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EXPORT-LED INDUSTRIALIZATION AND THE DUTCH DISEASE

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INTRODUCTION

THERE has recently been growing interest in the so-called Dutch disease, a phenomenon of deindustrialization characterized by a relative shrinkage of domestic manufacturing industries (import-substituting industries) and a relative expansion of service industries (non-traded goods industries), giving rise to a great deal of literature devoted to discussing and analyzing the subject. The framework of this analysis is simple, and therefore highly applicable. It sounds a warning to the theory of export-led industrialization called for by developing countries from the mid-1960s onwards, for example. In particular, the conclusion derived from this framework of analysis seriously questions the strategy of the resources-based industrialization development in developing countries which are relatively well-endowed with natural resources, suggesting, as it does the possibility of the growing difficulty of industrialization through expanded exports (of natural resources, processed products of natural resources, labor-intensive products, etc.). In this article, we will review this framework of analysis and study the relationship between this framework and the theories of industrial development. We will also show that "deindustrialization" by an increase in exports of natural resources is not necessarily an unavoidable phenomenon. In Section I, we will introduce this framework of analysis using two or three concrete examples, followed in Section II by a discussion of its relevance to the developing economies, proving that this framework of analysis cannot necessarily be applied to developing economies if the concept of an unlimited supply of labor is introduced as a characteristic feature of developing economies. Some of the past theories of industrial development will be further interpreted by using this framework of analysis. In Section III, we will show that there is the possibility that a similar phenomenon would take place under certain conditions such as the labor market being segregated into two; that is, skilled and unskilled. Future tasks will be discussed in the concluding part of this article.

This paper is a combined version of two papers; Hisashi Yokoyama, "Yushutsu shudō kōgyōka ron to 'Oranda byō'" [Export-led industrialization and the Dutch disease], *Ajia keizai*, Vol. 28, No. 10 (October 1987) and idem, "Tojō koku keizai to Oranda byō" [Developing economies and the Dutch disease: a model with segregated labor markets], *Ajia keizai*, Vol. 30, No. 1 (January 1989).

I. FRAMEWORK OF ANALYSIS OF THE DUTCH DISEASE

According to W. M. Corden [4], the term Dutch disease first appeared in an article in the November 26, 1977 issue of *The Economist*. This article reported that the Netherlands enjoyed a large surplus in its balance of payments with a strong guilder because of the rich deposits of natural gas it held, but that its domestic manufacturing industries were extremely inactive and the unemployment rate was renewing its record. This was called the "Dutch" disease, after the "British" disease, and its symptoms were reckoned to be "external health but domestic illness" [6]. Meanwhile, the Gregory thesis [10] (about the phenomenon of newly developed mineral resources leading to a currency depreciation which adversely affected traditional export industries or import-substituting industries) was discussed in Australia in the mid-1970s [9] [18]. Since then this problem has mainly been analyzed in British and Australian literature. In this section, the basic ideas of these theories will be reviewed in order to explore the mechanism which creates this phenomenon and show that it does not occur in some cases (depending on assumptions). There are many analyses which, considering monetary aspects, discuss this phenomenon in its relation to appreciated currency exchange rates. We will focus on the discussions in real terms, however.[1] In the following, therefore, exchange rates are so-called real exchange rates, or relative prices of non-traded goods measured in terms of traded goods.

A. *Cases of "Enclave"-Type Natural-Resources-Exporting Industries*

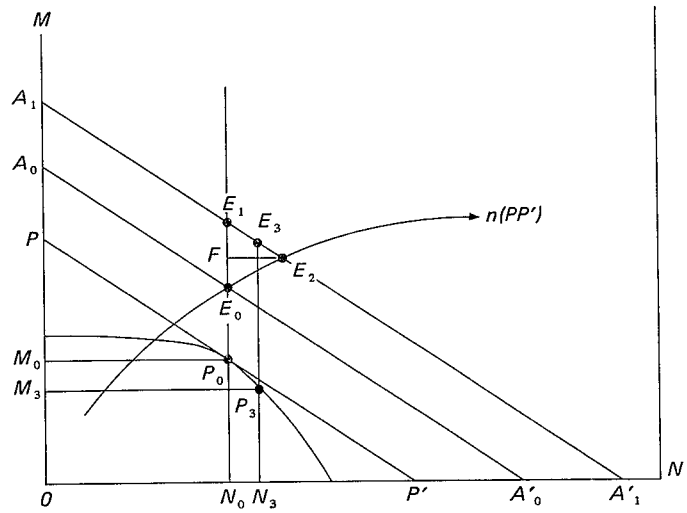
Suppose there is a natural-resources-exporting industry B in a small country which is completely "enclave"-type and which does not require any factor for production or requires only a specific production factor. Further, suppose that there is no domestic demand for the products of the industry which are all exported. Domestically, import-substituting industries of traded goods M and non-traded goods of manufacturing industries N are engaged in production by using fully employed capital and labor. It is also supposed that the market is complete and that demand function is given by the income-consumption line n in Figure 1 under price line PP'.[2]

Under the price PP', consumption is at point E_0, production at P_0, and export of natural resources measured in terms of M goods is PA_0. M goods are imported by the amount (E_0P_0), and the balance of payments is in equilibrium. However, suppose this country's export is expanded to A_1 for some reason. Then, if the income effect of demand on non-traded goods is nil, consumption is at point E_1 and newly acquired export earnings E_0E_1 are entirely used for import. Therefore,

[1] For example, W. M. Corden, "Exchange Rate Policy and the Resources Boom," *Economic Record*, Vol. 58, No. 160 (March 1982).

[2] This section depends heavily on the following: Makoto Ikema, *Shigen yushutsu koku no keizai moderu* [The economic model of resources-exporting countries], in *Shigen bōeki no keizaigaku* [Resources-trade economics], ed. Ippei Yamazawa and Makoto Ikema (Tokyo: Bunshindo, 1981).

