JOURNAL OF ECONOMIC DEVELOPMENT
Volume 20, Number 2, December1995

Growth Effects of Korean Economic Liberalization: An Explanation Based upon Endogenous Growth*

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The analysis indicates that liberalization of capital market is not necessarily benificial to the economy. Only with appropriate government intervention during the adjustment periods, does it have growth effects on both consumption and domestic capital process. The results also tell that current account liberalization is more effective in increasing the domestic capital stock and the best way to achieve overall economic growth is to open both accounts simultaneously in a gradual way. Since raising the domestic capital stock is relatively more important at first, the emphasis should shift from current account to capital account over time.

Ⅰ. Introduction

After the two oil crises of the past two decades, most LDCs faced a strong need to move from a situation characterized by stagnant growth to one characterized by high growth. The past development strategies of these countries were usually based on inward-looking trade regimes, extensive system of government controls in goods and factor markets, and restrictions on international capital movements. In the face of the poor economic performance of their countries, policy-markers had to reconsider their strategies. East Asian countries, such as Korea, Taiwan and Hong Kong, have done quite well by following strategies based on an export promotion policy. Even though approapriate government interventions have played an important role in their success, their

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trade regimes were more liberal than those of other LDCs. Their experiences support the view that outward-oriented trade regime is more efficient in fostering economic growth than inward-oriented trade regime (for example, Corbo, Krueger and Ossa (1985), and Tylet (1981)). However, existing models do not clearly show the relationship between trade regime and economic growth. Empirical evidence suggests that different countries have been growing at different rates for long periods of time (decades in fact) and most of these countires (developing and advanced countries) have shown sustained growth in per capita terms.

On the point concering the diversity of growth rates, Boldrin and Scheinkman (1988) argue that such differences in the rates of growth are not only due to differneces in natural resources, capital stocks, tastes and technologies, but also due to differences in the level of *experties* which can be obtained through the learnign-by -doing process. We can also infer from Schmitz (1989) that differences in the degree of communication infrastructure (or technological integration), which determine the level of entrepreneur's imitation activity, may also explain the differences in growth rates. On the point concerning sustained growth, neoclassical growth models do not provide a satisfactory explanation. According to this formulation, the only potential sources of long-run growth are *sustained increases* in factor suspplies and *exogenous* technological change.

Recently, there has been a remarkable progress in making capital formation endogenous. Lucas (1988) provides a model of human capital formation in which human capital is endogenously accumlated as an active decision by economic agents. Romer (1986) considers externalities and increasing returns in production as a source of endogenous growth. Stokey (1988) also present a model of new good introduction with learning-by-doing. More interestingly, Jones and Manuelli (1988) employ a convex production set and describe another models of capital formations in which sustained growth considers trade regime as an important argument in economic growth. In this paper, a Jones and Manuelli (1988)-type framework is extended to allow for the growth effects of both current account and capital account liberalization.

In section Ⅱ, the relationship between economic growth and trade regime is analyzed by modifying the Ricardian model of trade. International capital movement is not allowed at this stage, in the sense, that there is no foreign borrowing or lending. This assumption enables us to see the net effects of trade liberlization on output growth, without making things too complicated. Despite the simplic-

ity of this model, it still provides us several clear implications concerning how a free trade regime is more likely to promote economic growth than a restricted one[1]. Moreover, by incorporating a *learning-by-doing effect* in the production process, in section Ⅲ, the model is extended to the capital account. This enables us to analyze not only the market deregulation but also the interaction between current account liberalization and capital accout liberalization. Last section summarizes the main results of this paper and its implication to Korean economy.

Ⅱ. Current Account Analysis

In order to consider the net effects of trade liberalization, international capital movement (including international borrowing and lending) are excluded in this section.

A. General Framework of the Model

In the traditional one sector growth model, output of the economy is used either for consumption or investment. The marginal rate of transformation between consumption and investment is assumed to be one in this type of model. We need to modify this basic one sector model, as in Jones and Manuelli (1988), in order to examine the effects of an import tariff on growth.

