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A NOTE ON THE DUAL-INDUSTRIAL GROWTH AND LEARNING EFFECTS

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I. INTRODUCTION

TODAY, "export-led industrialization" seems to be the most successful scenario leading to industrialization in developing countries. The experiences of the Republic of Korea and Taiwan, where remarkable economic progress and rapid industrialization have been accomplished during the past thirty years, are usually referred to as examples of this success, and many theoretical and empirical studies of industrialization in these two countries have examined the rationale for the export-led industrialization strategy.[1] However, there still seems to be some vagueness remaining in their discussions of the mechanism of this industrialization strategy.

For example, to account for the achievements of these two countries, the effectiveness of trade liberalization is usually emphasized. It is said that the most important factor in their success was the "policy switch" from a restricted scheme keyed on import-substitution to a more liberalized one designed to promote exports.[2] In fact, after the period of the policy switch in 1960s, exports of manufactured products in both countries increased, and the rapid industrial development started in the same period.

Theoretical arguments for the mechanism of export-led industrialization seem less than satisfactory. Within the framework of traditional trade theory, it is usually explained that under the more liberalized trade scheme the comparative advantage of both countries in labor was utilized to increase exports of labor-intensive manufactured products, and that efficient resource allocation made their rapid industrial development possible. But this traditional framework is essentially static and is not sufficient for analyzing the process of economic development and the change in industrial structure. It leaves some questions unanswered: how did the policy switch dynamically promote overall industrial development, and by what process was this development promoted? Four points are to be considered in relation to these questions.

First, many studies have focussed on and criticized the demerits of protective measures. It is necessary, however, to examine the implications of the import-substitution policy during the period before the policy switch. Likewise, the timing of the switch has to be discussed.[3]

[1] See for example [1] [5] [3].
[2] See [3].
[3] Michaely [6] treated this issue.

Second, the policy switch was not as substantial as is voiced abroad. In Korea, the switch is said to have occurred in the early 1960s; but in actual fact the economy was only nominally liberalized and the domestic market remained rather heavily protected until the late 1970s. To consider the factors of success in export-led development, we should closely examine the real feature of policies and their effects in the process of structural adjustment after the switch.

Third, export expansion since the switch has not proceeded under free trade conditions. Besides surviving import-protection measures, various kinds of export incentives continue to exist. Thus the switch should be understood as a shift of government focus from fostering import-substituting industries to promoting export industries, not as a shift from protectionism to free trade.[4]

Fourth, it is necessary to shed light on the dynamic process of overall industrial development. Within the static framework of traditional trade theory, when labor-intensive industries expand as a result of the policy switch, capital-intensive industries must decline as a converse response. In fact, however, some capital-intensive industries in Korea, such as iron and steel, shipbuilding, and chemicals, have expanded, even after the switch, and have become exporting industries with international competitiveness. Thus, the dynamic aspects of industrial development should be analyzed carefully when we consider the experience of export-led growth as a success.

Taking these points into consideration, Ohno and Imaoka [8] tried to elucidate the feature of the industrial development process in Korea and Taiwan by proposing a hypothetical scenario which they called "dual–industrial growth." They maintained that the most important factor for understanding the success of development in the two countries is the coexistence of alternative policies, import-substitution and export-promotion policies, which together make dynamic use of the economies of scale.[5]

In this article we will examine the effects of export-promotion policy on an economy in which the government is simultaneously fostering import-substituting industries and discuss the rationale of the dual–industrial strategy. For this purpose, a two-period and three-sector model considering learning effects is introduced, with reference to the "Dutch disease" analysis, in the next section. In Section III, the equilibrium of the model and the effects of the export-promotion policy are discussed. The final section contains summary and conclusion.

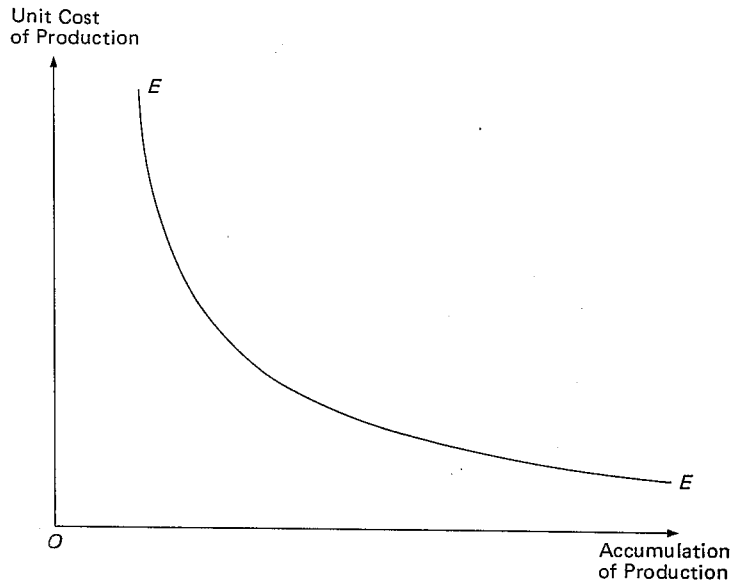
II. MODEL

Suppose an economy of developing country which consists of three sectors: a manufacturing sector (T), an infant-industry sector (M), and an export-promotion sector (V). The product of the manufacturing sector is tradable and its price is determined by the world market. We assume that the economy under consideration

