A SIMPLE MODEL OF ECONOMIC DEVELOPMENT IN THE EARLY STAGE OF INDUSTRIALIZATION*

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Introduction

The purpose of this paper is to construct a simple model to explain the economic development in the early stage of industrialization[1] by taking into account observable patterns in the Japanese economy. Attention shall be directed primarily to the following two questions: (i) what effect does the process of switching from a closed to an open economy have on industrialization in a backward country? and (ii) where is possibility to industrialize it in spite of operation of the theory of comparative cost? We shall pay great heed to technological changes brought about by the transition, analyzing that there occurs a kind of structural disequilibrium, though the system is on equilibrium in the short run. And we shall show the process of making disappear the disequilibrium in the long run tends to promote a rapid industrialization.

TABLE 1.
REAL INCOME PRODUCED IN SECONDARY INDUSTRY
(million yen; 1928–1932 prices)

1878–1882	147
1883–1887	262
1888–1892	356
1893–1897	528
1898–1902	793
1903–1907	803
1908–1912	1,037
1913–1917	1,479
1918–1922	1,826
1923–1927	2,253
1928–1932	3,373
1933–1937	4,713
1938–1942	7,050

Source: *The Growth Rate of the Japanese Economy Since 1878*, 1957, edited by K. Ohkawa, p. 17.

We shall start from observing three patterns in Japan which seem important to our analysis, then construct a simple model of the economic development by taking into consideration the effect of introduction of new techniques upon the relative share of labor and the rate of profit and finally point out some empirical support for our model.

I. *Three Observable Facts*

Let us start from glancing briefly at three patterns in the Japanese manufacturing industry.

The first is related to growth rates in the Japanese manufacturing industry. To investigate them, we may take a series showing real income produced in the secondary industry.

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[1] In the following the term industrialization will be used to mean mainly the development of modern large-scale industries.

Although this series consists of mining, manufacturing and certain public utilities (gas, electric light and power), the main component is manufacturing (in 1930 the weight of the latter income produced in the former was 87 percent). According to Table 1, while the real income produced grew at the annual rate of 8.5 percent till about 1900, after that it declined to the somewhat lower rate of 5.2 percent.[2] That is, though, generally speaking, the secondary industry expanded at a high growth rate, the tempo declined to some extent after 1900. Our main concern is the early high rate of growth.

The second refers to changes in the import-export structure. Light industry products, imported at first, soon became export products. On the other hand, heavy industry products continued to be imported for a long period, although increasing domestic supplies became available over time. Only in the latter stage of development did some of these products enter the export market. This fact can be observed from Table 2, where we show roughly situations of import and export of cotton yarns, cotton fabrics, steel products and pig iron. The first two are chosen as representative commodities of light industries and the latter two as those of heavy industries. The stars in Table 2 show the peak years of import or export, where there is no star for a column, the trend of which continues to be in one direction.[3]

TABLE 2

	Cotton Yarns (M. T.)		Cotton Fabrics (million yen)		Steel Products (1,000 M. T.)		Pig Iron (1,000 M. T.)	
	Import	Export	Import	Export	Import	Export	Import	Export
1868	2,195	0	2.5	···§)	210.2	0	1.0	0
1888	*28,464							
1890		6						
1906			*18.8					
1912						6.7		
1914		*99,174						
1924					*1,151.7			
1935				496		478.1	961.9	0

§) In 1868, export of cotton fabrics amounted to only 6,000 yen.

Source: Toyo Keizai Shinposha: *Foreign Trade in Japan*, 1935, The Ministry of Finance: *Dainippon Boeki Nenpyo* (Statistics of Foreign Trade in Japan), 1936 and The Ministry of Commerce and Industry: *Seitetsu Gyo Sankoshiryo* (Statistics in Iron-Steel Industry), 1918 & 1936.

Finally, we can observe an interesting tendency in the composition of capital by industry. Since data are not available in the early period, let us look at data on long-term capital in the latter half of 1935, where long-term capital is defined as follows;

long-term capital=paid-up share+reserve+transfer carried from prior period
+current net profits+long-term debt.