The simplest way of doing this is to employ a Ricardian model of trade in which differences between the home country and a foreign country are due to different technological possibilities. As a representative developing economy, the home country is assumed to be a small country which is inefficient in producing investment goods[2]. Let σ be the marginal rate of transformation between investment and consumption, where the superscripts h and ω denote the home country and the rest of the world, respectively. The above assumption implies that $\sigma^h > \sigma^\omega$ for the home country and $\sigma^\omega = 1$ for the rest of the world. The technology of the home country is given

[1] The following researchers have considered this problem: Aizenman (1981, 1983), Corden (1987), Edwards (1988), Krueger (1987), Matsuyama (1987)

[2] In reality, the trade restrictions have been imposed on both the consumption goods and the investment goods in Korea. However, in a 2 sector Ricardian economy the structure of the comparative advantage should be assumed. In order to explain the technological inferiority of LDCs this economy is assumed to have a comparative advantage in consumption goods rather than investment goods. The protection of heavy industry (such as, Pohang Steel Inc.) in 1970's is an example of the presumed structure.

by:

$$c_t + \sigma^h x_t \leq f(k_t)$$
$$k_{t+1} = (1 - \delta)k_t + x_t$$
$$(c_t, x_t) \geq 0, \ \sigma^h > 1,$$

where x_t = investment per capita at time t,
c_t = consumption per capita at time t,
k_t = capital stock per capita time t,
δ = capital depreciation rate,
$f(k_t)$ = production function of raw output at time t.

For simplicity, it is assumed that one unit of labor is supplied inelastically for all periods. The empirical evidence concerning differnet speeds of growth and sustained growth in per capita terms can be explained by employing the following type of production function. Arrow (1962) has analyzed a learning-by-doing model in which improvements in technique become available not from the passage of time as such, but from the generation of *experience* within the production process itself. In his model, cumulative gross investment is used as a measure of experience. Similarly, the *current capital stock* is taken as a proxy for experience in this paper. The larger the amout of capital stock is, the greater will be the opportunities for learning. Hence, the level of production will be higher with a larger amount of capital. Since opportunities for learning increase with a larger capital stock under this assumption, the marginal productivity of capital does not fall to zero even with a sufficiently large amout of capital stock, despite the general properties of the production function such as $f'(k) > 0$, $f''(k) < 0$ and $f'(0) > \delta$

To capture this aspect of the production process, I use a Gale and Sutherland (1968)-type production function which includes a term proportional to the amount of capital stock:

$$F(K, L) = G(K, L) + \rho K,$$

where $\rho > 0$ and $G(K, L)$ is any well-behaved concave production function that is homogeneous of degree one with $\lim_{K \to \infty} \partial G/\partial K = 0$. ρ could be interpreted as the degree of learning-by-doing effect in production with the assumption that experience is proportional to capital stock. In per capita terms, the production function of the home country can be written as:

$f(k) = g(k) + \rho k$,
where $f(k) = F(K/L, 1)$, $g(k) = G(K/L, 1)$ and $k = K/L$. $f(k)$ also satisfies all the neoclassical conditions for the production function except $\lim_{k\to\infty} f'(k) = \rho$.

As in any Ricardian model, under free trade a small country specializes in the production of a tradable good in which it has a comparative advantage. In this case, the home country produces only the consumption good and imports the investment good. If the government of the country imposes a tariff (τ_t) on imports of the investment goods, then the domestic price of the investment good in terms of the consumption good becomes $1+\tau_t=p_t$ when it is imported. If $1+\tau_t > \sigma^h$, the equilibrium is autarky since it is cheaper to produce the good domestically than to buy it abroad. Starting from this autarky situation, I examine the effects of import tariff on growth.

B. The Autarky Case

If $1+\tau_t > \sigma^h$, a representative individual produces both the consumption good and the investment good and maximizes his utility by solving the following problem:

$$(1) \quad \max \sum_{t=0}^{\infty} \beta^t u(c_t)$$

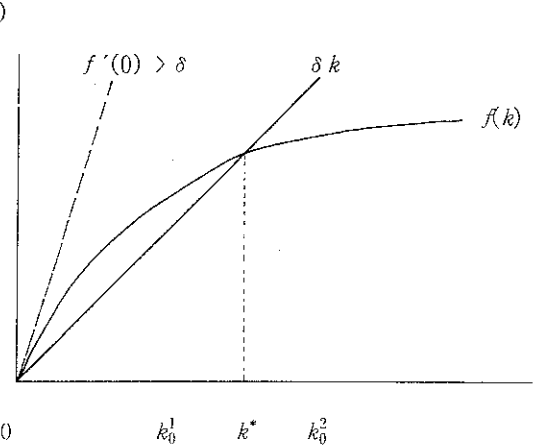
subjec to
$$(i)\ c_t + \sigma^h x_t = f(k_t)$$
$$(ii)\ k_{t-1} = (1-\delta)k_t + x_t$$
$$(c_t, x_t, k_t) \geq 0,\ \sigma^h > 1,$$

where k_0 is given and β is a discount factor. $u(c)$ denote the utility function which has usual properties such as $u'(c) > 0$, $u''(c) < 0$, $u'(0) = \infty$.

