Economic Take-offs in a Dynamic Process of Globalization

by

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December 2001
(Very Preliminary)

1. Introduction

In a dynamic process of globalization, trade liberalization often lowers the tariff-adjusted price of the importable. The scenario we develop in this paper suggests that a move towards free trade may enable a small open economy to reallocate production factors to modern export sectors where increasing returns to experience are present. As a consequence, the economy begins to take off, enjoying a more rapid rate of economic growth.[1] When the rate of accumulation in exporting experiences slows down as time goes by, economic growth declines.

The take-off associated with trade liberalization and a shift toward outward orientation in production has been noted in a number of examples of successful growth experience. Balassa (1972) observed that the rapid growth in Taiwan and Korea in the mid 1960s was accompanied by a rapid transformation from import substitution to non-traditional exportables. In fact, in the pre-liberalization stage, both economies imposed high effective protective rates (about 100%) to ensure competitiveness of domestic producers of import substitution sectors. By the mid 1960s, however, the effective protective rates were only about 50-60% in these economies. Such a sharp drop in tariffs and removal of heavy trade barriers have been believed to have crucial implications for their miraculous development performance.[2]

An important part of the development of the export sector is that international trade often requires specialized labor services to manage and promote foreign sales. In many East Asian economies, such activities are surprisingly organized. For example, what is called "Sogo Shosha" in Japan (as well

as in Korea) is a trade association handling matching between domestic producers and international buyers (Rauch 1996). Similar organizations, often referred to as the "supporting industry," are also found in Hong Kong and Taiwan, serving as international brokers by exploring new foreign markets and locating best domestic manufacturers to meet high-standard international demands (Van and Wan 1997). Exporting to advanced countries can accumulate experiences from competing in the international markets, whose essential role has been emphasized in the case studies of the success of Taiwanese machine tool firms (Amsden 1977) and the failure of Colombian apparel producers (Morawetz 1981).

To capture this dynamic process, we develop a simple multi-sectoral framework of trade in which the evolution of exporting experience is an integral part of the economic environment. In the basic setup outlined in Sections 2 and 3, we assume that labor is homogeneous and capital is a specific factor used in the import-competing sector. We show how trade liberalization can set off a dynamic evolution of comparative advantage when there are externalities from service sector activities.[3] Countries enter international production of labor intensive goods, with exports shifting toward more progressively service intensive goods over time as experience accumulates. The expanding modern sector will also squeeze out traditional export sectors. Our transition process differs from the "big push" model of Murphy, Shleifer and Vishny (1989), in which rising incomes create a multiplier effect in the demand for non-traded goods. In our model, the increased growth has the features of a "big push", but international trade plays a critical role.[4]

The role of externalities from learning by doing has also been stressed by Young (1991), who utilizes a Ricardian model of trade. In Young's framework, more sophisticated goods have higher unit labor requirements but generate greater gains from learning by doing. As a result, international trade may actually harm growth when trade opportunities encourage resource reallocation toward less sophisticated sectors.[5] Our model differs in that learning arises from exporting, so that the initial export of less sophisticated goods in the modern sector provides an entree into international markets and allows the

country to move up to more sophisticated goods requiring larger service inputs over time. As a consequence, we are able to show a positive growth effect of free trade within a simple general equilibrium framework without relying on any complex learning formulation.

Section 4 extends the basic model to distinguish between the factor inputs required in production and service activities. We examine the case in which service activities require physical and human capital inputs, while production activities require less skilled labor. This model allows us to explore the impact of the externalities in exporting on income distribution. We show that productivity enhancements in the export sector will raise the return of unskilled labor relative to capital when the country produces modern sector goods and traditional import-competing goods. However, the income distribution effects are reversed if the economy produces only modern sector goods. In either case, learning moves the country into the production of more service intensive goods over time.

2. The Model

We consider a small open economy that has the potential to produce N goods using fixed endowments of labor (L), land (T), and capital (K). Good 1 is assumed to be the traditional export good, e.g. an agricultural or mineral product, that is produced using labor and sector-specific land under conditions of perfect competition. We denote the sector 1 production function by $F(L_1,T)$, and F is assumed to be homogeneous of degree 1. Good 2 is the import-competing good, which is produced using labor and (sector-specific) capital according to the constant returns to scale production function, $G(L_2,K)$. Let p_2 denote the *world price* of good 2 and τ the ad valorem tariff, so the domestic price will be $p_2(1+\tau)$. Goods 1 and 2 are consumed domestically, with preferences described by $U(D_1, D_2)$. The production technology of the traditional sector of the economy is thus characterized by the specific factor model, with capital and land being sector-specific factors and labor the mobile factor. Absent any other production activities, the tariff protects sector-specific capital in the import-competing sector.

Goods 3 to N are modern export goods which are not consumed domestically but can be exported

to the world market at prices p_3 to p_N, respectively. It will be assumed that these modern sector goods are *produced* under constant returns to scale using only labor, where the unit labor requirement for these goods is denoted by a_{Li} (i = 3,...N). However, exporting such modern-sector goods requires not only production but service activities, which may include management and marketing as discussed in Jones and Kierzkowski (1990). In this section's basic model, such service sector activities make use only of labor as an input, but the quantity of necessary labor per unit of output tends to diminish as experience in establishing foreign contacts and obtaining knowledge of foreign distribution channels is acquired. To simplify, assume that this experience has the nature of a public good, so that individual producers of services will not capture the benefits of experience with production. The public good nature of the experience not only assures that knowledge accumulated in one modern export sector spills over to other modern export sectors, but also implies that these modern export sectors exhibit increasing returns as a result of uncompensated knowledge spillovers.