Fig. 1. "Enclave"-Type Export Industry



Source: Prepared by the author.

the production point stays as it was and does not move. However, since zero income effect is normally inconceivable, the income-consumption line n in the figure is drawn as normal goods. In this case, point E_2 will be a new consumption point if prices do not change. Production is proceeding at point P_0 at present, however, and a surplus in the balance of payments by the amount E_1F or excess demand for non-traded goods N by the amount FE_2 is generated. Therefore, the market will undergo a rise in the prices of non-traded goods, and as a result the price line will be made to incline more sharply. Consequently, the income-consumption line will move, and the consumption point will reach new equilibrium at some point on E_1E_1, or for instance, at point E_3.

As a result, in a new state of equilibrium, the production of traded goods declines from M_0 to M_3 (deindustrialization), and the production of non-traded goods grows from N_0 to N_3. The new price line, though not drawn in the figure, becomes sharper, and relative values measured in terms of traded goods rise. In other words, the real exchange rate appreciates. Naturally, national income is OA_1 in old prices and is increased by A_0A_1.

The above may be summarized as follows. In this case, export earnings created by export expansion are partially used for the import of traded goods, and the remainder creates new demand for non-traded goods. Production factors are thus shifted from traded goods industries to non-traded goods industries, with the result that the traded goods sector is reduced and the non-traded goods sector is expanded. In this way relative values become favorable to the non-traded goods sector, and in terms of currency value this means that the currency appreciates.

In order to facilitate understanding of the following discussion, the changes

reviewed above will be classified into two categories according to Corden and Neary [5]. Different authors use different terms,[3] but here we will call the change from E_0 to E_3 "spending effects," and the change from P_0 to P_3 "resource movement effects."[4]

B. *Case of an Export Industry Employing Labor*

Next, let us suppose that an export industry is not a complete "enclave," but is related to the domestic economy through a labor market. In other words, let us suppose that an export industry requires labor as a production factor like other industries, but that it does not require capital or employ some other special production factor.[5] This case is characterized by the fact that the two remaining sectors, excluding the export industry, constitute a typical instance of the Heckscher-Ohlin-Samuelson theorem, and also by the fact that in this case there is the possibility of pro-industrialization instead of deindustrialization.

Let us for the time being ignore spending effects and suppose that relative prices do not change. If exports grow, the demand for labor for the production of export goods grows accordingly, and the export industry absorbs labor from the remaining two industries. For the remaining two sectors, the hitherto maintained equilibrium is broken by a decrease in total labor available to them. Therefore, according to the well-known Rybczynski theorem, the output of labor-intensive industries declines relatively and that of capital-intensive industries expands relatively. If traded goods industries are more labor-intensive than non-traded goods industries, the output of the former declines and that of non-traded goods expands, as explained above.

Conversely, if a traded goods industry is capital-intensive and a non-traded goods industry is labor-intensive, the trade industry expands. This is a paradoxical case of Corden-Neary's pro-industrialization. As a result, however, the prices of products of the labor-intensive industry rise and consequently the wage rate also rises, as in the previous case.

Meanwhile, spending effects are approximately the same as in the previous case, resulting in import by the traded goods industry and an excess demand from the non-traded goods industry. Therefore relative prices measured in terms of traded goods rise. These effects are not dependent on factor intensity, however. As there is a change in relative values, the wage rate rises if the non-traded goods industry is labor-intensive, according to the Stolper-Samuelson theorem. Contrarily, the wage rate declines if the traded goods industry is labor-intensive.

As will be clear from the above analysis, it is difficult to draw a conclusion

[3] Corden and Neary [5] call the latter "resource movement effect," while Enders and Herberg [7] call it "labor movement effect" and Long [16] "direct resource pull effect." Furthermore, Corden and Neary name the former "spending effect" and Long "transfer equivalent effect," aware of the similarity of the effect of the former to it in the history of theories on international economics.

[4] Corden [4] cites eleven articles dealing only with spending effects, and seven articles dealing with both.

[5] The discussion of this case depends on the articles cited above by Corden and Neary [5].

simply from the effect of export expansion. It will be particularly clear that in the case of the traded goods industry being capital-intensive, there is the possibility that the traded goods industry will be promoted. Needless to say, there are other possibilities that a similar conclusion to that derived from the previous case.

C. *Other Cases*

It cannot necessarily be said that the above two cases express a characteristic feature of export goods as natural resources, therefore let us here introduce the assumption that domestic industries demand export goods as intermediate inputs.

In this case, if the traded goods industry uses intermediate resource inputs more intensively than the non-traded goods industry, the result will be instantly apparent. If export expansion is due to the rise of the export price of the natural resources, the traded goods industry using the resources as intermediate goods costs more than the non-traded goods industry. Furthermore, as an import-substituting industry in a small country it is put in an unfavorable position with regard to imports and declines.[6] Therefore, if there is already a disease caused by export expansion, the disease will become more serious. However, if the intensity is reversed, the conclusion is not so self-evident. For instance, Herberg and Enders [11] using a theoretical model say that no "disease" is caused in this case. This is because cost restrictions are too large for a non-traded goods industry which uses this factor more intensively as an intermediate input. However, Bruno and Sacks [3] show by using a model with parameters for Britain that the "disease" is caused after all. As will be explained later, this case is important to the theory of resource-based industrialization, and is a question which should be studied in the future both theoretically and empirically.

The above discussions may be extended in other directions (for instance, the removal of the small country assumption, a rise in export prices, introduction of the unemployment factor, the possibility of capital mobility among the three sectors or dynamic analysis). These extensions are left to Corden [4] and will not be touched upon here. However, it must be pointed out that Corden and Neary interpret the export expansion as Hicks's neutral technological progress enjoyed by the export sector to generalize this phenomenon [5, p. 825]. This theory may be applied to the phenomenon of an industry equipped with new technology replacing one with old technology. Furthermore, as for prescriptions for this disease, Corden [4, pp. 374–76] writes about the protection of manufacturing industries, while Wijnbergen [20] emphasizes learning effects. Enders and Herberg [7] and Herberg and Enders [11] as well as other economists [14] discuss foreign investment and other problems in detail.

