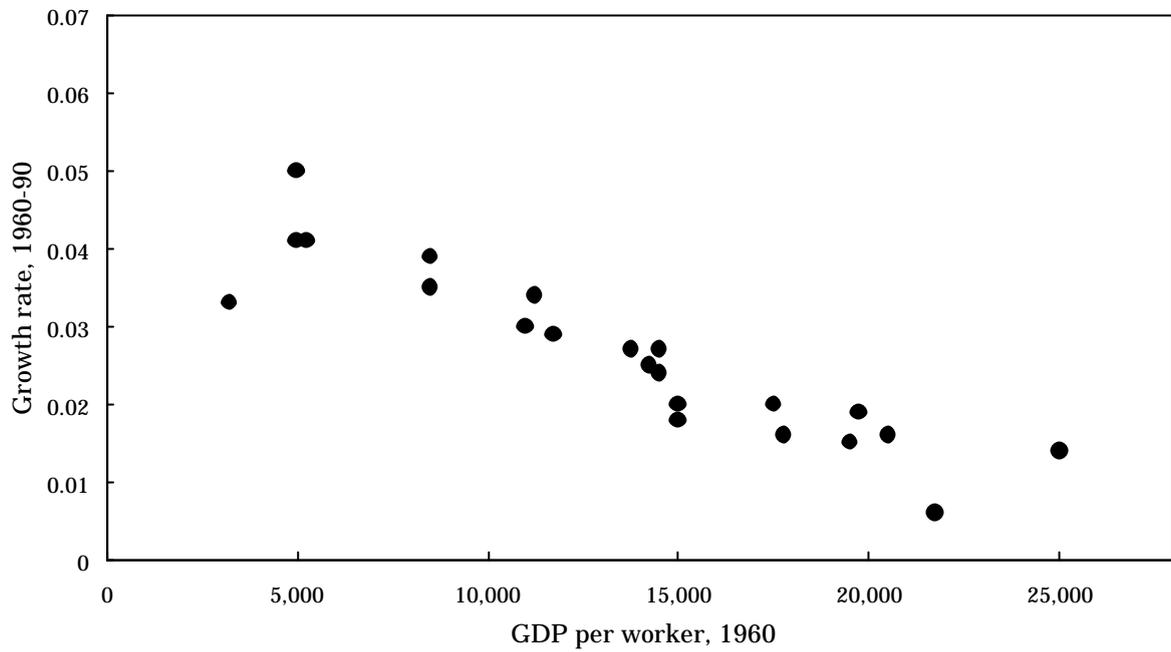
Figure 1  The Conventional Production Function with Decreasing Returns

$f(k) - k$              (a)

0          $k$

$r(k) = f'(k) - 1$             (b)