The Eular equation for this problem is valid only when $c_t > 0$ and $x_t > 0$ for all t. If $f'(\infty) = 0$, the demand for the investment good would be zero for sufficiently large initial capital stock, k_0. From a dynamic programming perspective, sustained growth is optimal if and only if augmenting the capital is optimal regardless of the level of the capital stock. If we assume that $\lim_{k\to\infty} f'(k) = 0$, we cannot obtain sustained growth in this economy when the depreciation rate is positive. As we can see from 1, there exists a unique k^* such that $\delta k > f(k)$ for all $k > k^*$. If the initial capital stock is k_0^1, then $k_t \leq k^*$ for all t.

Figure 1

Bound of capital growth in the Neoclassical Growth Model



If the initial capital stock is k_0^2, then $k_t < k_0^2$ for all t. Therefore, $\{k_t\}$ is necessarily bounded either by k* or by the initial capital stock. In this sense, sustained growth is not feasible if $\lim_{k\to\infty} f'(k) = 0$. As previously mentioned, the learning-by-doing process can explain sustained growth because the necessary condition for sustained growth is that the marginal productivity of capital, even for sufficiently large capital stock, is not too low, i.e., $\lim_{k\to\infty} f'(k) = \rho > 0$.

The first order conditions of problem (1) are summarized as follows:

$$(2)\quad \frac{u'(c_t^*)}{u'(c^*_{t+1})} = \frac{\beta[f'(k^*_{t+1})+\sigma^h(1-\delta)]}{\sigma^h},$$

where the asterisk denotes the optimal value.
Since $\lim_{k\to\infty} f'(k) = \rho^h$ and $f''(k) < 0$, we have for all t:

$$(3)\quad \frac{u'(c_t^*)}{u'(c^*_{t+1})} \geq \frac{\beta[(\rho^h+\sigma^h(1-\delta)]}{\sigma^h}.$$

If $\beta[(\rho^h+\sigma^h(1-\delta)]/\sigma^h > 1$, we have $c_t^* < c^*_{t+1}$ for all t at optimum. This implies that even in autarky the optimal consumption path of this economy can show sustained growth as long as the marginal productivity of capital is not too low, i.e.,

$$(4)\quad \rho^h > \sigma^h[1-\beta(1-\delta)]/\beta.$$

As long as condition (4) is satisfied, we can show that the capital accumulation path of the home country exhibits increasing pattern over time (see Appendix.)

As we can see form equations (2) and (3), the asymptotic growth rate of the marginal utility ratio of the home country crucially depends upon both ρ^h and σ^h. Since these values can be different across countries, we might say that different countries are autarky state in which both goods are produced. Even in this state, the home country may achieve sustained growth in per capita terms if the marginal productivity of capital is not too low. However, this autarky state is justified only when the home country can get a higher output stream in the future by protecting the currently inefficient investment good sector. In the next section, we consider the international trade case and compare the result with that of this section.

C. International Trade with Specialization

Suppose the import tariff rate is lowered at time t so that $1+\tau_t < \sigma^h$. Then all investment goods would be purchased abroad and the home country specializes in producing consumption goods since it is more expensive to produce investment good domestically than to buy it from the rest of world. Hence, the domestic price of the investment good in terms of the consumption good becomes $1+\tau_t = p_t$ when $x_t > 0$. In this case, the first constraint (i) of (1) is replaced by the following constraint:

$$\text{(i)}' \quad c_t + p_t + x_t = f(k_t) + g_t,$$

where g_t = per capita government transfer at time t. Althouth the representative individual regards the government transfer as independent of his own action, we have $\tau_t x_t = g_t$ in equlibrium, i.e., we assume that the government has a balanced bugget. From the first order conditions we can get the following marginal utility ratio between two periods which corresponds to Euler equation (2).

$$(5) \quad \frac{u'(c^*_t)}{u'(c^*_{t+1})} = \frac{\beta[f'(k^*_{t+1})+p_{t+1}(1-\delta)]}{p_t}.$$

Since $\lim_{k\to\infty} f'(k)=\rho^h$ and $f''(k)<0$, we have for all t:

$$(6) \quad \frac{u'(c^*_t)}{u'(c^*_{t+1})} \geq \frac{\beta[\rho^h+p_{t+1}(1-\delta)]}{p_t}.$$

If the right hand side of (6) is greater than one, $c^*_t < c^*_{t+1}$ for all t at the optimum. This implies that with trade optimal consumption path of this economy can show sustained growth as long as the marginal productivity of capital is not too low, i.e.,

(7) $\rho^h > [p_t - \beta(1-\delta)p_{t+1}] / \beta$.

