

Industrial Transformation: International Trade and External Economies

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by

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Abstract

A model is constructed in this paper to have three types of industries, all are subject to constant returns to scale. However, one sector is also subject to external economies apart from constant returns. Under international trade, a small economy may specialize in a different industry depending on the government policies. If the government does not intervene into the market, the industry with constant returns to scale may develop while government subsidies on the industry with external economies will encourage the development of this industry. Thus different government policies may achieve the same goal of industrial transformation though the welfare may be different. This model may be applied to explain why the emerging economies in East Asia have developed very fast until a financial crisis in 1997 even though the economies have very different government policies except export-promotion. The policy implication is that a government may need to consider the significance of external economies before committing to a specific industry.

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Introduction

Until the end of 1997, the high economic growth of East and South-East Asian economies has been regarded as “Asian miracle”. The representing economies are Hong Kong, Korea, Singapore and Taiwan. One interesting fact is that the four economies, commonly called “Four Little Dragons”, have little in common except that all of them emphasize international trade. Starting from 1980s, many other developing economies follow the examples of the Four Little Dragons and then trade liberalization has become a world trend. Although the Asian financial crisis has stopped the continuous growth in most Asian economies, the development of the Four Little Dragons is still an important reference for economic development. The Four Little Dragons are facing difficulties in maintaining economic growth. Many Asian economies, notably Hong Kong, Singapore, Taiwan as well as Malaysia, emphasize the development of information technology. It is important to evaluate whether the government intervention is positive in the economic transformation.

It is well-known that a small economy cannot produce everything, or even if a small economy is able to produce everything, the welfare loss is huge. The critical point of economic development is the choice of a new industry. From the experience of the Four Little Dragons, a formula of government policy leads to the target of higher welfare. Hong Kong is the most market-oriented while South Korea is heavily government intervened. Singapore and Taiwan are somewhat in the middle. However, all the four economies have similar successful stories, at least up to 1997 (Bradford and Branson, 1987; and Noland, 1990).

When we compare the change of export patterns of Hong Kong and South Korea, both economies do show different development paths (Table 1-Table 3). As shown in Table 1, Hong Kong has been a manufacturing economies in 1950s and clothing has always been at least one third of the total domestic exports, up to 1996. However, the growth of exports of electrical machinery is the most significant. In 1996, electrical machinery one fourth of the total domestic exports. Hong Kong has shown the largest emphasis of exports in service trade, not in commodity trade. Table 2 shows that service exports in Hong Kong has increased from 31.80% in 1986 to 58.26% in 1996. Hong Kong is dominated by service industries in 1990s.

<Table 1 and Table 2>

South Korea has shown very dramatic shift of exports from crude materials to manufactured goods from 1950s to 1960s (Table 3). The exports have also shifted to machinery. In 1996, over half of total exports was machinery and transport equipment. Electrical machinery and vehicles have shown the fastest growth in 1990s. On the whole, South Korea has been successful in developing heavy industry, especially automobile industry.

<Table 3>

This paper revisits the infant-industry argument on the government intervention on economic growth. Baldwin (1969) provides good reviews on the invalidation of tariff protection due to infant-industry argument. We apply a very simple partial equilibrium model to show that government intervention need not be necessary for a small economy. As long as an economy has relatively higher labour productivity in an infant industry, government intervention is not

necessary. However, if an industry has external economies of scale, government encouragement may be needed for developing that industry. Thus there is no single formula for a government to follow other than trade liberalization. This paper hints that the infant-industry argument should be more convincing in form of subsidies rather than tariff protection. Tariff protection cannot help exports, which are keys to industrial specialization. The policy implication is that if external economies are significant in an emerging industry but the local economy finds it hard to transform to that industry, government subsidies are necessary while international trade should still be maintained.

The Model

Assume that this is a world of only three goods: agricultural products, good A, and two manufacturing products, good X and good Y. All the three goods are subject to constant returns to scale but external economies also occur in good Y. The external economies are only effective within one nation only. We only focus on a small country, country H, which originally specializes in agriculture only. The domestic prices of country H are equal to the world prices under free trade. The only input is labour and country H is endowed with L units of labour. Labour is freely mobile across sectors but immobile across nations. The production functions of the three goods in country H are as follows:

Good A:

$$A = aL_A \quad (1)$$

Good X:

$$X = bL_X \quad (2)$$

Good Y:

$$Y = dL_Y - N^2 + eN \quad (3)$$

where A, X and Y represent quantity of good A, good X and good Y produced in Country H; L_j is labour used in producing good j, $j = A, X, Y$; N is number of firms producing good Y in country H; a, b, d and e are constants ($a, b, d > 0$, e is a positive even number).