0          $k$

## Figure 2  Development Stages and Growth Rate (OECD Countries)



Source:  Penn World Tables, Mark 5.6

## Figure 3  Development Stages and Growth Rate (104 Countries)
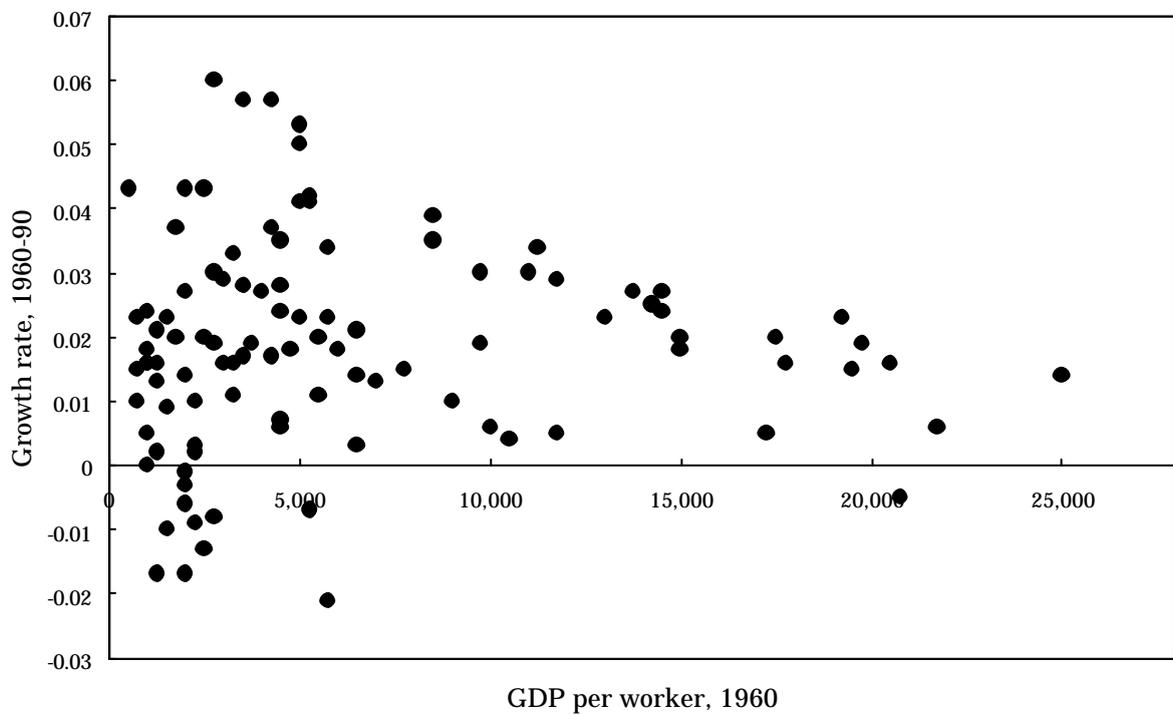


Source:  Penn World Tables, Mark 5.6

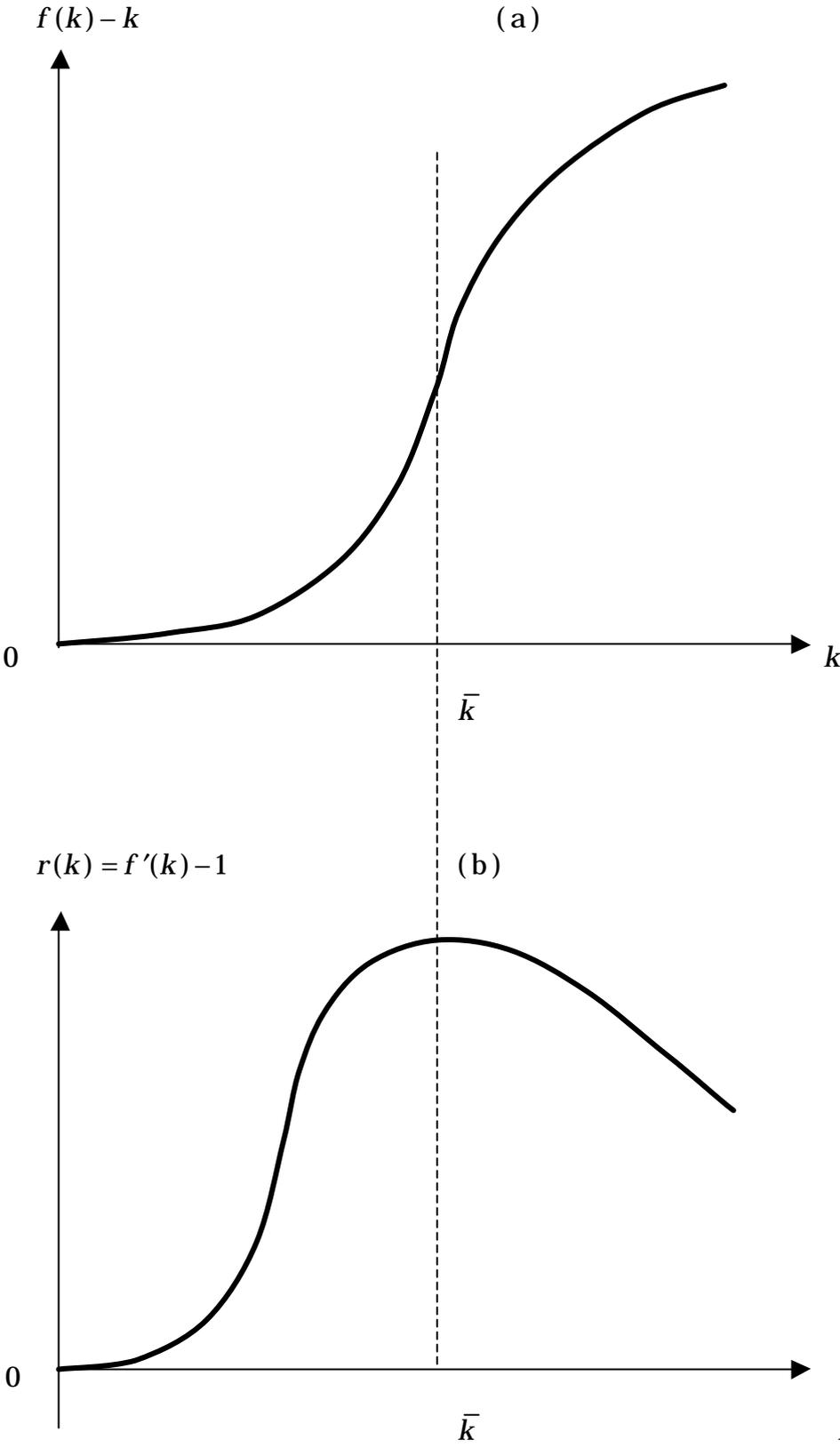