As long as condition (7) is satisfied, we can prove that the home country's capital accumulation path is increasing over time by using the same method.

Now starting from the autarky state, we consider three different trade liberalization cases depending on the path of the tariff structure. Suppose that there is an import tariff reduction at time t.

Case 1 : Tariff rate has been lowered once and for all at time t:
$p_{t+i} = p_t < \sigma^h$, for all $i \geq 0$.

Case 2 : Beginning at time t, the tariff rate has been gradually lowered over time:
$1 < p_{t+i+1} = p_{t+i}$, for all $i \geq 0$ with $p_t < \sigma^h$.

Case 3 : Tariff has been abolished as a one shot deal at tiem t:
$p_{t+i} = 1$, for all $i \geq 0$.

For each case we have the following marginal utility ratios between periods which correspond to the Euler equations (2) and (3) for all $i \geq 0$:

$$(8)\ \frac{u'(c^{1*}_{t+1})}{u'(c^{1*}_{t+i+1})} = \beta\left[\frac{f'(k^{2*}_{t+i+1})}{p_t} + (1-\delta)\right] \geq \beta\left[\frac{\rho^h}{p_t} + (1-\delta)\right],$$

$$(9)\ \frac{u'(c^{2*}_{t+1})}{u'(c^{2*}_{t+i+1})} = \beta\left[\frac{f'(k^{2*}_{t+i+1})}{p_{t+i}} + (1-\delta)\right] \geq \beta\left[\frac{\rho^h}{p_{t+i}} + (1-\delta)\right]\frac{p_{t+i+1}}{p_{t+i}},$$

$$(10)\ \frac{u'(c^{3*}_{t+1})}{u'(c^{3*}_{t+i+1})} = \beta\left[f'(k^{3*}_{t+i+1}) + (1-\delta)\right] \geq \beta\left[\rho^h + (1-\delta)\right].$$

The equations (8), (9) and (10) correspond to case 1, 2 and 3 respectively. For sustained growth, the last terms in each case should be greater than one. We can get the ranges of ρ^h for sustained growth in each case, which correspond to equation (4) in the autarky case:

(11) $\rho^h > p_t\,[1-\beta(1-\delta)]/\beta$,

(12) $\rho^h > p_{t+i}\,[1-\beta(1-\delta)p_{t+i+1}/p_{t+i}]/\beta$,

(13) $\rho^h > [1-\beta(1-\delta)_i] / \beta$.

The inequalities in (11), (12) and (13) correspond to case 1, 2, and 3, respectively. Since $1 < p_{t+i+1} < p_{t+i} < p_t = 1+\tau_t < \sigma^h$ for all $i \geq 1$ at time t, if p_{t+i+1}/p_{t+i} is close to one, a comparison between inequalities (4), (11), (12), (13) tells us that *the possibility of sustained growth increases with a more liberal trade regime.*

For example, if $[1 - \beta(1-\delta)] / \beta < \rho^h < \sigma^h [1 - \beta(1-\delta)] / \beta$, the home country can get sustained growth by going into free trade even if it cannot have sustained growth in the autarky state. Also, if $[1-\beta(1-\delta)] / \beta < \rho^h < p_t [1-\beta(1-\delta)] / \beta$, the home country cannot get sustained growth with the import tariff rate τ_t since it is still too high for sustained growth even though the home country lowered the autarky state import tariff rate to the level which satisfies $1+\tau_t < \sigma^h$. In this case, the initial level of import tariff is crucial for sustained growth. From now on, we assume that the home country shows sustained growth with free trade, that is, $\rho^h > [1-\beta(1-\delta)] / \beta$.