Indicate the labor required as service-sector activity to export a unit of commodity i as a_{Li}^S This is a composite of a fixed quantity of service-sector output per unit of exports, a_{Si}, which depends upon the commodity exported, and the quantity of labor required per unit of the service activity, b(Z). *Z* is an index of *experience* in exporting commodities in the modern sector, and such experience has the nature of a public good so that b(Z) is the same for all modern-sector goods. Thus the labor cost of services for the i^{th} commodity, wa_{Li}^S, equals $w[a_{Si}b(Z)]$, and b(Z) is assumed to exceed unity at all levels of experience, Z, less than some finite $\bar{Z}$ but to diminish towards unity as $\bar{Z}$ is approached. More formally put:[6]

$$b'(Z) < 0, \text{ for } Z < \bar{Z}; \text{with } b(0) > 1 \text{ and } b(Z) = 1 \text{ for } Z \geq \bar{Z} \qquad (5)$$

The competitive profit condition for good i can then be expressed as $w\left(a_{Li} + a_{Si}b(Z)\right) \geq p_i$ for i = 3,..,N.

For given world prices, it is useful to define the wage rate that is attained if modern sector good i

is produced for export,

$$\omega_i(Z) = \frac{p_i}{a_{Li} + a_{Si}b(Z)} \qquad (7)$$

Increased experience in production of good i reduces the labor requirement in the service activity, and hence will raise the wage that can be earned from exporting good i. The rate of increase in the wage that can be earned in sector i will be increasing in the service intensity of sector i, since the elasticity of the ω_i with respect to experience is $-\left(b'(Z)/b(Z)\right)\theta_{Si}(Z)$, where $\theta_{Si}(Z)$, equal to $a_{Si}b(Z)/\left(a_{Li} + a_{Si}b(z)\right)$, is the share of services in total costs in sector i. Assume, now, that the potential commodities in the modern sector are ranked from 3,…,N in ascending order of relative service intensities, a_{Sj}/a_{Lj}. Does this imply that each of these commodities will be produced in order? No, since, say, the world price of good 6 might be so low relative to costs as to preclude its adoption. However, suppose that at some level of Z, commodities i and j exhibit the same break-even wage rate: $\omega_i = \omega_j$. If j > i, the ascendancy of service shares assures that $d\omega_j/dZ$ exceeds $d\omega_i/dZ$. That is, for higher values of Z, commodity j would yield a higher wage rate in a competitive equilibrium than does commodity i.

Figure 1 exhibits the wage profiles for commodities 3, 4, and 5. The heavy upper envelope, $\tilde{\omega}(Z)$, is illustrated for these three commodities. More generally, summarize the employment opportunities available in the modern sector by:

$$\tilde{\omega}(Z) = \max_i \omega_i(Z), \qquad \tilde{i}(Z) = \max j \in \operatorname{argmax} \tilde{\omega}(Z) \qquad (12)$$

Since commodities are indexed in ascending order of service intensities, and discarding sectors not profitable at any $Z \in [0, \bar{Z}]$, $\tilde{i}(Z)$ is upper semi-continuous and non-decreasing.[7]

3. Equilibrium

The labor market equilibrium, given export experience Z, can be expressed as

$$L_1 + L_2 + [a_{L\tilde{i}(Z)} + a_{S\tilde{i}(Z)} b(Z)] X_{\tilde{i}(Z)} = L \qquad (15)$$

Figure 2 illustrates the labor market equilibrium for Z = 0 in case in which no activity in the modern sector is competitive. The marginal product of labor in sector 1, $F_L(L_1, T)$, is measured from left to right and that in sector 2, $(1+\tau)p_2 G_L(L_2, K)$, is the solid line from right to left. Given the initial factor endowments and the tariff rate, the wage at E obtained when all labor is employed in sectors 1 and 2 exceeds the wage attainable in the modern sector, $\tilde{\omega}(0)$.

The dotted line in Figure 2 shows the labor demand schedule after the tariff is eliminated as a consequence of trade liberalization. Here, the wage at E' is lower than $\tilde{\omega}(0)$ and hence the elimination of the tariff reduces the wage rate for labor sufficiently that it makes the modern sector competitive. This generates the standard gains from trade liberalization and the standard specific factor result from trade liberalization as the specific factor in the import-competing sector (K) loses.

A. Transitional Gains from Trade

We now turn to the dynamics that arise as a result of the opening of production in the modern sector. We define the accumulation of export experience as simply the accumulation of past modern sector export experience to be

$$\dot{Z}(t) = a_{S\tilde{i}(Z(t))} X_{\tilde{i}(Z(t))} \qquad (18)$$

We assume that experience exporting the traditional good does not generate the contacts and market information that are valuable in modern sector exports. If we consider an initial equilibrium in which the modern sector is in operation, as illustrated by the free trade equilibrium in Figure 2, the equilibrium employment levels in sectors 1 and 2 is given by

$$F_L(L_1, T) = \tilde{\omega}(Z)$$
$$p_2 G_L(L_2, K) = \tilde{\omega}(Z) \quad \textbf{(19)}$$

Equations (6) can be inverted to yield employment levels for the traditional sectors, $L_i(Z)$ for i = 1,2. The employment in the modern sector is derived from (4) to be

$$X_{\tilde{i}(Z(t))}(t) = \frac{L - L_1(Z(t)) - L_2(Z(t))}{a_{L\tilde{i}(Z(t))} + a_{S\tilde{i}(Z(t))} b(Z(t))} \quad \textbf{(20)}$$

Increased experience in the exporting sector will raise the return available in the modern sector, which results in greater employment in the modern sector. Furthermore, it raises the productivity of labor in the service activity, so $X_{\tilde{i}(Z)}$ will be increasing in Z. Substituting from (7) into (5) yields $\dot{Z}(t) = \Psi(Z(t))$, where $\Psi(Z) = a_{S\tilde{i}(Z)} X_{\tilde{i}(Z)}$. Since $\tilde{i}(Z)$ is non-decreasing in Z, $a_{L\tilde{i}(Z(t))}/a_{S\tilde{i}(Z(t))}$ must be non-increasing in Z. Moreover, L_1, L_2 and b are all non-increasing in Z. From (7), it is clear that Ψ is non-decreasing in Z, implying that the level of experience must be increasing over time until it reaches the upper bound $\bar{Z}$.