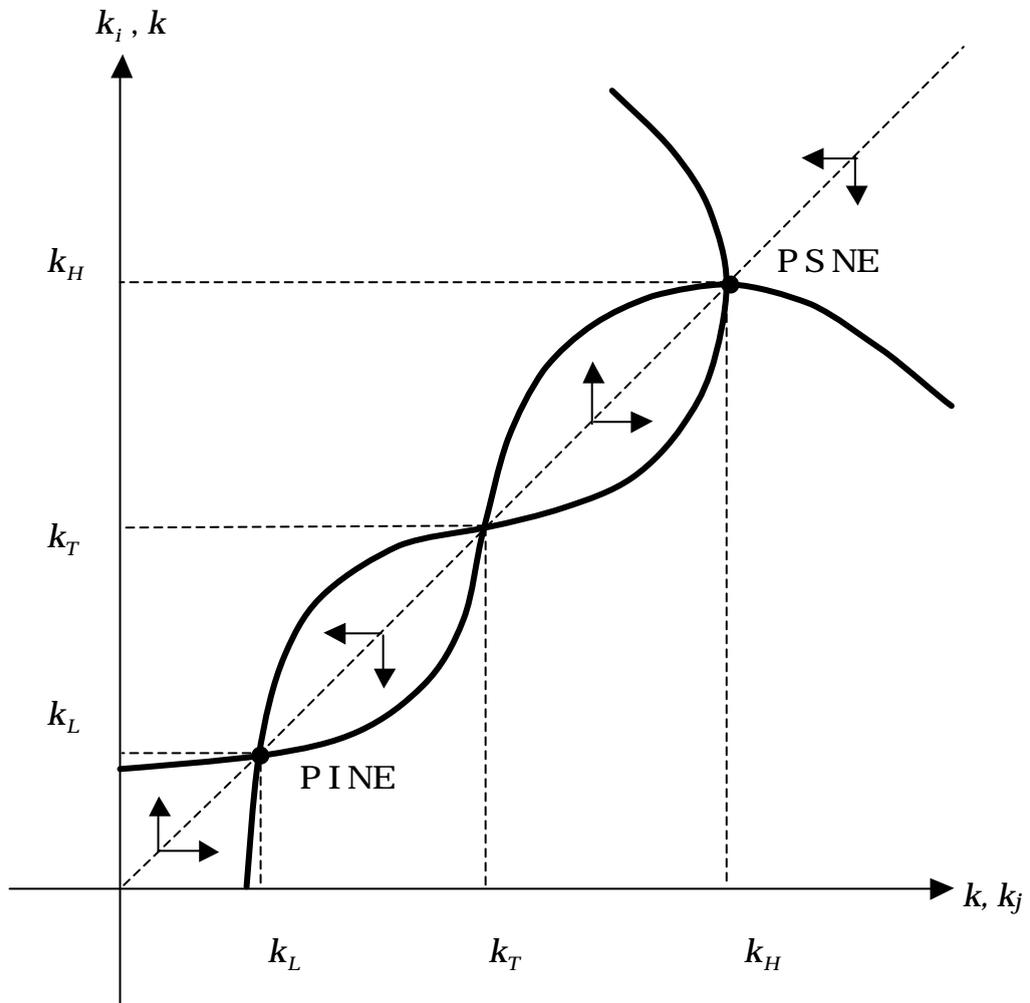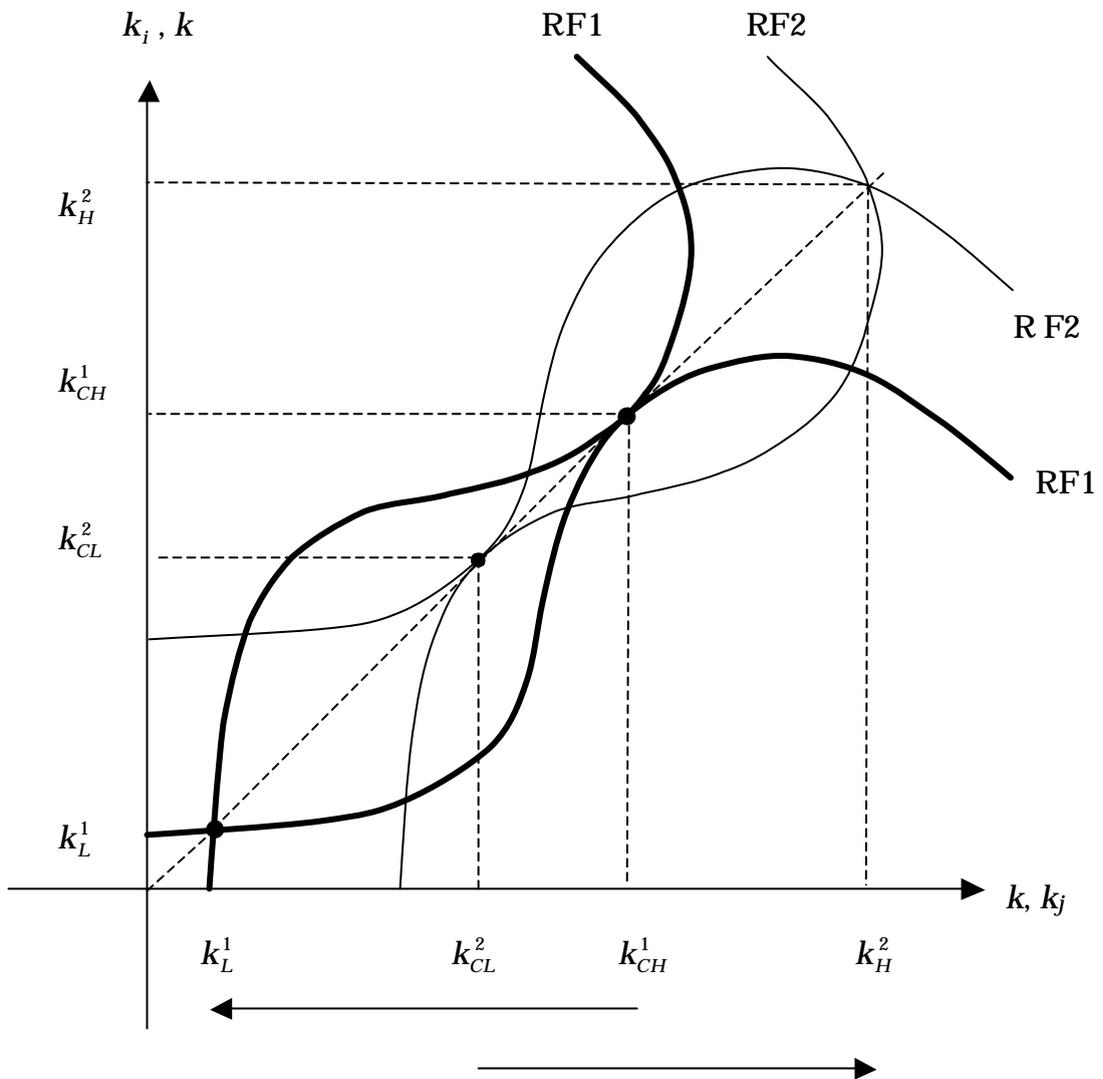Figure 4  Production Function with Increasing and Decreasing Returns