A comparison between (2) and (11) shows that the asymptotic ratio of marginal utility in case 1 is greater than the autarky case, which tells us that *trade liberalization indeed has growth effcts.* Similarly a comparison between inequalities (11) and (13) indicates that the more liberal the trade regime is, the higher the growth of the home country will be. In this model, abrupt liberalization is better than gradual liberalization in that the latter has slower economic growth during the adjustment periods. However, if we impose adjustment costs on the investment procedure of the home country, as in Cooper and Sachs (1985), gradual liberalization could be better than abrupt liberalization in the sense that gradual liberalization lessens the adjustment costs in the investment procedure through a tariff on the import of investment goods.

Ⅲ. Capital Account Analysis

In the real world, the current account is closely related to the capital accout in several ways. Economic liberalization of one account is not only affected by the status of other account, but also has a strong influence on the evolution of the other account. Hence, we need to consider these two accounts together to discuss the growth effects of economic liberalization.

A. General Description of the Capital Account

Many LDCs prohibited capital outflows until recently. However, some of them have liberalized their capital market in various ways.

Capital movement across countries plays an important role not only in the world financial market but also in the economic growth of each country. According to the World Bank report (1984), in a number of industrial countries, the impact of loosening capital controls was reinforced by deregulation in the domestic banking sector, changes in the tax treatment of capital transactions, and a broadening of the range of permissible financial instuments. These developments have contributed to increased integration and competitiveness of international capital markets, and have also had the effect of encouraging other countries to consider changes in their own regulations. In developing countries, although they still face difficult external financing situations, changes in the capital market are evidently in the direction of liberalization rather than intensification of restrictions (Harberger (1986) and Krueger (1978)).

The liberalization measures in a few countries are parts of a general reform of the financial sector and aim to broaden and develop financial markets by permitting participation in the domestic market and a resident's access to foreign markets. For example, discriminatory regulations against foreign banks were removed in Korea and a withholding tax on interest payment to nonresidents was abolished in Malaysia in 1985. These kinds of capital market liberalizations have significant effects on economic growth. However, existing models do not explain this effect in a systematic way. Most developing countries are debtors rather than creditors. Foreign debt is a major form of capital inflow in these countries. However, research on economic liberalization has generally assumed that these reforms take place in the absence of a foreign debt problems. Since foreign borrowing is necessary for economic growth in most LDCs, we need to consider economic liberalization with growth-cum -foreign debt (Cooper and Sachs (1985)).

In this section, we analyze the case in which outflows are prohibited. Hence, the scope of capital market restriction is different from the conventional ones in which both inflow and outflow of capital are regulated. The capital market restriction is defind as a regulation of the interest for the inflowed capital[3]. Simply, assume that foreign capital inflows take the form of foreign borrowing and repayment is due in one period. In most LDCs, the initial capital stock is low relative to advanced countries. Hence, assume that all foreign borrowings are used for capital accumlation, and not for con-

[3] Despite the narrow scope of the definition, it still reflects the current situation (growth-cum-foreign debt) of LDCs. However, it is desirable to generalize the scope of the definition in order to find out the overall effects of capital movement.

sumption. At this stage, the marginal productive of captial is high because of the low level of domestic capital stock. Foreigners have incentives to lend to this country as long as the solvency constraint and liquidity constraint are not binding as in Cooper and Sachs (1985). In LDCs, foreign capital inflows, such as foreign direct investment, are not fully liberalized. Foreign direct investment is different from foreign borrowing in that in tha latter case foreigners get the interest payment at the margin, but in the former case they get the productivity of capital at the margin. Furthermore, the former is determined by foreigners while the latter is determined by the residents of home country.

In general physical capital formation requires adjustment periods. During the adjustment periods of the domestic capital market, the government can support the domestic industries by regulating foreign direct investment. In addition to this, the government has another incentive to regulate foreign capital inflows because the increased foreign capital inflows may cause the home currency's appreciation, which would weaken the home country's exportable sector. If the government regulates foreign direct investment in order to make the adjustment of the marginal productivity of capital correspond to the domestic interest rate adjustment, foreign direct investment and foreign borrowing become analytically equivalent in terms of their rewards. Hence from now on, we assume that all foreign capital inflows take the form of foreign borrowing. Initially, the interest rate of the home country (r^h) is assumed to be higher than the world interest rate (r^w) due to differences in the level of capital stock. The world financial market is assumed to be sufficiently large and efficient in that the home country can borrow its optimum amount of foreign capital without changing the world interest rate. To simplify matters, assume that the world interest rate does not change over time. Because of the above reasons, it is assumed that there exists some regulations on the inflows of foreign capital in the home country. Without the inflow of foreign capital, the domestic interest rate is higher than the world interest rate. If foreigners lend B_{t-1} to the home country at time $t-1$, they get $[(1+r^w) + \alpha_t (r_t^h - r^w)] B_{t-1}$ at time t, where α_t denotes the degree of capital inflow restriction of the home country at time t and $0 \leq \alpha_t \leq 1$. If the restriction is very strict (i.e., $\alpha_t = 0$), they can get only $(1+r^w)B_{t-1}$ at time t. On the other hand, if there is no restriction on capital inflows (i.e., $\alpha_t = 1$), they can get $(1+r_t^h)B_{t-1}$ at time t. The optimum amount of foreign borrowing is determined by the home country, not by the rest of the world in this model. Therefore, no matter how much the foreigners want to lend to the home country, thy can lend only the limited amount which is decided by the home country. Also it is assumed that the domestic interest rate is fixed in the short run although it adjusts to the world interest rate over time as