Moreover, Benjamin, Devarajan and Weiner [2] as well as Auty and Gelb [1] and Jazayeri [13] deal with the question of oil producing countries as an application of this theory to developing countries, while Evans [8] discusses mineral

[6] Needless to say, foreign countries face a similar cost rise, and if this country can reduce costs more than other countries, by technology or other means, it would be possible for it to export.

ore export and Kamas [15] deals with the exporting countries of coffee and other products (Colombia).[7]

II. APPLICATION TO DEVELOPING ECONOMIES

As explained above, the framework of analysis for theoretically elucidating the phenomenon of the Dutch disease is relatively easy to understand. At the same time, this framework, because of its simplicity, seems to explain explicitly, many economic issues which have until now been discussed more or less intuitively. Looking back on the history of development economics, it is very relevant to the pessimistic view of the industrialization of developing countries through the export of primary products, which was discussed by Singer, Myrdal, and Prebisch in the 1950s and 1960s, as well as to the staple theory advocated by North, Baldwin, and others, a theory opposed to the above. It is also suggestive as regards the theory of resource-based industrialization formulated by Myint and others, because this framework of analysis can clarify the effects of the problems pointed out by the above-mentioned economists on developing economies.

Clearly, the problem of leakage of income to industrialized countries through export, pointed out by Singer and others, is directly related to the income effects which are one of the factors causing this disease. Furthermore, Myrdal's backwash effect is essentially the same as the phenomenon mentioned in the preceding section, a phenomenon of export industries absorbing labor, resulting in a rise in the wage rate. However, this framework of analysis seriously questions the validity of the staple theory and the theory of resource-based industrialization, as it is clear from the discussions in the preceding section that industrial development based on the export of domestically available resources suffers from the limitations that the industrial sector can develop only under certain conditions. In more general terms, so-called dual–industrial growth [12] [17] will result in the case of the export industry being labor-intensive and the import-substituting industry capital-intensive.

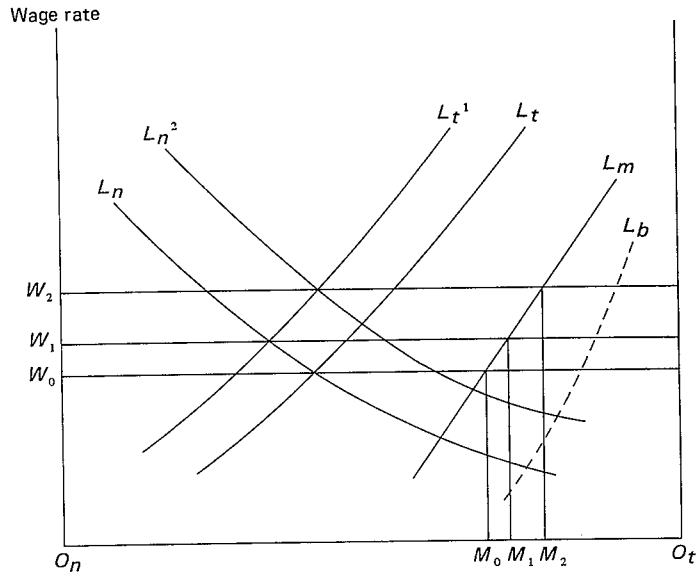
Whatever the case, a study of the phenomena and effects which have so far been asserted in development economics deserves an attempt, using this framework of analysis as a starting point. In the following, such an attempt will be outlined.

A. *Case of Unlimited Labor Supply*

As we have seen above, this model is based on strong assumptions in order to elucidate the generation mechanism of this disease. In considering a developing economy, it is necessary to relax various assumptions, including that of full employment. As is often supposed for developing economies, full employment is replaced with the assumption of unlimited labor supply. Furthermore, the effects of forward-backward (intermediate demand) linkage, final demand linkages

[7] The following are important reference articles: P. Daniel, Editorial of a special feature issue of *IDS Bulletin,* Vol. 17, No. 4 (October 1986). Also, M. Roemer, "Dutch Disease in Developing Countries: Swallowing Bitter Medicine," in *The Primary Sector in Economic Development,* ed. M. Lundahl (London: Croom Helm, 1985).

Fig. 2. Labor Market When the Dutch Disease Is Caused



Source: Prepared by the author.

(consumption, investment), technological diffusion, etc. are supposed to be non-existent in the discussions above.

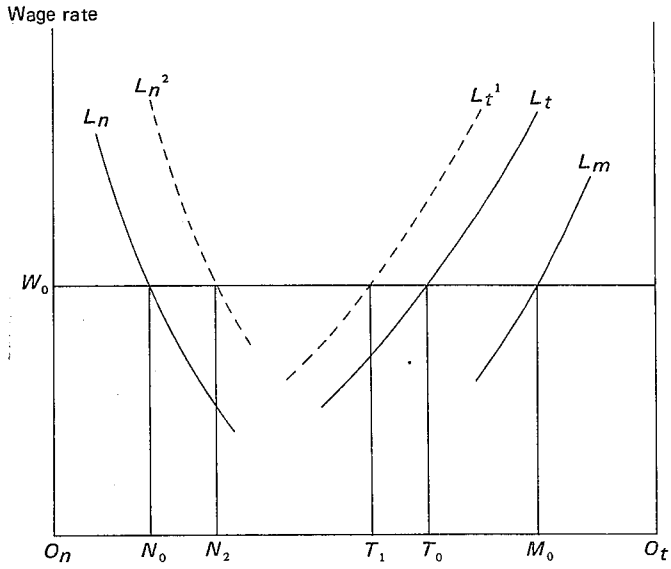
For instance, if the assumption of full employment is relaxed and the assumption of intermediate demand linkage and final demand linkages of an export industry introduced, the rise in the wage rate, the factor most responsible for the "disease," can be avoided. Moreover, an export industry generates new demand, therefore, it cannot necessarily be said that the disease is unavoidable, but rather it may be said that it may bring a favorable cycle in its train.

Let us consider this situation in a partial equilibrium analysis of the labor market.