In this dynamic process, the evolution of the export sectors can be illustrated by Figures 1 and 2. The accumulation of knowledge over time will raise the wage rate available in the export sector, and will cause production to shift into more service intensive goods. The growth in earning opportunities in the export sector will also draw additional labor from other sectors of the economy, with this process proceeding until the learning economies are exhausted at $\bar{Z}$. This indicates an increase in the growth rate of the aggregate wage income, $-\Psi b'/(a_{Li}/a_{Si} + b) > 0$, before reaching time t_J. The innovation here is that the liberalization will set off dynamic adjustments in sectors 3-N, since the accumulation of exporting experience will cause $\tilde{\omega}(Z)$ to increase over time. This generates the dynamic gains from trade liberalization as knowledge in the service sector is accumulated. It will also result in a shrinkage in both

the traditional export sector and the import-competing sector in response to the rising productivity in the new export sectors. This process will continue until experience reaches $\bar{Z}$ or the available modern exportable is exhausted (J = N), at which point a new steady state is reached. For sufficiently steep learning such that wage growth over-compensates declines in land rent and capital income, it is anticipated that the rate of income growth is increasing at the early stage of economic development. At the later stage when gains from experiencing slow down, wage income growth becomes decreasing. In summary, a hump-shaped transitional growth pattern is obtained.

Note that some of the initial income distributional effects of trade liberalization can be reversed during this process. Capital owners in the import-competing sector will unambiguously lose, because the rising labor productivity in the modern sector further reduces their return. The effect of trade liberalization on land owners and labor is ambiguous. The initial reduction in the wage rate from trade liberalization benefits land owners and hurts labor. However, the export boom in the modern sector raises wage rates and squeezes the traditional export sector, which reduces the return to land.

Despite its simplicity, our model captures some important elements of globalization. In particular, trade liberalization kicks off a process in which resources move from traditional exports into new goods (modern exports) that were not profitable before liberalization. The accumulation of knowledge in the service sector causes an increase in the growth rate (relative to the zero growth rate of the otherwise static model), yet this effect eventually goes away. Moreover, knowledge accumulated in one export sector spills over to other export sectors, which results in an evolving pattern of exports, moving toward more service-intensive sectors.

B. Determinants of Take-Off

The take-off in the modern export sector considered here is driven by cheap labor that can be used to produce goods for export. Entry into these sectors is less likely to occur in economies where

wage rates are initially high. The previous discussion has emphasized the role of tariff protection in raising the wage rate sufficiently that the modern sector is not competitive. This model also suggests another route. Economies that are rich in specific factors used in traditional exporting and import-competing sectors will have high wages, and as a result the modern sector may not be competitive on world markets. This will in turn make the take-off process more difficult. Regarding the second question, it may be noted that growth ceases when the benefit from experience vanishes or when the available exportable is exhausted (whichever arrives first). Thus, transitional growth is prolonged if increasing returns as a result of knowledge spillovers in modern export sectors are strong, if new technologies in producing modern exportable are easily accessible, and if new markets for selling modern exportable are abundant. This positive growth effect of free trade therefore contrasts with findings in conventional learning models developed by Stokey (1991) and Young (1991). Moreover, it also suggests that high tariffs designed to protect infant industries in import-competing sectors may inhibit this learning spillover process and thus harm long-term economic development. This may, at least partially, explain why "the emperor's new clothes are not made in Columbia" in the case study by Morawetz (1981).

The preceding arguments might explain why trade liberalization has a different effect in Latin America than in Japan and the newly industrialized economies (NIEs, Hong Kong, Korea, Singapore and Taiwan). All of these latter rapid growing economies are generally short of natural resources and agricultural land and many were not rich in internal funds four decades ago. However, in the absence of many competitors, these economies geared rapidly toward establishing a strong knowledge in international trade. As a consequence, they took off successfully in response to trade liberalization (and other development) policy. Moreover, the period 1960-1990 is full of improvements in networking, arrivals of easily accessible new technologies and increases in demands for new goods. Therefore, the rapid growing experience in Japan and the NIEs over that period has been prolonged, and is often noted as a development miracle.

The role of factor abundance in determining the profitability of the modern sector suggests that human capital accumulation could also be the source of the take-off. If labor requirements are measured in efficiency units, then improvements in the quality of low skill labor through education raise the productivity of labor and reduce the wage rate for an efficiency unit of labor. If the initial wage exceeds the wage at which the modern sector is competitive, improvements in the quality of labor could reduce the wage rate on an efficiency unit sufficiently that the modern sector becomes competitive.