foreign capital flows into the home country. With the restriction α_t, the government can get $(1-\alpha_t)(r_t^h-r^w)$ and support domestic capital formation. Net capital inflow, $B_t-[\ (1+r^w)+\alpha_t\ (r_t^h\ -\ r^w)]B_{t-1}$, and the government subsidy, $(1-\alpha_t)\ (r_t^h-r^w)B_{t-1}$, are used for purchasing investment goods.

B. The Model with a Capital Account

With international borrowing allowed, the representative household solves the following problem:

$$(14) \qquad \max \sum_{t=0}^{\infty} \beta^t u(c_t)$$

subject to (i) $c_t+p_t x_t+[(1+r^w)+\alpha_t(r_t^h-r^w)]B_{t-1}=f(k_t)+g_t+B_t$

(ii) $k_{t+1}=(1-\delta)k_t+x_t$

(iii) $\lim_{t\to\infty} B_t(1+r^w)^{-t}=0$

(iv) $(c_t, x_t, k_t)\geq 0.$

With the assumption of a balanced government budget, in equilibrium:

$$g_t=\tau_t x_t+(1-\alpha_t)\ (r_t^h-r^w)B_{t-1}$$

From the first order conditions the following two relation are dervied:

$$(15) \quad \frac{u'(c_t^*)}{u'(c_{t+1}^*)} = \frac{\beta[\ f'(k^*_{t+1})+p_{t+1}\ (1-\delta)\ ]}{p_t},$$

$$(16) \quad \frac{u'(c_t^*)}{u'(c_{t+1}^*)} = \beta[\ (1+r^w)-\alpha_{t+1}\ (r_t^h-r^w)\ ].$$

From equations (15) and (16), the following should hold in equilibrium:

$$(17) \quad f'(k^*_{t+1})=p_t[(1+r^w)-\alpha_{t+1}\ (r_t^h-r^w)]-p_{t+1}(1-\delta).$$

Because $\beta[(1+r^w)-\alpha_t\ (r_t^h-r^w)]\geq\beta(1+r^w)$, if the rate of time preference is lower than the world rate of interest, i.e., $\beta(1+r^w)>1$, the optimal consumption path exhibits an increasing profiles. Since we have allowed capital accumulation, this assumption is consistent with the above assumption that the proceeds of foreign loans are fully used to increase the capital stock.[4] In this model both current account and capital account are

[4] The opposite case is considered in Edwards (1986).

related to capital formation. Imports of the investment good contribute to the formation of additional capital stock and so does foreign capital inflow. At equilibrium, the ratio of the marginal utilities depends only on the interest rates since the capital stock adjusts to the steady-state equilibrium level of each period through the interaction of the two accounts. By comparing two polar cases, we can figure out the effects of the capital market deregulation and the interaction of these two accounts.

First, it the capital market restriction is *complete* so that $\alpha_{t+1}=0$, we have:

$$(18)\ f'(k^*_{t+1}) = p_t(1+r^w) - p_{t+1}(1-\delta).$$

In this case the level of the import tariff rate plays a crucial role in capital accumulation through the import of investment goods.
In the constant import tariff case, i.e., $p_{t+1} = p_t > 1$ for all $i \geq 0$:

$$f'(k^1{}^*_{t+i+1}) = (r^w+\delta)p_t.$$

In a gradual trade liberalization case, i.e., $1 < p_{t+i+1} < p_{t+i}$ for all $i \geq 0$:

$f'(k^2{}^*_{t+i+1}) = (r^w+\delta)p_{t+i} + (1-\delta)\varepsilon_{t+i}$ where $\varepsilon_{t+i} = p_{t+i} - p_{t+i+1} > 0$ and ε_t is assumed to be close to zero so that p_{t+i+1}/p_{t+i} is close to one.