All individuals are identical with everyone owning one unit of labour. All the three sectors are competitive such that profits are zero under free entry and free exit. Profits are pushed down to zero even though only one firm operates in any sector as suggested by contestable theory (Baumol, 1982 and Baumol et al., 1982). All labour is fully employed. The zero-profit condition in each sector is:

$$P_j = L_j w, \quad j = A, X, Y \quad (4)$$

where P_j = price of good j; L_j = labour employed in sector j, $j = A, X, Y$; w is wage rate. Under the full-employment condition, $L_A + L_X + L_Y = L$.

A representative individual i has utility function as:

$$U^i = \gamma c_A^\alpha c_X^\beta c_Y^{1-\alpha-\beta}, \quad 0 < \gamma, \alpha, \beta < 1 \quad (5)$$

where c_j is individual i's consumption of good j, $j = A, X, Y$. The whole income of individual i is wage rate, w. The income constraint is:

$$w = P_A c_A + P_X c_X + P_Y c_Y \quad (6)$$

Individual i maximizes utility function (5) subject to the income constraint (6).

An Agricultural Economy

Consider the situation that country H is an agricultural economy, i.e. country H produces good A only, and free trade is allowed. The production function is:

$$A = aL \quad (7)$$

while the zero-profit condition is:

$$P_A A = Lw \quad (8)$$

Combining (7) and (8), the wage rate is solved as follows:

$$w = aP_A \quad (9)$$

Multiplying the income constraint (6) by L and combining with the zero-profit condition (8), it is straight-forward to get the balance of trade:

$$P_A E_A = P_X M_X + P_Y M_Y \quad (10)$$

where E_A is export of good A, $E_A = A - Lc_A$, and M_j is import of good j , $j = X, Y$.

From the constrained utility maximization, i.e. maximization of utility subject to income constraint, we can derive the solutions of c_j , $j = A, X, Y$:

$$c_A = \alpha a ,$$

$$c_X = \beta \frac{aP_A}{P_X} ,$$

$$c_Y = (1 - \alpha - \beta) \frac{aP_A}{P_Y} .$$

Accordingly, the imports and exports are as follows:

$$E_A = (1 - \alpha)aL , \quad (11)$$

$$M_X = \beta \frac{aP_A}{P_X} L , \quad (12)$$

$$M_Y = (1 - \alpha - \beta) \frac{aP_A}{P_Y} L , \quad (13)$$

and the domestic consumption of good A is:

$$Lc_A = \alpha aL. \quad (14)$$

Industrialization: Sector X

Now we consider the typical economic goal of a developing economy: industrialization. In our model, it means that country A moves to either sector X or sector Y or both. Because the prices are fixed for small countries, the best strategy is specializing in only one sector. It is obvious by comparing the wage rates under different sectors. Let us neglect sector Y at first. The wage rate for producing good A is:

$$w_A = aP_A \quad (9a)$$

while the wage rate for producing good X is:

$$w_X = bP_X \quad (9b)$$

where w_A and w_X are wage rates for sector A and sector X respectively. Country H naturally turns to producing good X when $bP_X > aP_A$. A firm producing good X attracts labour from the existing sector A by offering a higher wage rate than w_A . Competition leads the wage rate equal to w_X and then country H specializes only in good X. Even though $bP_X = aP_A$, there is a possibility that country H is industrialized under free trade.

If $w_X > w_A$, i.e. $bP_X > aP_A$, country H will change to an industrialized nation without an government planning. The imports and exports are solved similar to an agricultural economy:

$$E_X = (1 - \beta)bL, \quad (15)$$

$$M_A = \alpha \frac{bP_X}{P_A} L, \quad (16)$$

$$M_Y = (1 - \alpha - \beta) \frac{bP_X}{P_Y} L, \quad (17)$$

and the domestic consumption of good X is:

$$Lc_X = \beta bL. \quad (18)$$

Industrialization: Sector Y

Because Good Y is subject to external economies to scale, the problem is more complicated. Suppose the situation is that $w_X < w_A$, sector X is not developed. A firm may consider producing good Y if it is able to afford a wage rate higher than w_A . Consider that one single firm enters the market of sector Y, thus $N=1$ in (3). From (3) and (4), the wage rate for producing good Y is:

$$w_Y^1 = \left(d + \frac{e-1}{L}\right)P_Y \quad (19)$$

where w_Y^1 is wage rate for sector Y with only one firm. If $w_Y^1 > w_A$, or $[d+(e-1)/L]P_Y$, the single firm enters the market by out-bidding the firms of sector A. Industry Y is developed without an government intervention.