The ratio of reserve, of long-term debt and of paid-up share to the long-term capital in seventeen modern large-scale manufacturing industries and public utilities are shown in Table 3.[4]

[2] The growth rate g is calculated by means of $Y_t=Y_0(1+g)^t$, where Y_t is real income produced in the t-th year.

[3] These phenomena correspond to what had been described by Professor K. Akamatsu as an industrialization-pattern in a backward country. See, for example, K. Akamatsu: *Keizai Seisaku* (The Economic Policy), 1951, pp. 162–163.

[4] For the sake of convenience, modern large-scale industry is defined to be one where the average long-term capital per corporation, as given in the Mitsubishi survey, is greater than 10 million yen.

TABLE 3. COMPOSITION OF CAPITAL

1935

	Reserve	Long-term Debt	Paid-up Share
Cotton Spinning	36.83%	10.07%	40.32%
Beer	27.13	1.87	59.71
Wool Spinning	25.04	11.45	53.95
Sugar	22.37	16.07	52.32
Glass	20.58	0	69.99
Electrical Machinery	16.56	7.36	66.14
Ship Building	14.74	11.15	69.44
Paper	14.48	34.60	48.38
Flour	14.08	36.93	42.06
Non-ferrous Metals	13.15	21.01	59.86
Iron & Steel	10.75	7.75	74.87
Synthetic Fibers	9.48	24.35	59.06
Cement	9.18	18.36	66.88
Gas	7.47	6.18	81.54
Fertilisers	6.22	34.45	55.00
Railways	4.92	45.38	47.55
Electric Light & Power	3.70	42.89	50.49

Source: Mitsubishi Institute of Economic Research: *Honpo Jigyo Seiseki Bunseki* (Statistics of Business Firms in Japan), 1935.

Among five light industries, *i.e.*, cotton spinning, beer, wool spinning, sugar and flour, the first four have higher reserve ratios than other industries, which belong to the heavy-chemical industry or public utilities. On the other hand, in the former the long-term debt ratios are, in general, smaller than in the latter. Generally speaking, public utilities show lower reserve ratios and higher long-term debt ratios than heavy-chemical industries. It seems this tendency suggests that capital in large-scale light industries was increased by means of internal accumulation and that heavy-chemical industries and public utilities developed by absorption of capital from the outside.

Keeping these observations in mind, let us try to construct a simple model to explain the economic development in the early stage of industrialization.

II. *Effect of New Techniques Upon the Relative Share of Labor and the Rate of Profit*

Our analysis starts from the time when a backward country has been just switched from a closed to an open system. For this analysis, let us examine first what occurs when an economy having operated under given techniques opens its eyes to the existence of new techniques. The introduction of new knowledge about techniques means that the production function changes. This is similar to the sudden appearance of a great number of inventions.

We may suppose the following relations among possible ones which will be established between each of new techniques and the corresponding old techniques under an arbitrary

amount of output. For simplicity, we consider cases of two factors, *i.e.*, capital (K) and labor (N). Both Fig. 1 and Fig. 2 show the isoquants under the new as well as under the old techniques. Fig. 1 indicates the case where the new techniques dominate decisively the old ones within the whole range of techniques. Fig. 2 shows the case where given different systems of prices of factors, new techniques or old techniques may each be advantageous, or