In the free trade case, i.e. $p_{t+i} = 1$ for all $i \geq 0$, we have for all $i \geq 0$:

$$f'(k^3{}^*_{t+i+1}) = r^w+\delta.$$

A comparison between these marginal productivities indicate the following order for all $i \geq 0$:

$$(19)\ f'(k^3{}^*_{t+i+1}) < f'(k^2{}^*_{t+i+1}) < f'(k^1{}^*_{t+i+1}).$$

These results tell that in the presence of capital controls, the accumulation of capital becomes faster with a more liberal trade regime.

Second, if there is no restriction on capital inflow so that $\alpha_{t+1}=1$, we have the following marginal productivity of capital corresponding to equation (18):

$$(20)\ f'(k^*_{t+1}) = p_t(1+r^h_{t+1}) - p_{t+1}(1-\delta).$$

A comparison of marginal productivity of capital for three different trade regimes reveals the same order as in (19). For any given level of capital market restriction, trade liberalization has *higher capital*

accumulation effects in the long run. It the capital market is continulously liberalized over time, the domestic interest rate would gradually fall and adjust to the world interest rate. As we can see from equation (15), the consumption growth rate depends on both the import tariff and the marginal productivity of capital. If the initial import tariff rate is high, the level of capital stock would be lower than that of a low import tariff case. Therefore the effect of high marginal productivity of capital on consumption growth cancels out the effects of a high import tariff rate. In equlibrium, hence, the consumption growth rate is determined by the degree of capital market restiction.

Comparing the marginal utility ratios between the two extreme case tells us that the consumption growth rate is higher with more liberalized capital market. Explicitly, for all $i \geq 0$, we have :

$$(21)\ \frac{u'(c^*_{t+1})}{u'(c^*_{t+i+1})}\Bigg|_{\alpha=1} = \beta(1+r^h_{t+i+1}) > \beta(1+r^w) = \frac{u'(c^*_{t+1})}{u'(c^*_{t+i+1})}\Bigg|_{\alpha=0}.$$

Ⅳ. Conclusion

We need to be careful in interpreting the above results since we are dealing with a dynamic problem, not a static problem. Starting from a situation of complete capaital market restriction, a higher growth could be obtained through the removal of such restrictions. With abrupt liberalization in the capital market, the domestic rate of interest instantly falls to the world rate of interest and the proportion of foreign capital in the home country's capital stock increases suddenly. This results in the replacement of domestic capital by foreign capital through a decrease in government subsidy. With a balanced government budget at equilibrium, the revenue of the government eventually belongs to the representative household for domestic capital formation. Hence, greater liberalization of the capital maket entails less government revenue.

However, with gradual liberalization the consumption growth rate continuously adjusts toward $\beta(1+r^w)$ in the long run with a lower proportion of foreign capital. This is a result of a higher government subsidy on domestic capital formation. Gradual liberalization in the capital market is better than abrupt liberalization in that the former generates a higher consumption growth rate during the adjustment period and fosters a larger domestic capital stock. Therefore equation (21) also indicates that the effects of a decrease in government subsidy due to capital market liberalization dominates the effects of the foreign capital inflow in this model. This result suggests that capital markets liberalization, without proper adjustments of the domestic industries and

capital markets, may result in relacement of domestic capital by foreign capital. Hence, liberalization of capital market is not necessarily benefical to the economy. Only with with appropriate government intervention during the adjustment periods does it have growth effects on both consumption and domestic capital process.

Finally, we would like to consider the question of "Which account shoul be liberalized first ?" This is an important question since the sequencing of reform is one of the critical determinants of the success of the liberalization process. As can be seen from (21), capital account liberalization plays a key role in consumption growth while the speed of such liberalization is important in fostering the formation of domestic capital. On the other hand, inequality (19) tells us that current account liberalization is more effective in increasing the domestic capital stock. Theoretically the best way to achieve overall economic growth might be to open both accounts simultaneously in a gradual way. Since raising the domestic capital stock is relatively more important at first, the emphasis should shift from current account to capital account over time. However, in real economies the success of economic liberalization heavily depends on the feasibility and credibility of political reforms. And this sadly seems the most difficult challenge of all.