$f(k) - k$             (a)

0

$\bar{k}$

$k$

$r(k) = f'(k) - 1$             (b)

0

$\bar{k}$

$k$

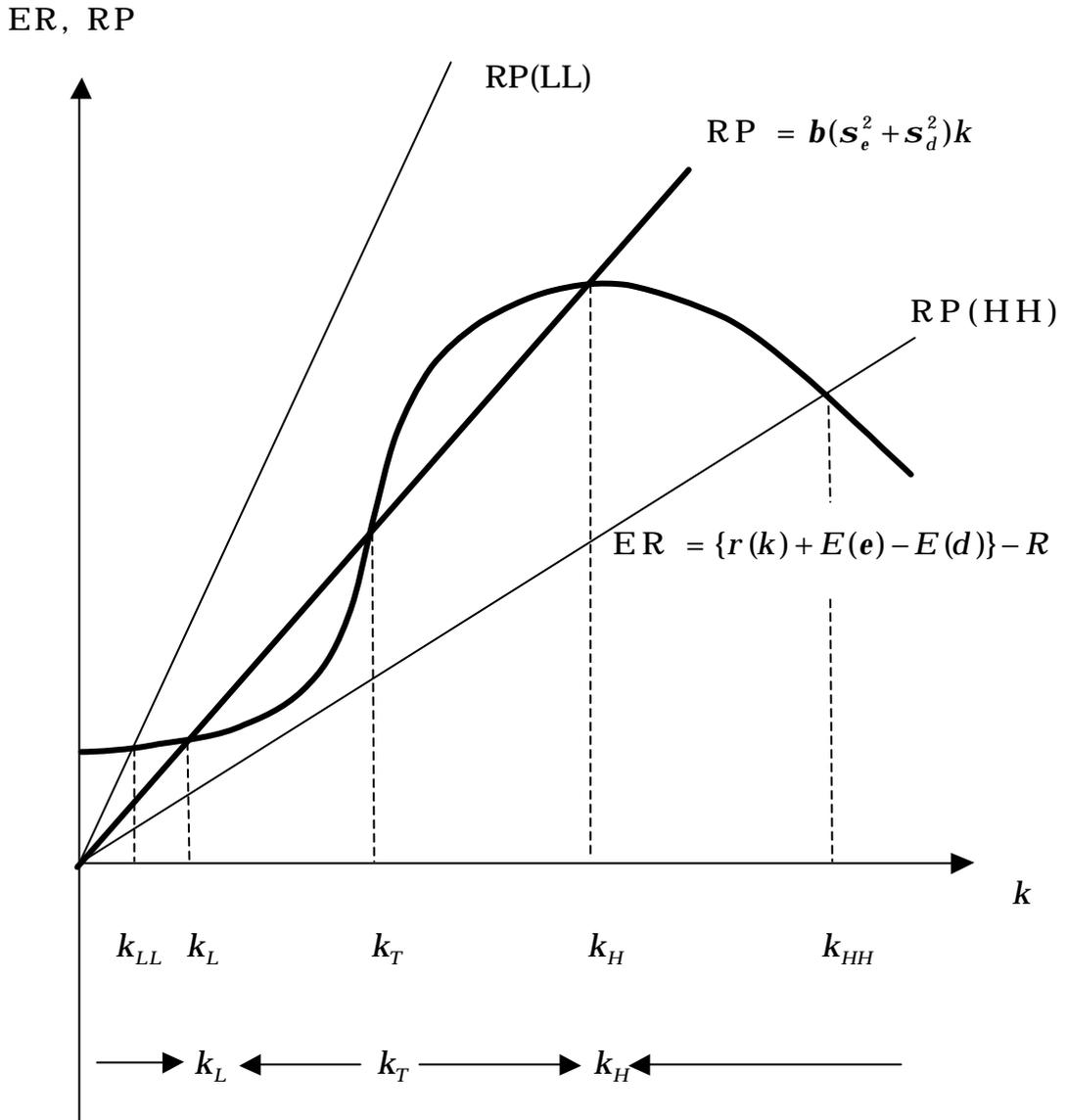Figure 5  Response Functions and Multiple Nash Equilibria