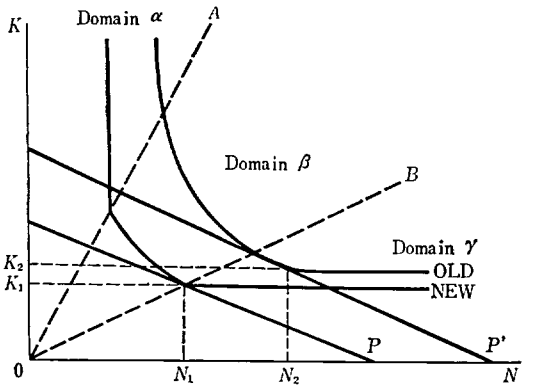

FIG. 1

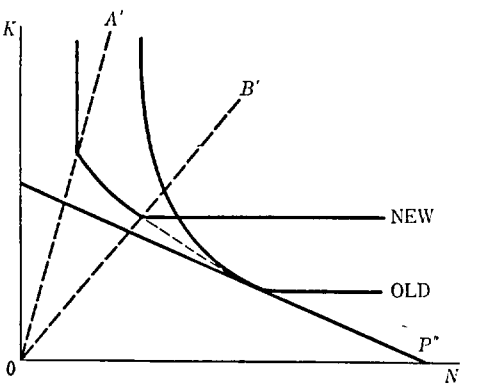

FIG. 2

both techniques may be advantageously applied. We assume in the two figures that although capital and labor are substitutable within a certain set of combinations between them, the substitutability disappears outside of the set. That is, it is an assumption of rigidity existing in some degree within techniques. We shall make clear its effect on our analysis later.

Because under a relatively low wage rate the first step of development will occur in industries shown in Fig. 1, let us examine the case of Fig. 1. Under an arbitrary system of prices and with output given, both the average productivity of capital and of labor are decisively greater in the group of new techniques than in the old group. If the price-line is given as in line P or P' in Fig. 1, the labor input is N_1 and that of capital K_1 under the new group of techniques on the one hand, and the former is N_2 and the latter K_2 under the old on the other hand. Here the degree of capital intensity (K/N) is greater in the new than in the old group. That is to say, as far as the system of prices gives a price-line being tangent to the old isoquant in the right domain of the substitutability-domain given by the new group of techniques (*i.e.*, in Fig. 1 in the domain to the right of line B), the degree of capital intensity under the new is greater than under the old group.

Now, for simplicity, we assume that the size of output can be expressed by real income Y, and that Y is a function of K and N, where Y and K are measured in terms of the price of products. Denote the average rate of profit on capital or the average internal rate of return on capital by r. r is defined as follows;

$$r \equiv (Y - wN)/K, \tag{1}$$

where w is the real wage rate in terms of the price of products.[5] We shall denote by the subscript n variables under the new techniques and by the subscript o variables under the old techniques. Under a given w,

[5] Here we define the term profit so that it can include the quasi-rent.

$$r_n-r_o=\left(\frac{Y_n}{K_n}-\frac{Y_o}{K_o}\right)-w\left(\frac{N_n}{K_n}-\frac{N_o}{K_o}\right). \tag{2}$$

If the given w makes possible the line P or P' in Fig. 1, we get $(K_n/N_n)>(K_o/N_o)$ as shown above. On the other hand (Y_n/K_n) is always greater than (Y_o/K_o) under an arbitrary system of prices, so that r_n is larger than r_o.

Furthermore the relative share of labor in the value added under the new is less than under the old techniques, because (Y_n/N_n) is larger than (Y_o/N_o) under any system of prices.

Next, let us compare the relative shares of labor in the value added and r's both of which are brought about by the new techniques under two different levels of real wage rate.[6] Denote the slope of line A in Fig. 1 by k_1 and that of line B in Fig. 1 by k_2. We define Domain α, β and γ as follows;

$$\begin{aligned}
&\alpha\equiv((Y,K,N);\ K>k_1N), \quad \text{where } N>0,\\
&\beta\equiv((Y,K,N);\ k_1N\geqq K\geqq k_2N), \quad \text{where } N>0,\\
&\gamma\equiv((Y,K,N);\ K<k_2N), \quad \text{where } K>0.
\end{aligned} \tag{3}$$

We assume that the production function is linear homogeneous in regard to K and N. Then the average productivity of labor $y(\equiv Y/N)$ is a function of the degree of capital intensity $k(\equiv K/N)$. That is,

$$y=f(k), \tag{4}$$

where we assume in Domain β that the first derivative of f regarding k is greater and the second one is less then zero and that the elasticity of f in regard to k is constant (we shall denote the elasticity in general by e, e in Domain α by e_α, e in Domain β by e_β and e in Domain γ by e_γ).[7, 8, 9]