[4] The effect of the policy switch is often explained as "neutralization" of the trade regime—export incentives offset the distortion in the domestic market. But the resulting regime should be distinguished from one of free trade.

[5] See [8] [4].

Fig. 1. Learning-Curve Effect



is that of a small country, so the domestic price of this product is identical to the world price.

The product of the infant-industry sector is also tradable and has an existing world price. However, the domestic price exceeds the world price because the domestic market is protected by the government from foreign competition, and there exists in this sector the "learning effects" of production.

The third sector is built up through the use of export-promoting measures. Here we assume that firms in this sector have been set up by the foreign direct investment and their products are only for export.

A. *Learning Effects*

Development of a country's manufacturing sector is promoted by the increase in productivity (the decrease in production costs) deriving from technological progress as a result of learning-by-doing. For instance, it is often pointed out that there exist "learning-curve effects" in the production process of manufacturing industries. Firms which have more experience in production can enjoy lower unit production costs than younger firms. Figure 1 indicates a learning curve (*EE*). The curve is downward sloping when accumulated quantity of output is measured along the horizontal axis and unit cost of production along the vertical axis.

Our model supposes two periods: the present (this) period and the future (next) period. We assume that the level of output in this period will affect the unit cost of production in the next period.

B. *Production*

We denote the levels of output in the manufacturing sector and infant-industries sector, and their domestic prices by x_T, x_M, p, and q, respectively.[6]

When full employment equilibrium is established with perfect competition in this economy, of which resource endowment and technology are given exogenously, the level of production in each sector is dependent only on prices. Thus, GDP of this economy in the present period can be expressed as a form of revenue function:

$$r(p, q) = px_T(p) + qx_M(q). \tag{1}$$

Differentiating $r(p, q)$ with respect to p and q gives supply functions for two sectors:[7]

$$\begin{aligned} r_q &= x_M(p, q), \\ r_p &= x_T(p, q). \end{aligned} \tag{2}$$

The level of production in the next period is affected by the learning effect in M sector. Therefore the revenue function can be expressed as below, with inclusion of the term for the learning effect, x_M.

$$R(P, Q, x_M) = PX_T(P) + QX_M(Q, x_M), \tag{3}$$

where we denote the levels of production for T sector and M sector, and their prices by X_T, X_M, P, and Q, respectively.

Supply functions are given as:

$$\begin{aligned} R_Q &= X_M(P, Q, x_M), \\ R_P &= X_T(P, Q, x_M). \end{aligned} \tag{4}$$

We assume that the increase in production for M sector in this period positively affects the level of GNP in the next period, and that its effect is accelerated in response to the increase (decrease) in the price of M product (T product) in the next period.

C. *Expenditure*

We assume that total expenditure for the two periods is determined by intertemporal cost minimizing behavior such as

$$E = \text{mini}\{nz + NZ \mid U(z, Z) > U\}, \tag{5}$$

where z and Z refer to sub-utility functions for the present and the next periods, respectively, n and N refer to expenditure functions per utility for the two periods, and h denotes discount rate.

From (5), the intertemporal expenditure function can be given as

$$E = E[n(p, q), hN(P, Q), U]. \tag{6}$$

[6] The framework of the model below is based on the work of Neary and Wijnbergen [7], who have analyzed dynamically the effects of the "Dutch disease."

[7] See [2].

Differentiating (6) with respect to q, p, P, and Q, we get the demand functions for two products in the two periods,

$$\begin{aligned} c_M &= c_M[n(p, q), hN(P, Q), U], \\ c_T &= c_T[n(p, q), hN(P, Q), U], \\ C_M &= C_M[n(p, q), hN(P, Q), U], \\ C_T &= C_T[n(p, q), hN(P, Q), U]. \end{aligned} \tag{7}$$

D. *Production Subsidy*

As mentioned above, the government protects M sector from foreign competition because there exist the learning effects in this sector. Here, we suppose the import of M-sector product is prohibited by the government. When the domestic market is insulated from the world market, the product can be considered as a non-tradable and its price and quantity are determined by the adjustment of supply and demand in the domestic market.