Appendix

Suppose the capital accumulation path of the home country does not exhibit increasing pattern over time, then $k_{t+1} \leq k_t$ *for some t.* Since $f'(k) > 0$, from (1) :

(A. 1) $c_{t+1} + \sigma^h x_{t+1} = f(k_{t+1}) \leq f(k_t) = c_t + \sigma^h x_t$.

Since $c_t < c_{t+1}$ for all t at the optimum under the above condition, we have $x_{t+1} < x_t$, from (A.1). Then we get :

(A. 2) $k_{t+2} = (1 - \delta)k_{t+1} + x_{t+1} < (1 - \delta)\, k_t + x_t = k_{t+1}$.

Hence, $\{k_t\}$ is a monotonically decreasing sequence after time t. However, this contradicts the above result showing that $c_{t+1} > c_t$ *for all* t since consumption grows without limit under the above condition, that is, $\lim_{t \to \infty} c^*_t = \infty$.

This can be proved in the following way with condition (4). Suppose to the contray that $c_t \to \overline{c} < \infty$. Then from the Euler equation (2) and relation (3) :

$$(A.3)\quad 1 = \frac{u'(\bar{c})}{u'(\bar{c})} = \lim_{t\to\infty} \frac{u'(c^*_t)}{u'(c^*_{t+1})} = \lim_{t\to\infty} \frac{\beta[f'(k^*_{t+1}) + \sigma^h(1-\delta)]}{\sigma^h}$$

$$\geq \frac{\beta[\rho^h + \sigma^h(1-\delta)]}{\sigma^h} > 1.$$

This is a contradiction. Hence we have the desired result. If $\{k_t\}$ is a monotonically decreasing sequence after time t, $\{f(k_t)\}$ is also a decreasing sequence after time t. However, this cannot support the above result, lim $c^*_t = \infty$, since $f(k_t)$ is the sum of c_t and $\sigma^h x_t$. As a result, we have $k_{t+1} > k_t$ for all t as long as the condition for sustained consumption growth is satisfied.

References

Aizenman, J., "Dynamics of Trade Liberalization Policy," *Journal of Development* Economics, 13, 1983, 133-142

Arrow, K., "The Economic Implications of Learnign by Doing," *Review of Economic studies*, 29, 1962, 155-173

Barro, R., G. Mankiw, and X. Sala-i-Martin, "Capital Mobility in Neoclassical Models of Growth," *American Economic Review*, 85, March 1995, 103-115

Boldrin, M. and J. Scheinkman, "Learning by Doning, International Trade and Growth: A Note," in *The Economy as an Evolving Complex System,* Addison Wesly Publishing Company, 1988, 285-300

Cooper, R. and J. Sachs, "Borrowing Abroad: The Debtor's Perspective," in *International Debt and the Developing Countries,* Smith, G. and J. Cuddington eds., World Bank, 1985, 21-60

Corbo, B., A.O Krueger and F. Ossa, "Export Oreinted Development Strategies : The Success of Five Newly Industrializing Countries," *Westview Press*, 1985.

Corden, M., "Protection and Liberalization : A Review of Analytical Issues," *IMF Occasional Paper*, 54, 1987.

Edwards, S., "Openness, Outward Orientation, Trade Liberalization and Economic Performance in Developing Countries," *NBER Working Paper*, 2908, 1989.

Jones, L. and R.E. Manuelli, "A Model of Equilibrium Growth : Theory and Policy Implications, *Journal of Political*

Economy, 98, 1990, 1008-1038.

Krueger, A., "Prospects for Liberalizing the International Trading System," *NBER Working Paper, 2409, 1987.*

Lucas, R., "On the Mechanics of Economic Development,"*Journal of Monetary Economics*, 22, 1988, 3-42

Matsuyama, K., "Current Account Dynamics in a Finite Horizon Model," *Journal of International Economics*, 23, 1987, 299-313

Romer, P., "Increasing Returns and Long Run Growth," *Journal of Political Economy,* 94, 1986, 1002-1037

Schmitz, J., "Imitation, Entrepreneurship, and Long Run Growth," *Journal of Political Economy,* 97, 1989, 721-739

Stokey, N., "Learning by Doing and the Introduction of New Goods," *Journal of Political Economy*, 96, 1988, 701-717

Tyler, W., "Growth and Export Expansion in Developing Countries : Some Empirical Evidence," *Journal of Development Economics*, 9, 1981, 121-130