P S NE = Pareto-Superior Nash Equilibrium

PINE = Pareto-Inferior Nash Equilibrium

Figure 6  Economic Takeoff and Capital Flight in terms of Response Functions



$k_i$ , $k$

RF1     RF2

$k_H^2$

$k_{CH}^1$

$k_{CL}^2$

$k_L^1$

R F2

RF1

$k, k_j$

$k_L^1$     $k_{CL}^2$     $k_{CH}^1$     $k_H^2$

Economic Takeoff:  $k_{CL}^2 \longrightarrow k_H^2$

Capital Flight:  $k_L^1 \longleftarrow k_{CH}^1$

Figure 7  Excess Return Curve and Risk Premium Line



ER, RP

RP(LL)

$RP = b(s_e^2 + s_d^2)k$

RP(HH)

$ER = \{r(k) + E(e) - E(d)\} - R$

$k$

$k_{LL}$  $k_L$       $k_T$       $k_H$       $k_{HH}$

$k_L$       $k_T$       $k_H$

Risk Premium Line:    $RP = b(s_e^2 + s_d^2)k$

Excess Return Curve:  $ER = \{r(k) + E(e) - E(d)\} - R$

Figure 8  Changes in Expected Exchange Rate, Expected Productivity, and the World Interest Rate
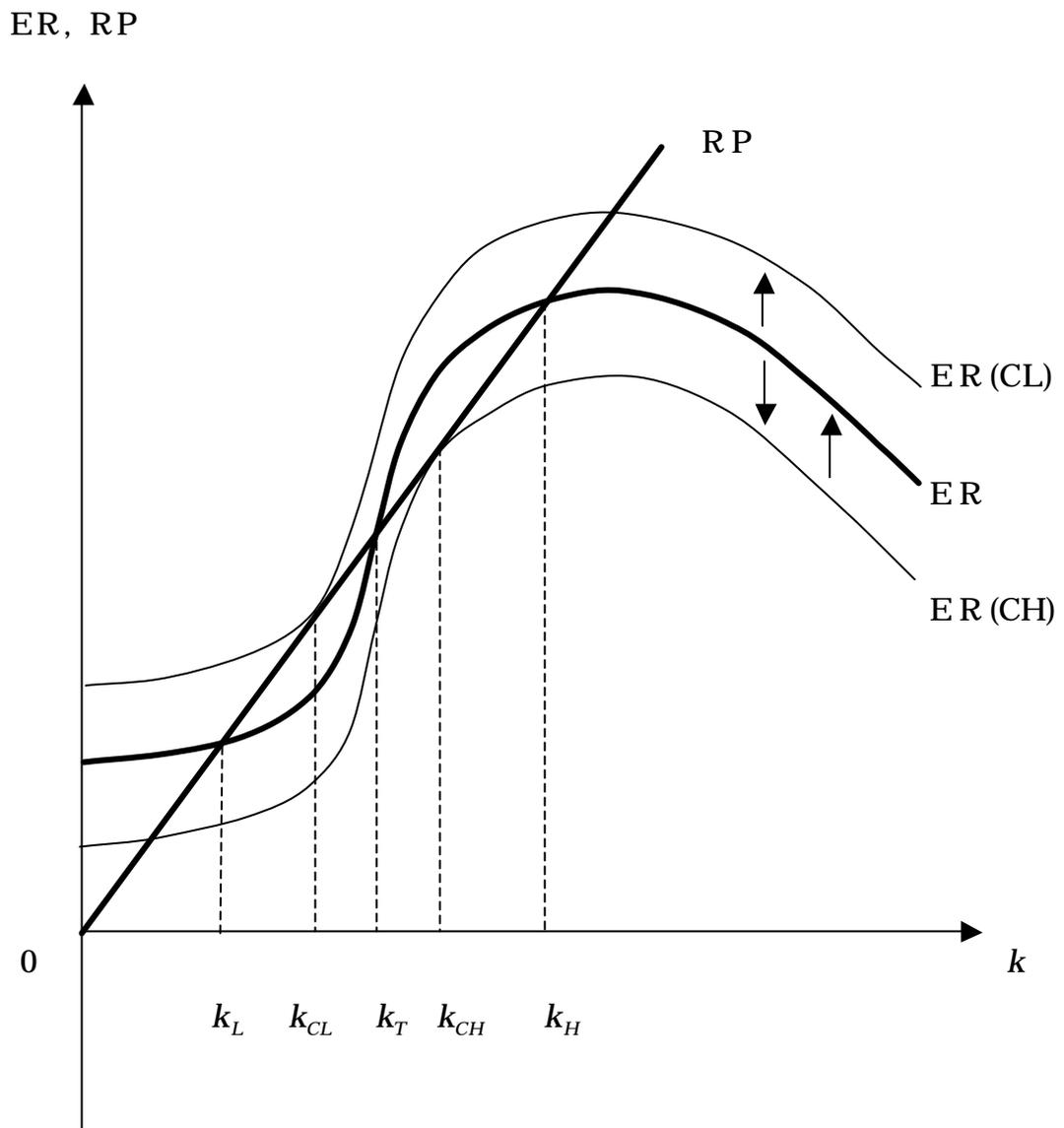
ER, RP

RP

ER (CL)

ER

ER (CH)