Figure 2 shows a labor market where only the labor force can move freely between the three sectors [5]. The vertical axis indicates the wage rate measured in terms of traded goods, and the horizontal axis the labor force of the non-traded goods sector N. From right to left, we have the sum of the labor force of the export goods sector B and the traded goods sector M, while O_nO_t represents aggregate labor force. Therefore, the marginal product curve of the traded goods sector L_m does not have the price of the sector as a shift parameter, but L_b and L_n of the two other sectors shift together with their respective prices.

At first, the market is maintained in equilibrium at an intersection of L_t $(= L_m + L_b)$ and L_n. Let us suppose that the wage rate is W_0. If export is expanded then L_t shifts leftward. The new wage rate therefore becomes W_1, and the employment of the traded goods sector is reduced from O_tM_0 to O_tM_1 (factor movement effect). As we have seen above, if the prices of non-traded goods rise due to

Fig. 3. Case of Unlimited Supply of Labor



Source: Prepared by the author.

income effects by export earnings, L_n shifts and the wage rate rises further to W_2 (spending effects), to cause the Dutch disease. In other words, the traded goods sector is reduced from O_tM_0 to O_tM_1 and then to O_tM_2. However, it should be noted that new demand for traded goods due to income effects is met by import, and that there is no change in the output of traded goods.

Now, if the assumption of unlimited supply of labor is introduced, we will get Figure 3. As is well known, under this assumption, because of the function of infinitely elastic supply, W_0, unemployment by an amount of N_0T_0 or some sort of disguised unemployment occurs in N_0O_t.

If export is expanded at this time, the export industry shifts the labor demand curve L_t to the left. This time, however, the factor movement effect is nil as the supply function is infinitely elastic. Furthermore spending effects due to income effects do not expand or reduce the traded goods industry, although they absorb unemployment and expand non-traded goods industries. Therefore, no Dutch disease is caused. On the contrary, favorable effects are produced—an increase in employment and a decrease in unemployment. In addition to the above assumptions, let us consider forward-backward linkage demand from export goods industries, or final demand linkages due to an increased outlay of wages for labor employment. Then, a new effective demand which previously was not seen in the traded goods industry, is created, and L_m is shifted to the left (not drawn in the figure), and the traded goods sector expands. Therefore, the traded goods industry expands together with the expansion of the export industry.

In this way, if the assumption of an unlimited supply of labor, which is a characteristic of developing economies is introduced into the framework of analysis of the Dutch disease, main cause of the Dutch disease, a rise in the wage rate, does not occur, and the Dutch disease is avoided. The above mechanism is based on strong assumptions however, and it must be noted that where such assumptions are not tenable, the above conclusion is hardly supportable. As mentioned in the preceding section, for example, differences in factor intensity, the existence of forward linkage industries, and other factors are not considered. If other characteristics of developing economies are introduced into the assumptions, the above conclusion can hardly be maintained.

As one of the other characteristics of developing economies let us examine the case in which the labor market is not homogeneous and in which, unlike labor markets in developed countries, special skills are required of workers in export industry B and only a limited number of such skilled workers are available. In this case, the increased demand of an export industry for skilled workers due to export expansion is not necessarily met without a rise in wages. This is because skilled labor, of which there is a scarcity, flows into the export industry resulting in a drop in the supply of such labor to other sectors. This backwash effect pointed out by Myrdal is frequently observed in developing countries. Furthermore, there is a possibility that the wage rise may overflow into the unskilled labor market. In such a case, the wage rate rises after all, and the Dutch disease may occur.

Secondly, let us look at the problem of the supply of capital or technology. In the above, it is supposed that the supply function can cope with sufficient elasticity with surplus demand arising in the traded and non-traded goods sectors thanks to an unlimited supply of labor. Bottlenecks in this supply now pose a problem because of the lack of entrepreneurship, production technology, capital and other factors to cope with changing demand.

In addition to these long-term problems, there are short-term ones. Thus, thirdly, it is necessary to study the problem of the balance of international payments. Generally speaking, the income elasticity of demand (for traded goods) exceeds 1 in many developing countries, so that there is ample possibility of importing goods exceeding export earnings. This poses a problem as regards the balance of international payments. A favorable cycle can be expected if domestic import-substituting industries are capable of meeting surplus demand. For this purpose, however, newly generated income is required to be effectively invested for future production. The experience of many Latin American countries may be considered representative of this case in that they failed to invest export earnings gained in the boom period effectively.[8]

A delay in taking proper policy measures after an export boom, as was the case with Colombia which was analyzed by Kamas, is a phenomenon frequently observed in developing countries. Generally speaking, a boom is a boom because it is short-lived, and in many cases the question is how to deal with economic

[8] A good example is the article by Auty and Gelb [1], which deals with Trinidad and Tobago.

problems after a boom. A country's currency appreciates during a boom, but the currency value must be restored to normal and excessive government spending due to export earnings reduced as soon as a boom is over. Delays in making a policy change tend to lead to various problems in the wake of a boom.

B. *Avoidance of the Dutch Disease*

As we have seen above, it is clear that the mechanism explained in the preceding section which underlies the Dutch disease, cannot be applied directly as it is to the economies of developing countries. Various models which take into consideration various characteristics of developing economies, may be reinterpreted as models for avoiding the Dutch disease by utilizing this framework of analysis however. In short, the model, which attaches importance to final demand linkages under unlimited labor supply, is Yokoyama's model [21] for Southeast Asian countries, and a model which also takes forward-backward linkages into consideration can be interpreted as a model based on the staple theory and the theory of industrialization through resources-processing industries. As mentioned at the beginning of this section, if we read "import-substituting industries" for "export industries," and introduce backward linkages in between, we can get a method for studying a "dual–industrial growth."

Yokoyama finds a major factor for the growth of Southeast Asia in the 1970s against the background of an unlimited labor supply in the fact that "under a favorable environment of active export, agriculture, which enjoyed an advance in productivity due to technological innovations [the green revolution etc.] and capital accumulation, played the role of a locomotive, providing funds for capital accumulation and labor power...while manufacturing industries, together with foreign capital, met demand for consumer goods newly created in the agricultural sector" [21, p. 110] and calls it a combined growth of agriculture and manufacturing industries.