If $w_Y^1 < w_A$ (and $w_X < w_A$), the firm will not set up and then country H has troubles to be industrialized. However, country H may be better off (i.e. higher wage rate) by transforming to sector Y. When there is only one firm in sector Y, the production function is:

$$Y^1 = dL_Y^1 - 1 + e \quad (3')$$

When more firms enter the market, the production function of each firm is increasing until $N = e/2$. When the firm size is larger than $e/2$, the production function is decreasing when more firms enter the market. The optimal production function is:

$$Y^{e/2} = dL_Y^{e/2} + (e/2)^2 \quad (3'')$$

$Y^{e/2}$ is production and $L_Y^{e/2}$ is labour employed a firm of sector Y when $N=e/2$. The wage rate with

$e/2$ firms in sector Y is derived by applying (4) and summing up all production and labour in (3''):

$$w_Y^{e/2} = \left(d + \frac{e^3}{8L}\right)P_Y \quad (20)$$

where $w_Y^{e/2}$ is wage rate for sector Y with $e/2$ firms. The wage rate $w_Y^{e/2}$ in (20) is larger than equal to w_Y^1 in (19) because $e^3/8 \geq e-1$, e being a positive even number. The condition of e being a positive even number ensures meaningful number of firms. Thus even if the first firm is reluctant to enter the market, country H is able to transform to sector Y when the number of firms is large enough. The comparison of $e^3/8 \geq e-1$ can be understood from external economies of scale.

When the case is that $w_Y^{e/2} > w_A > w^1$, country Y is better off with government intervention. For example, Country-H-Government subsidizes firms in sector Y in order to compensate for the lower wage rate for the first firm. If balanced budget is not considered, the effective subsidy is at least equal to the difference between w_A and w_Y^1 and thus:

$$s \geq aP_A - dP_Y - \frac{e-1}{L} \quad (21)$$

where s is a subsidy for each worker in sector Y under deficit budget. In order to finance the public budget, a tax is charged on every individual. Because, all workers will shift to sector Y, a balanced budget requires the tax equal to the subsidy for each individual. After the first firm is encouraged to enter the market, more firms also join the market until the optimal size is reached in sector Y. Alternatively, a tax equal to the amount of (21) on workers in sector A has the same result. All individuals ultimately have the same income as all of them shift to sector Y. Under either subsidization on sector Y or taxation on sector A, country H is transformed to sector Y and every individual is better off.

Even though country H transforms to sector X but not sector Y when $w_X > w_A$ and $w_X > w_Y^1$, government intervention is appealing if $w_Y^{e/2} > w_X > w_Y^1$. The analysis is similar to the transformation from sector A to sector Y. Either subsidizing sector Y or taxing sector X will achieve the transformation to sector Y with a higher welfare.

Concluding Remarks

The model in this paper suggests that different economies may have different choices of government policies, depending on the productivity of different industries. The key is production specialization and international trade. Thus the different government policies of the Four Little Dragons have the same successful results in terms of economic growth. The simple model provides a way for a government of a small economy to determine the development direction. It is possible that an economy may be either based on market force or government intervention to develop an industry. If the external economies of scale are not critical for hindering the economic transformation, market-driven force can lead to economic development. One of the best examples is Hong Kong. Hong Kong is changing from an entrepot to a textile production centre in the 1960s and then to an electronics production centre in the 1970s. In the 1980s and 1990s, Hong Kong has developed to be a financial centre. However, if the external economies of scale is hindered by the market, government encouragement may be important for industrial transformation. Korea is an example. It is no doubt that government subsidies have helped the development of automobile industries and other heavy industries in Korea (Amsden, 1989).

Although the Asian financial crisis calls a halt on the Asian prolonged economic growth, the Asian experience in the last few decades is still very valuable. The experience can also be good lessons for the Four Little Dragons themselves. The Four Little Dragons have difficulties in face

of competition from other emerging economies, well before the Asian financial crisis in 1997. One important policy implication of the model is that new industries may require government encouragement if the external economies are significant while market force cannot lead to industrial transformation. Korea already established its R&D in manufacturing industries. Singapore and Taiwan have been well ahead in promoting high-technology industries through government intervention. Governments of Hong Kong and Malaysia recently also start to encourage the development of high-technology industries. If the external economies of scale are highly significant in high-tech industries, the emerging Asian economies may be correct to develop specific industries by active government involvement.

Even if this paper focuses on small economies, large economies may find the policy implication of the model be valid. If we sub-divide a large economy into small regions, each small region can be treated as a small economy in the world. Thus each small region in a large economy may have different policies on economic growth.