4. Factor Proportions in the Modern Sector

The benchmark model constructed in Section 3 is specific factors with Ricardian supplement, where we assumed that the labor utilized in service and production activities in the service sector is homogeneous and capital is a specific factor used in the import-competing sector. In this section we generalize the model to allow for the possibility that the service sector activity requires a different mix of skills than does the production activity. In particular, it is likely that the marketing and financial services required to sell the goods on world markets will require a higher level of human and entrepreneurial capital than does the production of goods for the world market.[8] We will refer to the factor utilized in the service sector activity as 'capital,' which should be interpreted broadly to include human, entrepreneurial, knowledge and physical capital (and is hence denoted by H to differentiate it from the specific factor K in Section 3). As we allow this capital to be used for the production of the import-competing good, we extend the model of the previous section in the sense that there are capital and labor used as well in nontraditional export sectors and that both capital and labor are mobile between the traditional import-competing sector and the modern sector.[9] In keeping with our assumption that the worldwide location of the modern sector production activity is primarily determined by the availability of cheap labor, we will assume that the modern sector uses labor more intensively than the import-competing sector.

A. Equilibrium Prior to Trade Liberalization

Let w be the unskilled wage and v be the return to capital. The competitive profit condition for good i now becomes:

$$c_i(w,v,Z) = a_{Li}w + a_{Si}b(Z)v \geq p_i \quad \text{for } i = 3,...,N \tag{31}$$

where we simplify by assuming fixed coefficients for the production labor and service sector capital. We continue to assume that a_{Si}/a_{Li} is increasing in i. The ABCD locus in Figure 3 illustrates the factor price frontier for the modern sector given the prices p_i, which is the upper envelope of the loci from (8) at which $c_i(w, v, Z_0) = p_i$. The segment AB (CD) corresponds to the factor prices at which the most (least) service intensive activity in the modern sector is profitable.

As in the previous case, the modern sector will not produce if the returns available in traditional production activities with the tariff in place lie above the locus ABCD in Figure 3. The equilibrium factor prices (w_0, v_0) that would arise in the absence of modern sector production activity are obtained as the solutions to

$$\begin{aligned} F_L(L - L_2,T) &= (1+\tau)p_2G_L(L_2,H) = w_0 \\ (1+\tau)p_2G_H(L_2,H) &= v_0 \end{aligned} \tag{32}$$

The first equation in (9) describes the labor market clearing condition with no production activity in the modern sector, while the second yields the return to capital available in the import-competing sector. Letting $c_2(w,v)$ denote the unit cost function for good 2, the values of w and v consistent with zero profits in production of good 2 (i.e., $c_2(w,v) = p_2(1+\tau)$) are illustrated by the EF locus in Figure 3. The slope of the EF locus is $-a_{H2}(w,v)/a_{L2}(w,v)$, where $a_{j2}(w,v)$ is the amount of input of factor j per unit of good 2 at factor prices (w,v). This locus is steeper than the factor price frontier for the modern sector because the modern sector is assumed to be labor intensive relative to the import-competing sector 2. The modern sector will be shut down prior to trade liberalization if the equilibrium described by (9) lies on the

segment EF in Figure 3. It is straightforward to show that this is more likely to occur the greater are the endowments of T and K and the lower the endowment of L as in the previous section.[10]

A decrease in the tariff will shift the factor price frontier inward, as illustrated by the shift from EF to E'F' in Figure 3. The reduction in the tariff will be accompanied by a decrease in w and v, with v falling by proportionately more as illustrated in Figure 3 by the dotted line through point w_0 in Figure 3. In the case illustrated in Figure 3, the modern sector becomes profitable at the point where trade liberalization reaches F'. Since the dotted locus w_0F' illustrates equilibrium values with production of goods 1 and 2 only, the capital to labor ratio in sector 2 (evaluated at the factor prices given at point F') equals $H/(L-L_1(w,T))$, where $L_1(w,T)$ is the demand for labor in sector 1. Further reductions in the tariff, as shown by the shift to E"F" in Figure 3, must result in an increase in w and a reduction in v along the factor price frontier of the modern sector.

Note that there are two specialization patterns that can be observed when trade liberalization results in a unit cost curve for good 2 as illustrated by the locus E"F" in Figure 3. One possibility is an equilibrium at the factor prices given by the point F", with production of good 2 and the modern sector good associated with the segment BC of the modern sector factor price frontier. This case arises when $H/(L-L_1(w,T)) \in (a_{Hi}/a_{Li}, a_{H2}/a_{L2})$ when evaluated at the factor prices at point F" and using the modern sector i corresponding to segment BC. The factor prices in this case will be determined by the following conditions:

$$\begin{aligned} w a_{L2}(w,v) + v a_{H2}(w,v) &= p_2 \\ w a_{L\tilde{i}} + v a_{S\tilde{i}} b(Z) &= p_{\tilde{i}} \end{aligned} \qquad \textbf{(34)}$$

Full employment of labor and capital require that,

$$a_{L2}(w,v)G + a_{Li}X_i = L - L_1(w,T)$$

$$a_{H2}(w,v)G + a_{Si}b(Z)X_i = H \qquad \textbf{(35)}$$

Given the factor prices from (10), the output levels can be solved from (11).

The other possibility is that $H/(L-L_1(w)) < a_{Hi}/a_{Li}$ when evaluated at the factor prices at point F" and using the modern sector good corresponding to segment BC. In this case only modern sector goods will be produced. For example, if $H/(L-L_1(w,T)) \in (a_{Hi}/a_{Li}, a_{Hj}/a_{Lj})$ for neighboring modern sector goods on the factor price frontier, then the equilibrium will involve production of goods i and j. The equilibrium wage rates in this case will be determined by the zero profit conditions (10) and the full employment conditions (11) using sectors i and j instead of i and 2.