Since the marginal productivity of labor is equal to $(Y/N)\cdot(1-e)$, the marginal productivity of capital to $(Y/K)\cdot e$ and $\frac{dr}{dk}$ to $(y/k^2)\cdot\left(e-1+\frac{w}{y}\right)$, we can easily prove the following;

(i) $\frac{dr}{dk}<0$ is equivalent to $e<1-\frac{w}{y}$, $\frac{\partial Y}{\partial N}>w$ and $\frac{\partial Y}{\partial K}<r$ respectively,

(ii) $\frac{dr}{dk}=0$ is equivalent to $e=1-\frac{w}{y}$, $\frac{\partial Y}{\partial N}=w$ and $\frac{\partial Y}{\partial K}=r$ respectively,

and

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[6] The following analysis is nothing but an examination along the line of the capital theory of the Austrian school, especially of K. Wicksell. K. Wicksell: *Value. Capital and Rent*, 1954.

[7] This assumption appears, for example, in the Douglas' production function.

[8] e_β is larger than zero and less than unity. The former assertion is self-evident. On the other hand, because the marginal productivity of labor or of capital in this case depends only on k and the former (or the latter) increases (or decreases) as k increases, and because the former or the latter is proportional to the average productivity of labor or of capital respectively, $d\left(\frac{Y}{K}\right)\Big/d\left(\frac{Y}{N}\right)$ is negative. Then $d(f/k)/df$ must be negative, *i.e.*, $\left(k-\frac{dk}{df}f\right)$ is negative or $\left(\left(1\Big/\frac{df}{dk}\right)f-k\right)$ is positive. Consequently we get $e_\beta<1$.

[9] In Domain α, Y becomes linear homogeneous in regard to N, so that the marginal productivity of labor is equal to (Y/N) (=const.), the marginal productivity of capital to zero, the derivative of y regarding k to zero and e_α to zero. On the other hand, in Domain γ Y becomes linear homogeneous in regard to K, so that the marginal productivity of labor is equal to zero, the marginal productivity of capital to (Y/K) (=const.) and e_γ to unity. At the same time y is linear homogeneous in regard to k in Domain γ.

(iii) $\frac{dr}{dk}>0$ is equivalent to $e>1-\frac{w}{y}$, $\frac{\partial Y}{\partial N}<w$ and $\frac{\partial Y}{\partial K}>r$ respectively.

Suppose the real wage rate is, for instance, w^{**} in Fig. 3, where curve $(mp)_N$ shows the marginal productivities of labor under a given K. Because of limitation of the substitutability expressed by kinked isoquants, the curve $(mp)_N$ jumps, for example, at N^* from $(1-e_\beta)\cdot(Y^*/N^*)$ to zero and, for example, at N^{***} from (Y^{***}/N^{***}) to $(1-e_\beta)\cdot(Y^{***}/N^{***})$, where Y^* (or Y^{***}) is the output corresponding to N^* (or N^{***}) under the given K.

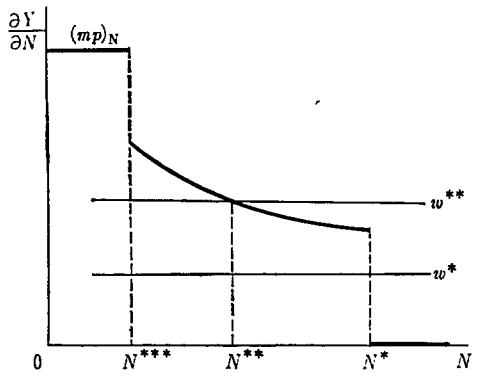

FIG. 3

Then, in order to maximize r, firms will choose the value of k which corresponds to N^{**} under the given K, where obviously the relative share of labor (w/y) is equal to $(1-e_\beta)$ (see (ii)). Under a given rate of interest, maximizing the average rate of internal return on capital r is equivalent to maximizing the average rate of net return on capital defined by the difference between r and the market interest rate, the latter of which is nothing but the external rate of return on capital. Thus, to maximize the average rate of net return on capital firms will choose the above magnitude of k.