The domestic market equilibrium, however, is not necessarily the second best in respect to maximizing the intertemporal social welfare under the constrained system. The government gives a subsidy, s, for production of the product of M sector in the first period for the purpose of increasing social welfare. The subsidy is assumed to be financed by a lump-sum tax on consumers, sx_M. The revenue function and supply function of each product in the first period can be expressed as

$$r = r(p, q + s), \tag{1'}$$

$$\begin{aligned} x_M &= x_M(p, q + s), \\ x_T &= x_T(p, q + s). \end{aligned} \tag{8}$$

III. THE EFFECTS OF AN EXPORT-PROMOTION POLICY

A. *Market Equilibrium and Optimal Subsidy*

The product of T sector is tradable and its price is exogenously determined by the world market. Excess demand is fulfilled by import or export. The price for the M-sector product is determined domestically and the supply-demand conditions can be expressed as

$$x_M = c_M[n(p, q), hN(P, Q), U], \tag{9}$$

$$X_M = C_M[n(p, q), hN(P, Q), U]. \tag{10}$$

The intertemporal budget constraint is,

$$E[n(p, q), hN(P, Q), U] = r(p, q + s) + hR(P, Q, x_M) - sx_M + V, \tag{11}$$

where V denotes the trade balance.

In the model under consideration, three endogenous variables, q, Q, and U^* (or s), are determined by three equations (9)–(11), given p, P, and h exogenously. Differentiating (11) with respect to q, Q, and U gives,

$$dU/dx_M = (hR_M - s)/E_U. \tag{12}$$

From the necessary condition for maximizing social welfare, $dU/dx_M = 0$, the optimal subsidy, s^*, is given by the following as

$$s^* = hR_M. \tag{13}$$

Under the optimal subsidy, the model can be expressed as

$$r_q(q + s^*) = E_q(q, Q, U), \tag{14a}$$

$$R_Q[Q, r_q(q + s^*)] = E_Q(q, Q, U), \tag{14b}$$

$$s^* = hR_M[Q, r_q(q + s^*)]. \tag{14c}$$

Given the level of U, the equilibrium conditions for the present and future markets can be expressed as lines (or functions) in terms of q and Q, respectively. The slopes of these lines, by differentiation, are shown as

$$dQ/dq = (r_{qq} - E_{qq})/(E_{QQ} - r_{qq}hR_{MQ}) > 0, \tag{15a}$$

$$dQ/dq = (R_{QM}r_{qq} - E_{Qq})/(E_{QQ} - R_{QQ} - R_{QM}r_{qq}hR_{MQ}). \tag{15b}$$

Equation (15a) shows that the slope of the equilibrium line for the present market is positive; however, the sign of the slope for the future market is ambiguous. When the learning effect, $(\partial X_M/\partial x_M)(\partial x_M/\partial q)$, is larger than the intertemporal substitution effect, $(\partial C_M/\partial q)$, the slope is negative. The increase in the price of M product, q, brings about an excess supply in the future market of M product and causes a decline in its price, Q. In the opposite case the slope is positive.

B. *Export-Promotion Policy*

Under the above system with import protection and production subsidy, we will consider the effects of the export-promotion policy on the overall economy.

The increase in exports is indicated as $dV > 0$ in the model. We ignore the inter-sectoral resource movement, which implies that the productivity of T sector increases as the result of more efficient resource allocation or technological progress within the sector. We can suppose a case of foreign direct investment in the export processing zone, for example.

Differentiating (11) and (14) totally, given $dq = 0$, wet get

$$dQ/dV = (E_{qU}/E_U)/(r_{qq}hR_{MQ} - E_{qQ}) < 0, \tag{16}$$

$$dQ/dV = (E_{QU}/E_U)/(R_{QQ} - E_{QQ} + R_{QM}r_{qq}hR_{MQ}) > 0. \tag{17}$$

Equation (16) shows that the equilibrium line of the present market shifts downward when exports increase. Conversely, the equilibrium line of the future market shifts upward as shown in (17).

Figure 2 shows the case where the learning effects are larger than the substitution effects. The increase of exports results in the downward shift of the present line from mm to $m'm'$ and the upward shift of the future line from MM to $M'M'$. As a result, the intertemporal equilibrium point is changed from A to A'. The price of M product in the present market increases from q_A to q_A' and the price in the future declines from Q_A to Q_A'.