B. Growth of the Modern Sector

The onset of modern sector production will result in knowledge accumulation and dynamic adjustments, because export experience raises the productivity of capital in the modern sector. From (8), an increase in Z will shift each segment of the factor price frontier in the modern sector rightwards, and by the same percentage amount. Therefore in Figure 4, B' should be the same percentage rightward shift from B, as is C' from C (and D' from D). The impact of experience on factor prices will depend on the equilibrium production pattern.

Suppose that we are in the case in which one modern sector i and the import-competing sector 2 are in operation. Totally differentiating (10) and manipulating, one obtains:

$$\frac{\hat{w}}{\hat{Z}} = -\left(\frac{\theta_{Hi}\theta_{H2}}{\Theta}\right)\varepsilon > 0, \qquad \frac{\hat{v}}{\hat{Z}} = \left(\frac{\theta_{Hi}\theta_{L2}}{\Theta}\right)\varepsilon < 0 \qquad \textbf{(36)}$$

where $\hat{u} \equiv du/u$, $\theta_{L2} \equiv wa_{L2}/p_2 = 1 - \theta_{H2}$ is the cost share coefficient for labor in sector 2, $\theta_{Li} \equiv wa_{Li}/p_i = 1 - \theta_{Hi}$, $\varepsilon \equiv -Zb'(Z)/b(Z) > 0$ and $\Theta \equiv \theta_{L2}\theta_{Hi} - \theta_{Li}\theta_{H2} < 0$ provided that modern export sector is labor intensive. This result follows the standard Heckscher-Ohlin intuition:

technical progress in the labor intensive good will result in an increase in the return to labor and a decrease in the return to capital.[11] Note also that experience will also tend to shift production toward more service-intensive goods in the modern sector over time. This is illustrated in Figure 4, where point F" represents the point with initial production of good 2 and the modern sector good in the BC segment. Experience in the modern sector results in a shift to a new equilibrium at G" , where good 2 and the modern sector good associated with the AB' segment will be produced. As a consequence, the industrial evolution as well as wage income growth are qualitatively similar to the homogeneous labor case, although the output of the nontraditional export good need not rise with the experience (see the Appendix for a formal proof of the assertion). Intuitively, the accumulation of exporting experience raises the wage rate, thus reallocating labor from the traditional export sector to the "nugget" of the import-competing and one of the modern sectors. Yet, under the assumed factor intensity ranking (the import-competing sector uses capital H more intensively), the expansion of Z is akin to an expansion of H, yielding expansions of import-competing instead of the modern sector. This latter effect is absent in the basic model displayed in Section 3.

A second possibility is that the initial equilibrium is one in which production of good 2 has been shut down, as would occur at point C in Figure 4.[12] In this case export experience raises experience in both goods, so the production point with incomplete specialization in modern sector goods would shift to the point C' in Figure 4. Evaluating the zero profit conditions in (10) when modern sector goods i and j (i < j) are being produced, it can be shown that

$$\frac{\hat{w}}{\hat{Z}} = 0, \qquad \frac{\hat{v}}{\hat{Z}} = \varepsilon \tag{13}$$

Since the capital-augmenting productivity gain occurs in all sectors, it raises the return to capital in all sectors proportionally, leaving the return to raw labor unaffected. Since the technical progress reduces the use of capital in both sectors, it will require a movement into more capital-intensive nontraditional

export goods production over time as long as a_{Hj}/a_{Lj} falls below $H/L\text{-}L_1(w)$.

The results of this section share two features of the model of the previous section. The first is that trade liberalization opens the possibility of the flow of labor into labor-intensive activities in the modern sector. The second is that the productivity enhancement resulting from experience in the modern sector will result in a shift into more service-intensive activities over time. The major difference is that the income distribution results will differ from the homogeneous labor model, because factor proportions play a role in determining the outcome. Technical progress will raise the return to labor relative to capital when modern sector and traditional import-competing goods are both being produced. On the other hand the return to labor will fall relative to capital if the traditional import-competing sector is shut down. Note, however, that the wage rate will not fall in terms of the fixed commodity prices. As well labor has gained relative to the price of importables in the initial process of freeing up trade, albeit the wage rate then did fall relative to the price of traditional exportables. There has been a prolonged controversy about whether trade has widened income distribution between the unskilled and the skilled.[13] Since our returns to capital can be regarded as skilled wages, the above findings may generate useful implications for assessing the distributional effects of trade.

5. Concluding Remarks

We have provided a simple illustration for trade to play an important role in promoting economic take-off and growth. By focusing on the accumulation of the experience, we have characterized the industrial evolution process, as well as income growth and distribution. Along these lines, it may be interesting to develop a parallel framework modeling the reverse-engineering process. That is, rather than accumulation of exporting experience, it is now learning from producing exportables that exhibits increasing returns, leading to a decreasing average cost over time.[14] A second possibility is to consider the accumulation of general capital and allow the rate of accumulation to depend on the society's average stock of general capital.[15] One may then examine whether the patterns of industrial evolution or income

distribution may differ in these alternative setups from what has been obtained in the present paper.