On the other hand, if the real wage rate is lower than w^{**} and lies, for instance, in the level of w^* in Fig. 3, the marginal productivity of labor at the employment being smaller than or equal to N^* (being greater than N^*) is greater than (less than) the real wage rate. Then firms will adopt the value of k corresponding to N^* under the given K, in order to maximize r. It is nothing but full utilization of capital. Since $e_\beta<\left(1-\frac{w}{y}\right)$ in this case (see (i)), the relative share of labor is less than $(1-e_\beta)$.

Furthermore, under w^{**} r is less than under w^*. When we differentiate r in regard to w we get the following equation;

$$\frac{dr}{dw}=(1/k^2)\cdot\left(y\frac{dk}{dw}\left(e-1+\frac{w}{y}\right)-k\right). \tag{5}$$

In the neighborhood of w^*, (or in the change of w from w^* to w^{**}) $\frac{dk}{dw}$ is equal to or greater than zero on the one hand, and $\left(e-1+\frac{w}{y}\right)$ is negative on the other, so that $\frac{dr}{dw}$ is negative. Consequently we can conclude that the rate of profit under w^{**} is less than under w^*.

In sum, under w^* the new production function leads to greater rate of profit and lower relative share of labor than the old production function, and in an economy where w^* prevails the new production function brings higher rate of profit and lower relative share of labor compared with another economy in which the real wage rate is w^{**}.

III. *A Simple Model of Economic Development in the Early Stage of Industrialization*

Now let us construct a simple model of economic development. Suppose in our economy the following assumptions are satisfied.

(Assumption I) Before the economy turns to an open system, the marginal productivity of labor (or capital) in the native manufacturing sector or in the agricultural sector is equal to the real wage rate (the rate of profit) in each sector respectively. At the same time the real wage rate (the rate of profit) in the native manufacturing sector is equal to that in the agricultural sector.

This is the initial situation from which the economy will start. Because of the above assumption, we can treat the two sectors as a simple sector, which we shall call Sector 2.

(Assumption II) When the economy has been just switched from a closed to an open system, regarding changes of techniques the case shown in Fig. 1 corresponds to light industries and the case shown in Fig. 2 to heavy industries.

This is the most fundamental assumption. Though it might be possible in a certain backward country that the modern techniques of agricultural production are also decisively efficient compared with the old ones, we assume that the differences of techniques reveal themselves in manufacturing.[10]

(Assumption III) The population grows rapidly, so that the rate of increase of labor force is high.

We may think that the main source of labor in the economy is Sector 2. Consequently this assumption will play an important role in regard to interrelationship between newly established manufacturing (we shall call it Sector 1) and Sector 2 as well as the growth of Sector 2 itself.

(Assumption IV) The real wage rate in the economy is very significantly lower than in an advanced economy.

This is, in a sense, a reflection of Assumption II and III, and we shall examine later how such wage rate is determined.

(Assumption V) Competitive forces operate strongly in the international trade market.

In other words, substitution between a commodity produced in a country and the same commodity produced in another country is highly elastic in regard to the relative price between them.

When the economy has just transfered itself from a closed to an open system, we might observe internationally the following situation. Since in the economy knowledge of new techniques have not yet been digested, resources per unit of products are relatively higher in manufactured goods than in agricultural goods compared with an advanced economy.[11] Then manufactured products will be imported in the economy, and at the same time agricultural goods will be exported from it according to the principle of comparative cost. Foreign manufactured products will flow into the economy at a lower price compared with domestic

[10] The fact that agriculture in Japan was concentrated on cultivation of rice was a factor to prevent direct introduction of agricultural techniques from Europe and America. We may assert that the same is true in some of manufacturing industries, products of which have no counterpart in Europe or America.