If we read "agriculture" for "export industries" and "manufacturing industries" for "traded goods (import-substituting) industries," this corresponds as to the case of an unlimited supply of labor. This also indicates that restrictions on capital were resolved by direct foreign investments, and restrictions on the balance of international payments were eased by the then prevailing relaxed international capital market, making it possible for Southeast Asia to cover certain deficits. In other words, this also indicates that under conditions where capital and the bottlenecks of international balance of payments were not tight, developing countries were able to increase employment through increased export of primary products and technological innovations (Corden-Neary's general understanding of export expansion) and expand import-substituting industries on the basis of demand for consumer goods due to increased rate earnings. It may be said that this points to a method of avoiding the Dutch disease under conditions in which there is an unlimited supply of labor as discussed above.

Secondly, Thoburn, aptly summing up the staple theory, says as follows:

> Export growth both offers opportunities for new economic activities (i.e., embodying more advanced technology) to develop elsewhere in the economy and it conditions

> the responsiveness of the economy to those opportunities.... Successive development is determined by the type of market which grows up for local consumer goods, and, as D. C. North stresses, by the investment opportunities offered to industries producing intermediate products for the export sector or using the export good as an input...—backward and forward linkages. [19, p. 34]

Though this assertion differs from the above in that it stresses the propagation of technology through export without paying attention to capital or the international balance of payments, and also focuses on intermediate demand and final demand linkages on the demand side, yet the mechanism is considered to follow approximately the same mechanism as in the preceding case. Here too another way to avoid the Dutch disease by the same mechanism explained in the preceding section is shown. In this case however, the necessary conditions for this mechanism to work are the propagation of technology through export and release from the restrictions of capital and international balance of payments, which are not clearly noted in the staple theory.

Lastly, let us consider a model of dual–industrial growth as a case in which export products are not confined to natural resources in the application of this framework of analysis.

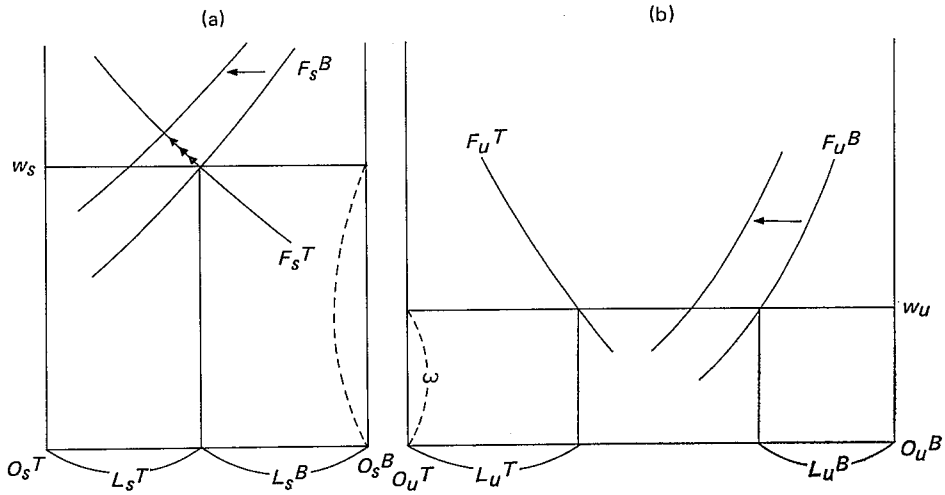
Many proponents of the model of dual–industrial growth assert that not only the export expansion of labor-intensive industries due to the comparative advantage theory, but also the import-substituting process of capital-intensive industries as backward linkage industries played an important role in the high economic growth of the Republic of Korea and Taiwan. They insist that the high economic growth of these countries was supported not only by the one track of labor-intensive light manufacturing industries which expanded remarkably with the policies for export promotion, but also by the other pole of capital-intensive heavy manufacturing industries which was protected by policies of import substitution. These policy measures for import substitution and export expansion, international capital movement, demand for intermediate goods and investment goods from labor-intensive light manufacturing industries, scale economy of capital-intensive heavy manufacturing industries, etc. are singled out as important background factors.

If we compare this with the previous case, labor-intensive light industries here are export industries, and traded goods industries are import-substituting industries. The assumptions of unlimited labor supply and international capital movement in the preceding case are a part of the conditions for a dual–industrial growth. It is therefore possible to consider that here too the mechanism observed above of avoiding the Dutch disease can be applied. The existence of economy of scale in traded goods industries was not necessarily supposed in the previous case, however, thus it would be necessary to further study dual–industrial growth theoretically focusing on these points.

III. TWO SEGREGATED LABOR MARKETS

This section studies another characteristic case of developing countries, namely, a case in which labor markets are not homogeneous and in which, unlike workers

Fig. 4. Primary Effect of the Shift of Resource-exporting Industry



Source: Prepared by the author.

in labor markets in developed countries, the workers of an export industry B require special skills and only a limited number of them are available. In such a case, demand for skilled labor in the growing export industry due to export expansion cannot necessarily be met without a raise in the wage rate, because skilled labor as a scarce production factor flows into the export industry at the expense of other sectors. Furthermore, there is a possibility that this wage increase may overflow into the unskilled labor market. In such a case, the wage rate will ultimately rise, and the Dutch disease may occur.

Here we will introduce another labor market in addition to the market of unlimited labor supply and study the implications of the two markets existing side by side. The market of unlimited labor supply is a market of unskilled labor with a degree of unemployment, as mentioned in the preceding section. The new market is a market of skilled labor where full employment is assumed. Capital and other factors are assumed to be the same as in the preceding case. For the sake of simplification, as regards the market of goods, we will ignore the market of non-traded goods in contrast to the preceding case, and focus on two industries, the resource-exporting industry and the import-substituting traded goods manufacturing industry.