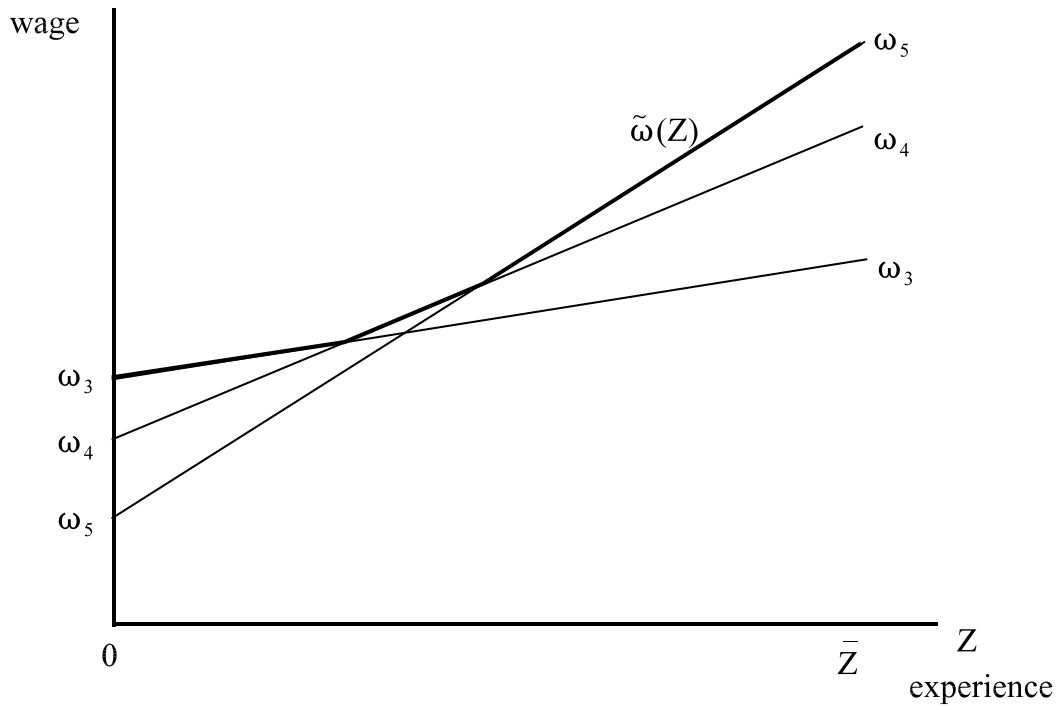

Figure 1: The Wage Schedule

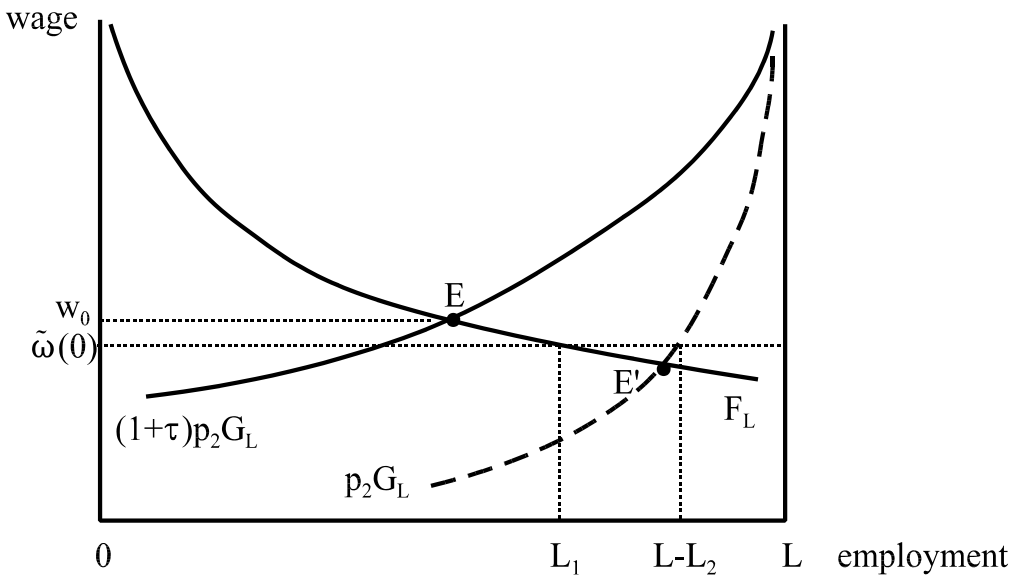

Figure 2: Labor Market Equilibrium

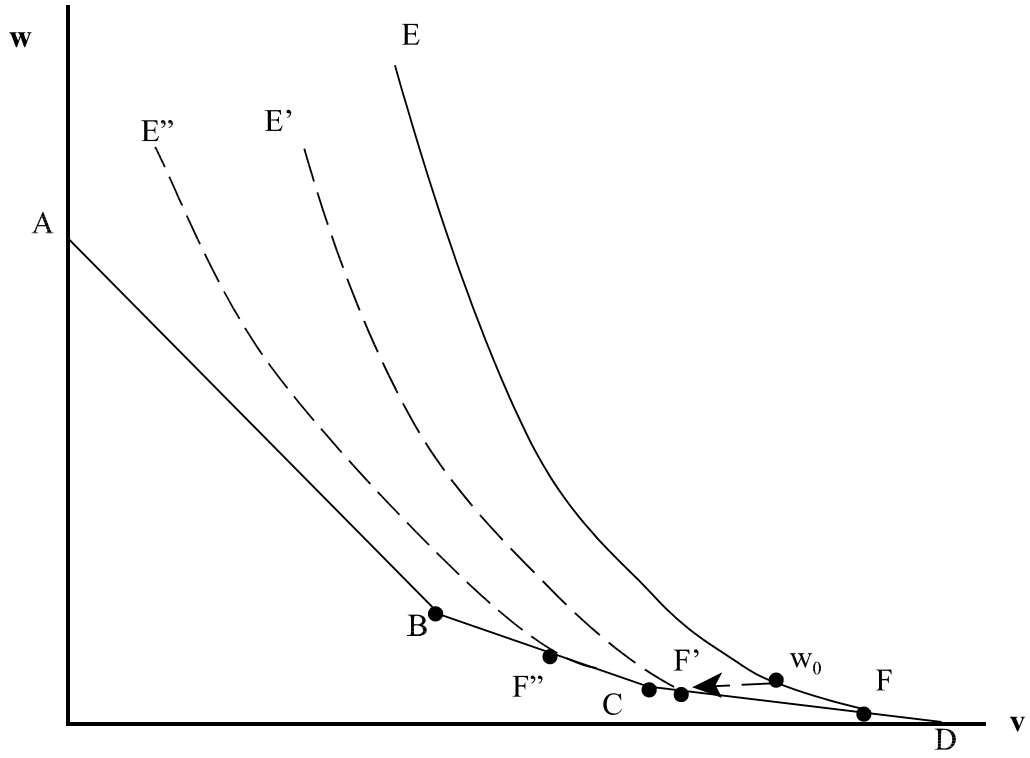

Figure 3: Factor Price Frontier and Trade Liberalization

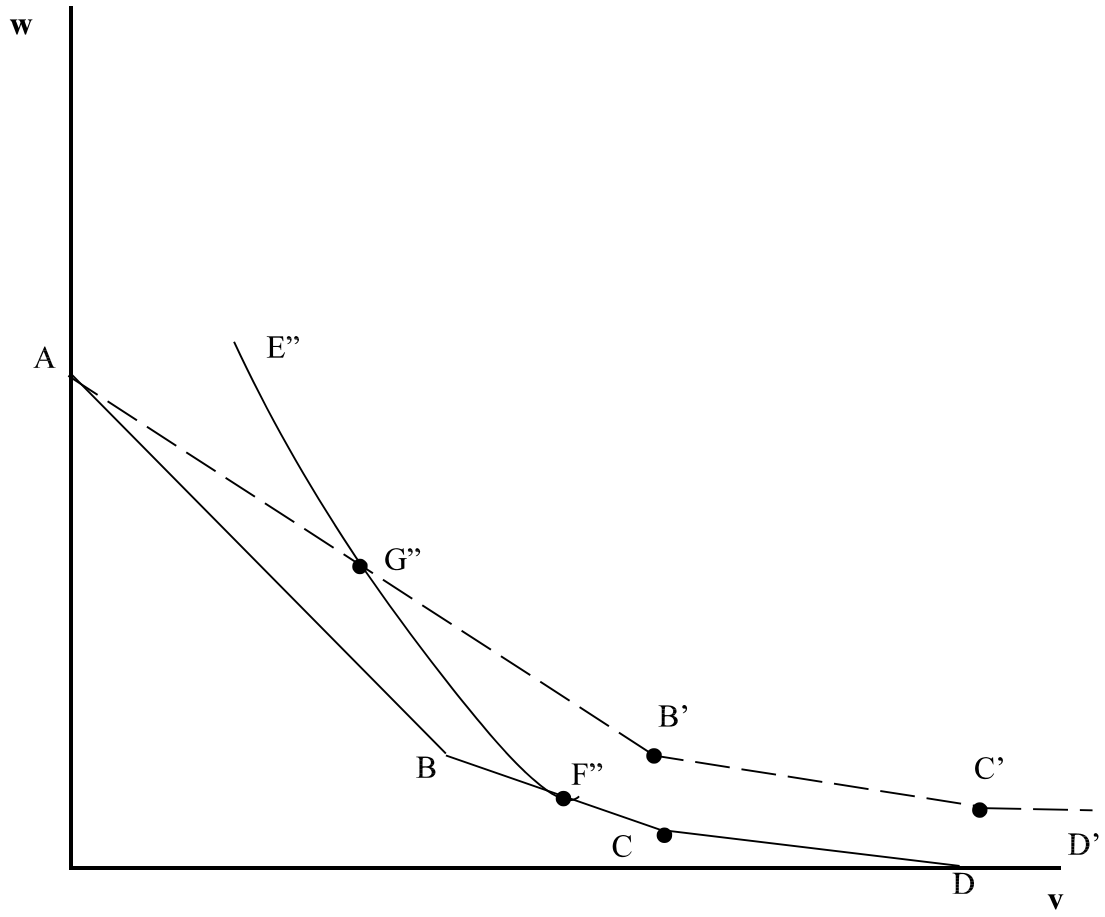

Figure 4: Evolution of the Modern Sector

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Appendix

The formal proof of the assertion follows the techniques developed by Jones (1965). Denote the associated factor allocation fractions for the import-competing sector by $\lambda_{L2} \equiv a_{L2}G/(L-L_1) = 1-\lambda_{L\tilde{i}}$ and $\lambda_{H2} \equiv a_{H2}G/H = 1-\lambda_{H\tilde{i}}$. Total differentiation of the full employment conditions (11) yields:

$$\lambda_{L2}\hat{G} + \lambda_{L\tilde{i}}\hat{X}_{\tilde{i}} = -\left(\frac{L_1}{L-L_1}\right)\hat{L}_1 - \lambda_{L2}\hat{a}_{L2}$$

$$\lambda_{H2}\hat{G} + \lambda_{H\tilde{i}}\hat{X}_{\tilde{i}} = -\lambda_{H2}\hat{a}_{H2} + \lambda_{H\tilde{i}}\varepsilon\hat{Z}$$

By definition of the elasticity of substitution (between capital and labor in sector 2, denoted σ_2), we have: $\hat{a}_{L2} - \hat{a}_{H2} = -\sigma_2(\hat{w}-\hat{v})$. Moreover, cost minimization implies: $\theta_{L2}\hat{a}_{L2} + \theta_{H2}\hat{a}_{H2} = 0$. These relationships can be used with (12) to derive:

$$\hat{a}_{L2} = \sigma_2\left(\frac{\theta_{H\tilde{i}}\theta_{H2}}{\Theta}\right)\varepsilon\hat{Z}, \qquad \hat{a}_{H2} = -\sigma_2\left(\frac{\theta_{H\tilde{i}}\theta_{L2}}{\Theta}\right)\varepsilon\hat{Z}$$