0

$k$

$k_L$   $k_{CL}$   $k_T$   $k_{CH}$   $k_H$

Figure 9  Changes in Exchange Rate Risk, Productivity Risk, and Risk Aversion
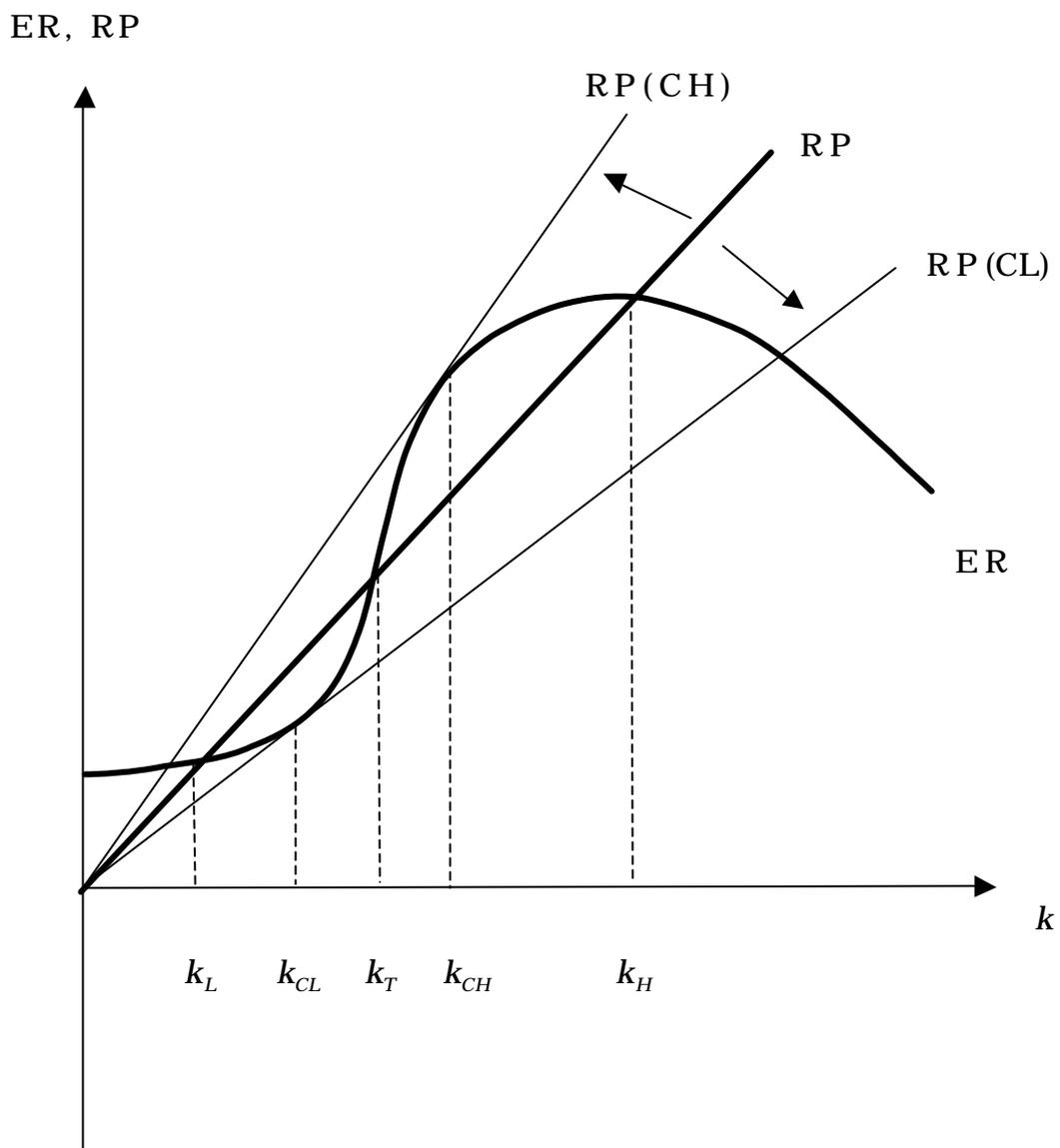
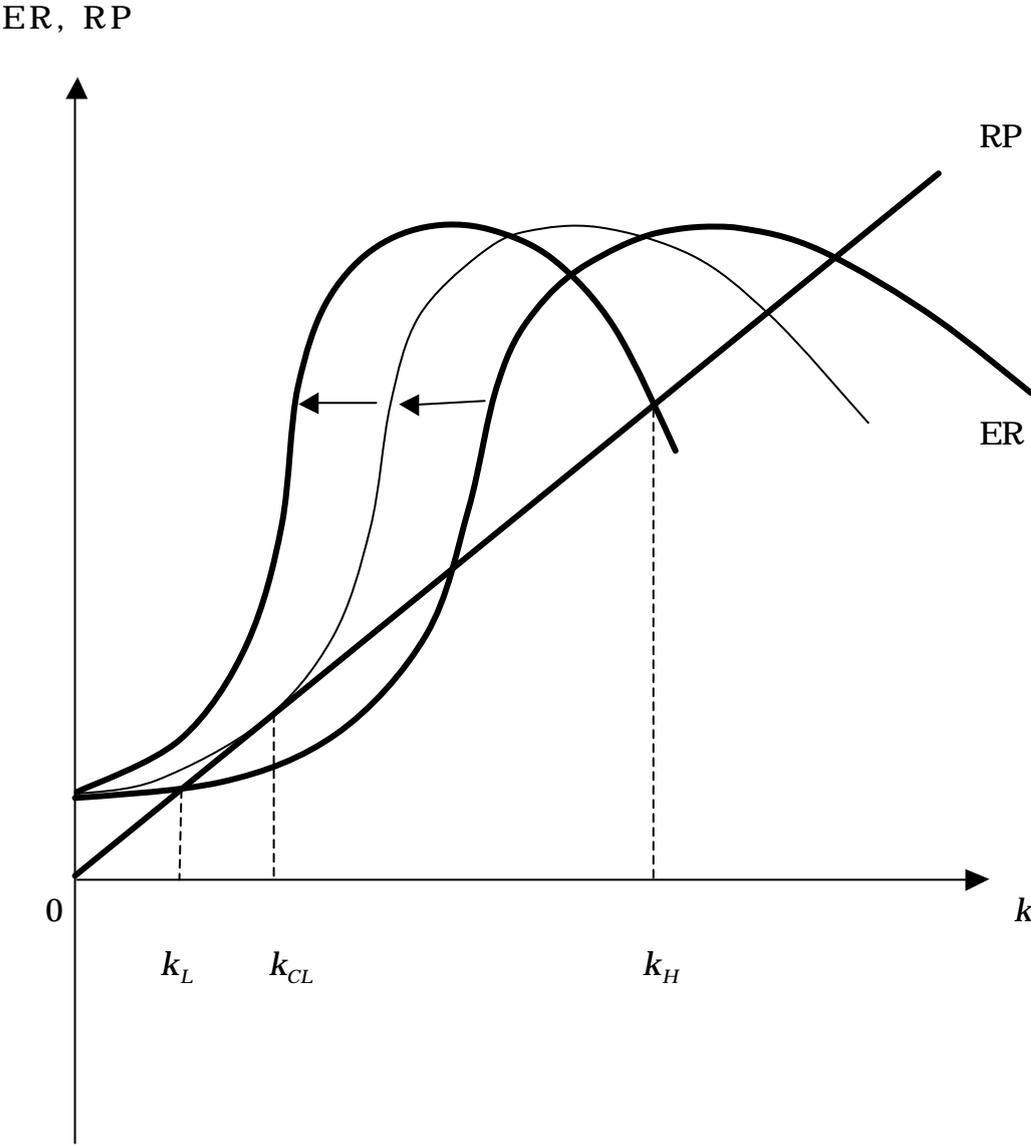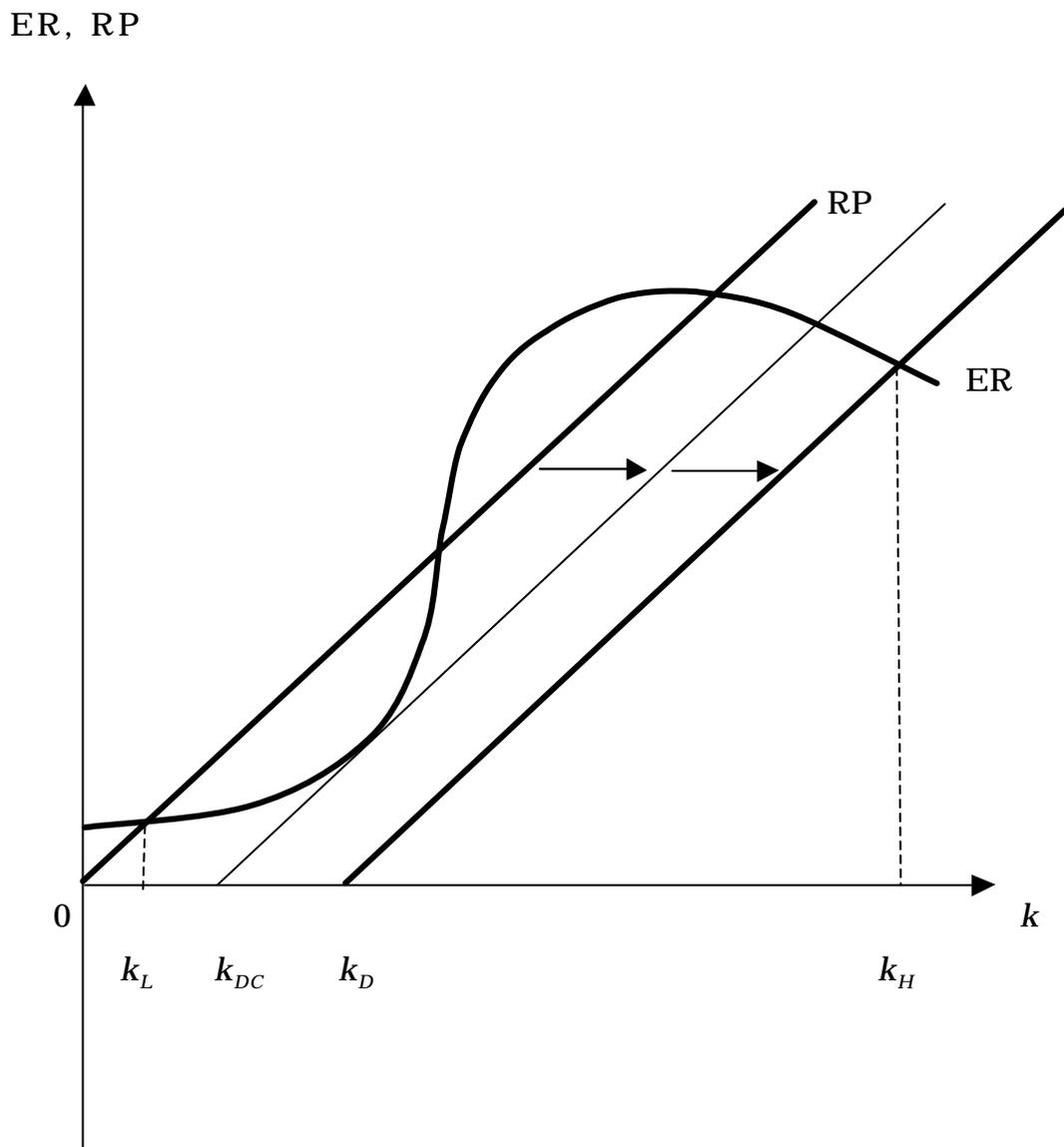Figure 10  Globalization of Capital Markets and Economic Takeoff

ER, RP

RP

ER

0

$k$

$k_L$   $k_{CL}$   $k_H$

Figure 11  Domestic Capital Accumulation and Capital Market Liberalization

ER, RP



Domestic Capital Accumulation = $k_D$

Capital Inflows = $k_H - k_D$