Figure 4(a) shows the market of skilled labor where full employment is assumed. Like Figure 3, Figure 4(b) showing the market of unskilled labor, indicates that underemployment is caused under a function w_U of infinitely elastic supply. $F_S{}^T$, $F_U{}^T$ ($F_S{}^B$, $F_U{}^B$) in both these figures are, respectively, the functions of demand for skilled S and that for unskilled U labor from the traded goods (resource-exporting) industry. w_S in Figure 4(a) represents the wage level determined by full employment. Let us suppose that the unskilled labor wage w_U is institutionally set at a

certain rate ($\omega, 0 < \omega < 1$) of a wage level w_S determined by the skilled labor market. This relationship is represented by the following equation.

$$w_U = \omega w_S \quad (0 < \omega < 1).$$

Let us assume that in this case the two markets are in a state of equilibrium at an employment level of L_S^T, L_U^T (L_S^B, L_U^B) respectively. Let us also suppose that the production of the resource-exporting industry expands due to some reason or another and that F_S^B, F_U^B shifts to the left. Then, the wage in the skilled labor market rises temporarily and the employment of the traded goods industry L_S^T declines. At the same time, under the impact of this wage raise, the wage in the unskilled labor market w_U rises, and the employment of the two industries decreases. However, the effect does not end here, as employers examine the two markets and adjust employment. There is a possibility of skilled labor being partially replaced by unskilled labor in order to counter the increased wage of skilled labor, while employment may change in both markets depending on the selection of technology by employers. Therefore, a further close study is needed to see where a new equilibrium is finally attained.

Here we will specify the two above-mentioned markets as follows. Let us suppose that employment is adjusted so that the demand function be equal to marginal products under given prices and wages, and that prices are adjusted to be expressed in the same unit being set at 1 for both kinds of goods. If the unskilled labor wage in terms of the skilled labor wage is ω ($= w_U/w_S$), the above model can be expressed as follows:

$$\begin{cases} F_S^T(L_S^T, L_U^T) - F_S^B(L_S^B, L_U^B; \alpha) = 0 \\ F_U^T(L_S^T, L_U^T) - F_U^B(L_S^B, L_U^B; \alpha) = 0 \\ \omega F_S^B(L_S^B, L_U^B; \alpha) - F_U^B(L_S^B, L_U^B; \alpha) = 0 \\ L_S^T + L_S^B = L_S, \end{cases}$$

where

α: a shift parameter of the function of demand for skilled and unskilled labor in the resource-exporting industry,

ω: wage rate differential ($0 < \omega < 1$) between the two markets.

Another wage rate equation,

$$\omega F_S^T(L_S^T, L_U^T) - F_U^T(L_S^T, L_U^T) = 0,$$

is excluded because it is not independent. This is a model with four unknown variables, that is, L_S^T, L_S^B, L_U^B, and ω, four independent equations, a parameter, and L_S (aggregate available skilled labor). For future reference, this system is expressed below in a total differential equation. However, here F_{IJ}^K is a partial derivative with respect to the J factor of the I factor of industry K.

$$\begin{bmatrix} F_{SS}^T & -F_{SS}^B & 0 & -F_{SU}^B \\ F_{US}^T & -F_{US}^B & 0 & -F_{UU}^B \\ 0 & \omega F_{SS}^B - F_{US}^B & F_S^B & \omega F_{SU}^B - F_{UU}^B \\ 1 & 1 & 0 & 0 \end{bmatrix}$$

$$\times \begin{bmatrix} dL_S{}^T \\ dL_S{}^B \\ d\omega \\ dL_U{}^B \end{bmatrix} = \begin{bmatrix} F_{S\alpha}{}^B \\ F_{U\alpha}{}^B \\ -\omega F_{S\alpha}{}^B + F_{U\alpha}{}^B \\ 0 \end{bmatrix} d\alpha.$$

The determinant of the first matrix, **D**, on the left side is calculated as follows:

$$|\mathbf{D}| = F_S{}^B[(F_{SS}{}^B F_{UU}{}^B - F_{SU}{}^B F_{US}{}^B) + (F_{SS}{}^T F_{UU}{}^B - F_{SU}{}^B F_{US}{}^T)].$$

The first term on the right side becomes zero if the production function of the resource-exporting industry is a homogeneous equation of degree one regarding skilled and unskilled labor.[9]

$$F_{SS}{}^B F_{UU}{}^B = F_{SU}{}^B F_{US}{}^B.$$

$F_S{}^B$ representing marginal labor product, $|\mathbf{D}|$ becomes positive when the partial derivative of the marginal product of labor, both skilled and unskilled, satisfies the following relationship:[10]

$$F_{SS}{}^T F_{UU}{}^B > F_{SU}{}^B F_{US}{}^T,$$
$$\frac{F_{SU}{}^B}{(-F_{SS}{}^B)} > \frac{F_{SU}{}^T}{(-F_{SS}{}^T)}.$$

This means that in order to increase the marginal product of skilled labor, an industry may increase unskilled labor or decrease skilled labor. When the relative ratio between the two, or the degree of the contribution of unskilled labor is higher in the resource-exporting industry than that of contribution of skilled labor, this inequality holds. Conversely, in the case of the change in the marginal product of skilled labor ($F_S{}^T$) in the import-substituting industry being relatively higher than the change in that of the resource-exporting industry ($F_S{}^B$) due to an increase in unskilled labor, this inequality does not hold, and the $|\mathbf{D}|$ becomes negative.

Now, let us see what change is caused by a variation in the shift parameter α of the resource-exporting industry. Suppose that α is raised for some reason, and that as a result additional demand for labor is created in the resource-exporting industry. Then,

$$\frac{\partial L_S{}^T}{\partial \alpha} = \frac{1}{|\mathbf{D}|} \begin{vmatrix} F_{S\alpha}{}^B & -F_{SS}{}^B & 0 & -F_{SU}{}^B \\ F_{U\alpha}{}^B & -F_{US}{}^B & 0 & -F_{UU}{}^B \\ -\omega F_{S\alpha}{}^B + F_{U\alpha}{}^B & 0 & F_S{}^B & \omega F_{SU}{}^B - F_{UU}{}^B \\ 0 & 1 & 0 & 0 \end{vmatrix}$$
$$= \frac{1}{|\mathbf{D}|}(-F_{UU}{}^B)[(\omega F_{SS}{}^B - F_{S\alpha}{}^B)F_{S\alpha}{}^B + F_{SS}{}^B F_{U\alpha}{}^B].$$

In case $|\mathbf{D}|$ is positive,

[9] Generally speaking, in case the production function, $Y=f(X_1, X_2)$, is a homogeneous first degree equation, $Y=f_1X_1+f_2X_2$. Consequently, $f_1=f_1+f_{11}X_1+f_{21}X_2$. Therefore, $f_{11}=-(X_2/X_1)f_{21}$; similarly, $f_{22}=-(X_1/X_2)f_{12}$. Therefore, $f_{11}f_{22}=f_{21}f_{12}$.