Furthermore, total differentiation of the demand schedule for the unskilled in sector 1, $F_L(L_1, T) = w$, gives: $(L_1F_{LL}/F_L)\hat{L}_1 = \hat{w}$, which together with (12) yields,

$$\hat{L}_1 = -\left(\frac{\theta_{H\tilde{i}}\theta_{H2}}{\Theta}\right)\left(\frac{\varepsilon F_L}{L_1F_{LL}}\right)\hat{Z}$$

Substituting these results into the full employment conditions and solving yields :

$$\hat{X}_{\tilde{i}} = \left[\frac{\lambda_{L2}\lambda_{H\tilde{i}}}{\Lambda} + \frac{\lambda_{H2}\theta_{H\tilde{i}}}{\Lambda\Theta}\left(\lambda_{L2}\sigma_2 - \frac{\theta_{H2}F_L}{(L-L_1)F_{LL}}\right)\right]\varepsilon\hat{Z}$$

where $\Lambda \equiv \lambda_{L2}\lambda_{H\tilde{i}} - \lambda_{L\tilde{i}}\lambda_{H2} < 0$ provided that modern export sectors are skill intensive in physical measures. In this case, the first term in the square bracket of this expression is negative whereas the second term is positive. Thus, the output of modern export goods need not be increasing in the level of experience in exporting over the range of $Z < \bar{Z}$. Note that the possibility of a negative relationship between Z and the modern sector output depends crucially on the assumed factor intensity ranking. Should the modern sector $\tilde{i}$ uses H more intensively than sector 2, the accumulation of Z always expands the modern sector output.

Endnotes

1. For a discussion of the definition of an economic take-off and a formal growth model of such a process, the reader is referred to Rostow (1960) and Tsiang (1964), respectively.

2. Although the effective protective rates are still higher than Japan (about 30%) and the U.S. (about 20%) during that period, they are much lower than the comparable figures in Argentina and Brazil (both exceeding 100%). The trade liberalization policy and the consequent export promotion have been emphasized by Adelman (1999) to lead Korea and Taiwan to rapid growth, whereas the overly protective important substitution in Columbia has been argued by Morawetz (1981) to inhibit its long-run competitiveness in international markets.

3. For a comprehensive discussion of the role of services in production and trade, the reader is referred to Jones and Kierzkowski (1990).

4. Matsuyama (1991) and Chen and Shimomura (1998) examine models in which the presence of external economies leads to multiple equilibria. They show that a big push may enable a country to move from a low to a high-growth equilibrium. While the equilibrium selection in Murphy, Shleifer and Vishny is history-dependent, self-fulfilling prophecies play important roles in Matsuyama and Chen and Shimomura. Findlay and Jones (2001) point out that this big push literature largely ignores any essential role of trade played in the process of economic take-offs.

5. Stokey (1991) makes a similar conclusion, arguing that if human capital is accumulated via learning by producing high quality goods, free trade will slow such a process down in the South.

6. Our way to model the export experience as a public good is made for convenience. Alternatively, one may consider Marshallian externality in knowledge capital, human capital and raw labor as in Romer (1986), Lucas (1988) and Matsuyama (1991), respectively.

7. Note that a necessary condition for each good to be produced at some Z is that p_i/a_{Li} be increasing in i. Since $\omega_i = (p_i/a_{Li})(1 - \theta_{Si}(Z))$, a good would never be produced if it had a lower value of p_i/a_{Li} than a less service intensive good.

8. This argument was put forth in Jones, Beladi and Marjit (1999), where the human capital services in exporting represent one of the 'three faces of factor intensities'. We do not permit international mobility of skilled alien labor to complement local workers. Those interested in such a possibility are referred to Jones and Marjit (1995).

9. This model is an application of the so-called Gruen-Corden (1970) model, where a "nugget" appears of two sectors using a pair of factors (i.e., sector 2 and a modern export sector using L and H), as well as a third sector (i.e., sector 1) using L and a specific factor (T).

10. Totally differentiating the first equation in (9), we obtain:

$$\frac{dw_0}{dL} = \frac{F_{LL}(1+\tau)p_2 G_{LL}}{\Delta} < 0; \quad \frac{dw_0}{dK} = \frac{F_{LL}(1+\tau)p_2 G_{LK}}{\Delta} > 0$$

$$\frac{dw_0}{dT} = \frac{F_{LT}(1+\tau)p_2 G_{LL}}{\Delta} > 0; \quad \frac{dw_0}{d\tau} = \frac{F_{LL}\, p_2 G_L}{\Delta} > 0$$

where $\Delta \equiv F_{LL} + (1+\tau)p_2 G_{LL} < 0$.

11. Of course, if production of some more advanced modern exportables uses H more intensively than the import-competing sector, then the comparative-static results on factor returns will be reversed.

12. More precisely, it is possible that not only that the import-competing sector shuts down, but that as well only one modern export good is produced. This occurs, for example, when the economy is between G" and B' in Figure 4. Then this Gruen-Corden economy reduces to one with specific factors, as discussed in Jones and Marjit (1992).

13. For example, Leamer (1993) and Wood (1994) emphasize that North-South trade is important for the widened inequality, whereas Lawrence and Slaughter (1993) disapprove such a view.

14. Wan (2001) considers this type of external effects in his study of industrial policy particularly relevant to East Asian economies.

15. This type of externality is studied in closed economy endogenous growth models developed by Romer (1986) and Lucas (1988).