Fig. 2. The Effect of Export Promotion Policy ($ds^*<0$)

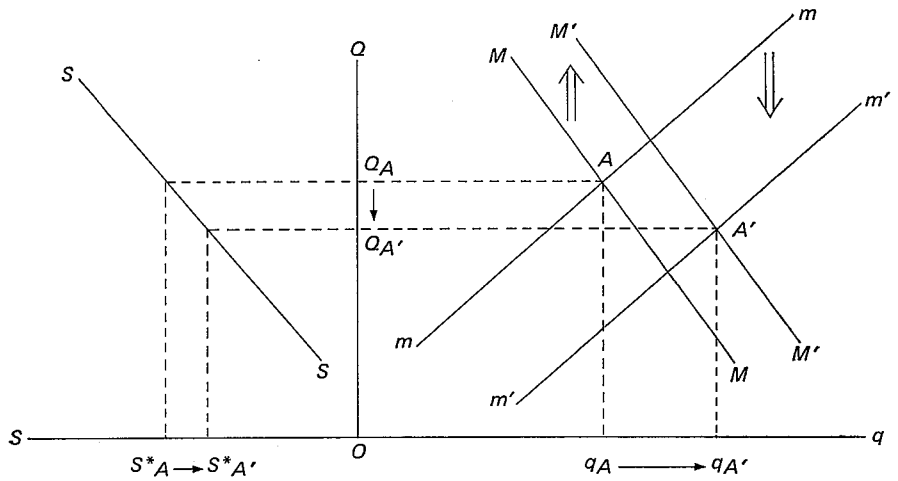
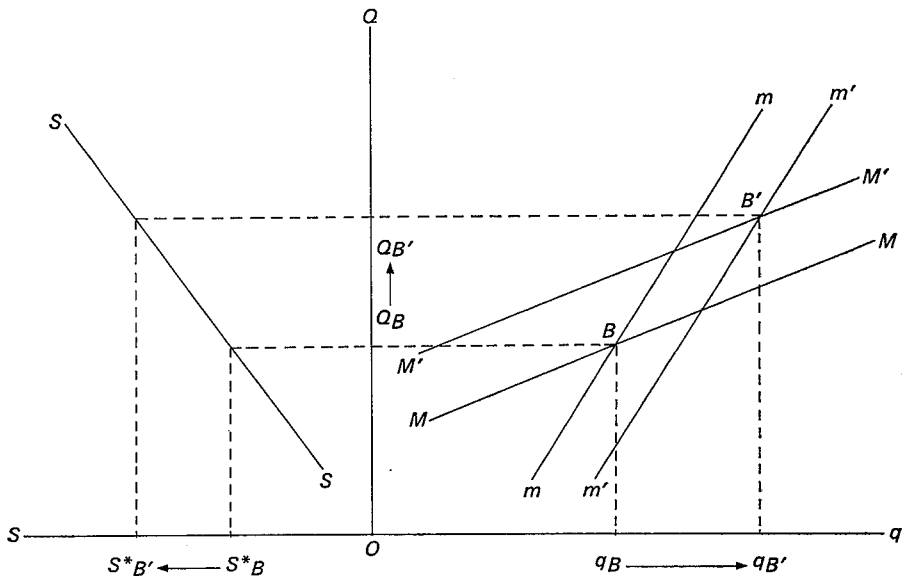


Fig. 3. The Effect of Export Promotion Policy ($ds^*>0$)



On the left-hand side of Figure 2, the horizontal axis indicates the level of subsidy and the optimal subsidy line (ss) shows the relation of (14c).[8] The rise in the future price reduces the level of optimal subsidy from S^*_A to $S^*_{A'}$. Conversely, when the learning effects are smaller than the substitution effects, the equilibrium point shifts from B to B' as shown in Figure 3. The prices of both periods increase and the level of optimal subsidy rises.

IV. SUMMARY AND CONCLUSION

In this article, we examined the effect of an export-promotion policy on the economy of a developing country in which the government has attempted to promote industrialization through a policy of import substitution.

The government has been fostering an infant industry (in which there exist learning effects) using a production subsidy and protecting the domestic market. The optimal level of subsidy for the infant industry is determined so as to maximize social welfare through two periods. At the same time the government has newly introduced an export promotion policy.

We examined how the optimal subsidy should be set when exports are expanding. Two cases were considered, depending on the relative magnitude of learning effects and the intertemporal substitution effect in the infant industry. When the learning effects exceed the substitution effect, the increase of exports reduces the level of the optimal subsidy. In such case the export promotion policy should be enforced together with the reduction in subsidy. Conversely, the increase of subsidy is requested when the substitution effect is larger.

The above conclusion is suggestive to the discussion for the efficacy of "policy switch" in the context of export-led industrialization. When the learning effects in the import substituting industry are sufficiently large, export promotion and liberalization of the domestic market should be done simultaneously. Conversely, when the learning effects are small, a higher level of protection is called for. It is noteworthy that market liberalization is supported in the case of larger learning effects, which seems to intuitively call for higher protection.

There remains the empirical question as to whether or not the experience of dual–industrial growth in Korea and Taiwan should be understood as a case of export-promotion with increasing subsidy. The answer to this question will be taken up in future studies.

[8] Differentiating (14c) and considering the linearity of the learning effects, we get
$ds^*/dQ = hR_{MQ} > 0$.

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