[10] This is also a necessary condition for stability.

$$\frac{\partial L_S{}^T}{\partial \alpha}<0.$$

Contrarily, in case $|\mathbf{D}|$ is negative,

$$\frac{\partial L_S{}^T}{\partial \alpha}>0.$$

Similarly, in case $|\mathbf{D}|$ is positive,

$$\frac{\partial L_S{}^B}{\partial \alpha}=\frac{1}{|\mathbf{D}|}F_S{}^B[F_{S\alpha}{}^B(-F_{UU}{}^B)+F_{SU}{}^BF_{U\alpha}{}^B]>0,$$

$$\frac{\partial \omega}{\partial \alpha}=\frac{1}{|\mathbf{D}|}(F_{U\alpha}{}^BF_{SU}{}^B-F_{UU}{}^BF_{S\alpha}{}^B)(\omega F_{SS}{}^T-F_{US}{}^T)<0,$$

$$\frac{\partial L_U{}^B}{\partial \alpha}=\frac{1}{|\mathbf{D}|}F_S{}^B[F_{S\alpha}{}^B(F_{US}{}^B+F_{US}{}^T)-(F_{SS}{}^TF_{U\alpha}{}^B+F_{SS}{}^B)]>0.$$

From the other wage equation,

$$F_S{}^T\frac{\partial \omega}{\partial \alpha}+\omega\left(F_{SS}{}^T\frac{\partial L_S{}^T}{\partial \alpha}+F_{SU}{}^T\frac{\partial L_U{}^T}{\partial \alpha}\right)$$
$$=F_{US}{}^T\frac{\partial L_S{}^T}{\partial \alpha}+F_{UU}{}^T\frac{\partial L_U{}^T}{\partial \alpha}.$$

$$\therefore\ \frac{\partial L_U{}^T}{\partial \alpha}=\frac{\omega F_{SS}{}^T-F_{US}{}^T}{\omega F_{SU}{}^T-F_{UU}{}^T}\cdot\frac{1}{|\mathbf{D}|}\cdot$$
$$[-F_S{}^T(F_{U\alpha}{}^BF_{SU}{}^B-F_{UU}{}^BF_{S\alpha}{}^B)+F_{UU}{}^BF_S{}^B(F_{SU}{}^BF_{U\alpha}{}^B-F_{UU}{}^BF_{S\alpha}{}^B)],$$

$$\frac{\partial L_U{}^T}{\partial \alpha}>0.$$

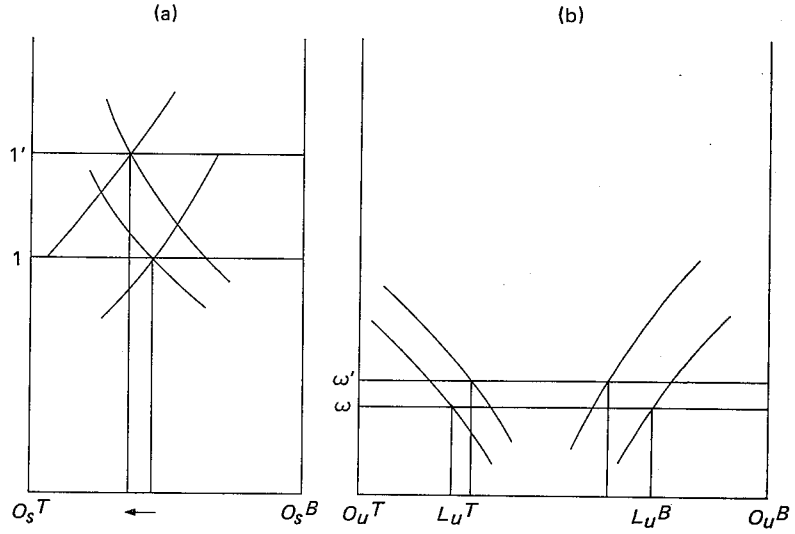
However, needless to say, the above inequality is reversed, in case $|\mathbf{D}|$ is negative.

From the above results we can infer that if $|\mathbf{D}|$ is positive, or the resource-exporting industry is able to increase its marginal product by employing relatively low-cost labor, the import-substituting industry (at least its skilled labor) is reduced. At the same time, the wage rate differential widens.

At first, demand for both skilled and unskilled labor increases in the resource-exporting industry, and the wage rate of skilled labor rises in proportion to the demand increase. Therefore, both these industries attempt to replace skilled labor with unskilled labor. However, as the resource-exporting industry is able to increase the marginal product of skilled labor by employing more unskilled labor, the resource-exporting industry employs more skilled labor. Since the wage rate of unskilled labor is relatively lower in both industries, more unskilled labor is employed. This situation is shown in Figure 5.