One important result of the model is that government intervention is not necessary even though external economies exist. It is only a possibility that subsidizing a new industry with external economies leads to a higher welfare. Government intervention may lead to lower welfare if another industry with higher productivity is driven out. Thus a safer policy is to wait a while to see whether industrial transformation is difficult before determining a government policy.

Even though government intervention is favourable, not all types of policies are helpful. This model relies on international trade. Thus tariff protection cannot achieve the goal of optimal welfare. The result is compatible to the trend of trade liberalization. Either subsidization on a new

industry or taxation on an existing industry can achieve the goal. The implication on world trade negotiation is that government subsidization need not be totally regarded as “unfair trade”. In order to help developing economies, government subsidization should be carefully investigated before charging it as dumping or other trade impediments.

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**Table 1: Percentage of Selective Items on Hong Kong Total Domestic Exports of
Commodity Goods**

	1959	1966	1976	1986	1996
Food and live animals	5.26	2.69	1.69	1.05	1.46
Beverages and tobacc	0.61	0.66	0.14	0.74	1.27
Crude materials, except fuels	5.08	1.92	0.91	0.80	0.95
Mineral fuels	.	.	.	0.30	0.15
Animal and vegetable oils	0.09	0.07	0.01	0.01	0.07
Chemicals	1.88	0.92	0.72	0.98	4.10
Textiles	18.13	16.07	9.35	7.11	6.45
Manufactures of Metals	5.26	3.07	2.59	2.26	1.99
Electrical machiner	1.53	8.31	12.86	19.59	24.53
Clothing	34.73	35.51	43.79	33.88	32.73
Footwear	4.77	3.21	1.05	0.79	0.02
Watches and clocks	0.61	1.24	4.81	8.47	7.11

Source: *Hong Kong Annual Report*, various issues.

Note: The percentage is based on the value of an individual item divided by the value of total domestic exports of commodity goods.

**Table 2: Percentage of Selective Items on Hong Kong Total Domestic Exports,
1986 and 1996**

	1986	1996
Food and live animals	0.72	0.61
Beverages and tobacc	0.51	0.53
Crude materials, except fuels	0.55	0.40
Mineral fuels	0.21	0.06
Animal and vegetable oils	-	0.03
Chemicals	0.67	1.71
Textiles	4.85	2.69
Manufactures of Metals	1.54	0.83
Electrical machiner	13.36	10.24
Clothing	23.10	13.66
Footwear	0.54	0.01
Watches and clocks	5.78	2.97
Total domestic commodity exports	68.20	41.74
Transportation	12.38	19.78
Travel	8.17	16.63
Insurance	0.34	0.56
Financial	1.91	3.74
Trade-related	6.37	13.44
Total domestic service exports	31.80	58.26

Sources: Domestic commodity exports: *Hong Kong Annual Report*, various issues.

Service exports: *Estimates of Gross Domestic Product 1961 to 1998*, Government of the Hong Kong Special Administrative Region, March 1999.

Note: The percentage is based on the value of an individual item divided by the value of the total domestic export (total domestic exports is equal to sum of total domestic commodity exports and total domestic service exports)

Table 3: Percentage of Selective Items on South Korea Total Commodity Exports

	1956	1966	1976	1986	1996
Food and live animals	5.54	16.40	6.58	4.52	2.09
Beverages and tobacc	0.01	2.80	1.01	0.28	-
Crude materials, except fuels	79.71	18.80	2.45	0.97	1.24
Mineral fuels	-	0.80	1.91	1.87	3.00
Animal and vegetable oils	0.24	0.04	-	-	-
Chemicals	3.39	0.28	1.48	3.08	6.95
Manufactured goods by materia	9.35	33.60	30.38	23.59	21.10
Veneers, Plywood, etc.	-	12.40	4.39	0.15	-
Textiles	-	13.60	12.50	9.27	9.80
Iron and stee	-	3.20	4.78	5.68	4.14
Manufactures of Metals	-	1.60	2.99	4.10	1.92
Machinery and transport equipmen	0.75	4.00	17.93	33.58	52.08
Industrial machinery	-	-	0.71	1.31	4.78
Electrical machiner	-	2.00	12.48	20.05	31.11
Road vehicles	-	-	0.32	5.29	9.52
Other transport equipmen	-	0.32	4.12	6.22	5.89
Clothing	-	13.20	24.06	15.79	3.27
Footwear	-	2.00	5.17	5.93	0.69

Source: *International Trade Statistics Yearbook*, United Nations, various issues.

Note: The percentage is based on the value of an individual item divided by the value of total commodity exports.