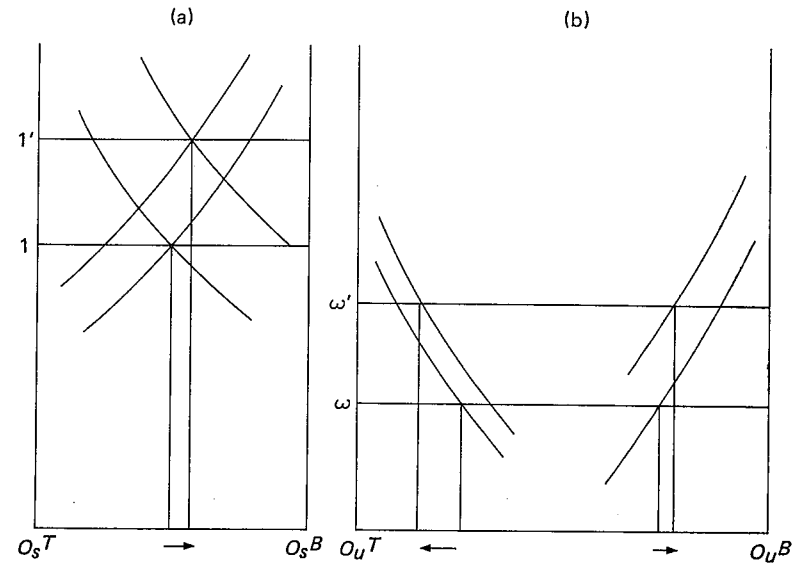
On the other hand, if $|\mathbf{D}|$ is negative, the import-substituting industry can increase its marginal product of skilled labor by employing more unskilled labor, with the result that it employs more skilled labor than before. In this case, the increase in the marginal product leads to an increase in the marginal product of

Fig. 5. The Effect of the Shift of the Resource-exporting Industry (If |**D**| Is Positive)



Source: Prepared by the author.

Fig. 6. The Effect of the Shift of the Resource-exporting Industry (If |**D**| Is Negative)



Source: Prepared by the author.

unskilled labor, with the result that the latter's marginal product further increased and the wage rate differential is reduced. Because of this, the employment of unskilled labor declines in both industries due to the spread of the increased wage of skilled labor to the wage of unskilled labor. This situation is indicated in Figure 6.

It would be useful to study an intermediate case between the two examples above. In this instance, there is no change in the employment of skilled labor in these two industries. Therefore,

$$dL_S{}^T = dL_S{}^B = 0.$$

Hence,

$$(-F_{SU}{}^B)dL_U{}^B = F_{S\alpha}{}^B d\alpha,$$
$$(-F_{UU}{}^B)dL_U{}^B = F_{U\alpha}{}^B d\alpha.$$

In order that these equations may hold at the same time,

$$-\frac{F_{S\alpha}{}^B}{F_{SU}{}^B} = \frac{F_{U\alpha}{}^B}{F_{UU}{}^B}.$$
$$\therefore \quad \frac{\partial F_U{}^B/\partial L_S{}^B}{\partial F_U{}^B/\partial(-L_U{}^B)} = \frac{\partial F_S{}^B/\partial\alpha}{\partial F_U{}^B/\partial\alpha}.$$

Furthermore, from the following equation,

$$F_S{}^B d\omega + (\omega F_{SU}{}^B - F_{UU}{}^B)dL_U{}^B = (-\omega F_{S\alpha}{}^B + F_{U\alpha}{}^B)d\alpha,$$
$$\left.\frac{\partial\omega}{\partial\alpha}\right|_{dLS=0} = \frac{1}{F_S{}^B F_{SU}{}^B}(F_{U\alpha}{}^B F_{SU}{}^B - F_{S\alpha}{}^B F_{UU}{}^B) > 0.$$

Therefore, in the intermediate case in which there is no change in the allocation of skilled labor, it is clear (1) that the rate of change in labor demand in the resource-exporting industry is equal to the rate of change in the marginal product of unskilled labor and (2) that the wage differential is reduced.

Here let us consider another intermediate case in which there is no change in the wage differential. In this example, in which $|\mathbf{D}|$ is clearly zero, with the above assumptions,

$$\frac{\partial F_S{}^B/\partial L_U{}^B}{\partial F_S{}^B/\partial(-L_S{}^B)} = \frac{\partial F_S{}^T/\partial L_U{}^T}{\partial F_S{}^T/\partial(-L_S{}^T)}.$$

This means that the relative change in the marginal product of skilled labor as a scarce production factor is equal in both industries.

Consequently, increased demand for labor due to an expansion of the resource-exporting industry has different effects on the two industries where there is both a skilled labor market in which full employment is assumed, and an unskilled labor market characterized by unlimited labor supply, depending on the technical levels of these industries. When the import-substituting industry is provided technology ($|\mathbf{D}|$ is negative) which would allow a relative increase in the marginal product of skilled labor through an increase in the employment of unskilled labor, the

import-substituting industry may also be expected to expand because of the expansion of the resource-exporting industry. Furthermore, in this case the wage differential may also be reduced. No increase in the employment opportunities of unskilled labor can be expected because of the wage increase, however (Figure 6[b]).

Conversely, if technology is provided by which the marginal product of skilled labor in the resource-exporting industry can be expanded through an increase in the employment of unskilled labor, a completely opposite effect will be produced and the Dutch disease will occur.

In this sense, in order to expand not only the resource-exporting industry but also the import-substituting industries (or to prevent the Dutch disease), it would be necessary to choose technology which increases the marginal product of skilled labor in the import-substituting industry through employing unskilled labor.

CONCLUSION

In the above, we have studied the basic mechanism of the Dutch disease in the simplest cases, by changing assumptions introduced the factor of unlimited labor supply; a characteristic of developing economies. We have also seen that the phenomenon of deindustrialization is not necessarily unavoidable if factor intensity, unlimited labor supply, international capital movement, and other factors are taken into consideration. At the same time, we have seen that it is possible to elucidate some of the arguments on export-led industrialization by applying this mechanism. We have also analyzed the effect of production expansion of the resource-exporting industry on the labor market, when it consists of a skilled and unskilled labor market. As a result, it was clear that so far as the above model is concerned, no Dutch disease is caused under conditions of unlimited labor supply, but that the Dutch disease may occur depending on how far the skilled and unskilled labor is complementary and substitutable. The model used here is supported by strong assumptions however, so that in future studies it would be necessary to relax these assumptions. It would be especially necessary to consider the introduction of the non-traded goods industries and the demand generation effect of the income effect, which are important factors in a discussion of Dutch disease economics, even though such a model will unavoidably become complex.

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