[11] Here we suppose a composite factor of services of resources.

manufactured products. As a result, the former will dominate the domestic markets.[12]

However, this situation does not continue. For knowledge of new techniques will be introduced into the economy with the import of manufactured products. Among new techniques, first of all, the techniques shown in Fig. 1 will be taken into practice under the relatively low real wage rate. In this connection it seems that there are three questions of whether the techniques are easy to learn or not,[13] whether there exists sufficient demand for commodities produced by them[14] and whether there are sufficient funds to adopt them. We may suppose that techniques in light industries are relatively easier to learn than those in heavy industries. Secondly products in light industries are, in general, consumers' goods and products in heavy industries mainly capital goods. Consequently even at the beginning demand for products of light industries will exist. But not until light industries grows, will demand for products of heavy industries develop. Thirdy to adopt the new techniques firms will probably need a considerable amonnt of funds. Because of rigidity of capital equipments once invested, it is not easy to transfer capital operating under the old techniques into capital needed by the new ones. Therefore some amount of liquid funds must be available as the initial condition for the adoption of new techniques. Let us assume, for the time being, that this condition is satisfied in the economy.[15]

In usual analysis of international trade, the world is divided between one economy and the rest of the world. In analyzing the process of industrialization, however, it seems desirable to take into account at least three components of the world, *i.e.*, the group of advanecd countries (we may identify them with industrialized countries), the developing economy being examined and the group of other backward countries (we may identify them with the non-industrialized countries). Owing to Assumption II, light industries in the developing economy with new techniques will be able to produce at lower costs than the same industries using old techniques and the same industries in the industrialized countries. This will enable the price of products in Sector 1 to be cheaper than the price of imported goods. Although the development of an infant industry can be made possible by a protective tariff, the same effect will be brought about by a price cut, if this is possible.[16] It is evident that in Sector 1' this is possible. On the other hand, for simplicity, assume that in the third group of countries nearly same techniques as the old ones in our economy prevail. Then, under the condition of Fig. 1, the new techniques in light industries in the economy are superior to the techniques adopted in the third group as well as the domestic old ones. This enables the economy to specialize in modern light industries from the point of view of comparative advantages between the economy and the third group.[17] Thus development in Sector 1 is launched.

[12] In his analysis of international trade, M. Manoïlesco denys the theory of comparative cost. M. Manoïlesco: *Theory of Protection and International Trade*, 1931. But his assertion does not convince us of defect of the theory of comparative cost. It seems that the theory is true so far as assumptions to derive it are satisfied. Rather we should pursue dynamic factors neglected on deriving it in the analysis of industrialization.

[13] We have to bear in mind that in light industries unskilled labor is employed and on the other hand in heavy industries skilled labor is employed.

[14] See K. Mandelbaum: *The Industrialization of Backward Areas*, 1955, pp. 4–7.

[15] We shall examine later how such funds were created in the early stage of Japanese economy.

[16] It seems that in Japan protection was not an important factor in the development of new industries at least until about 1900, because she had no independent right to levy tariffs on imports until 1899.

[17] Generally speaking, when Japan was starting to industrialize, East-Asian countries stil remained stagnant, though in India there was industrialization in some degree. It seems that this situation played an important role to promote industrialization in Japan. We should keep in mind that Japanese manufactured products were mainly exported to East-Asian countries in the pre-war period.

Next we have to consider how the real wage rate, especially in Sector 1 is determined in the labor market as a whole, which is given to each firm. As seen in Fig. 3, the demand for labor in Sector 1 takes a shape as shown by curve D in Fig. 4 (we neglect here the left discontinuous part of $(mp)_N$ in Fig. 3).

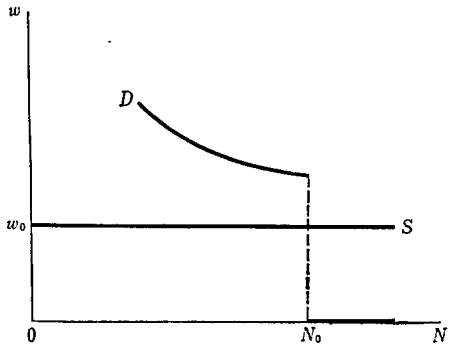

FIG. 4

On the other hand, what is the shape of the supply curve of labor to Sector 1? We suppose that in the agricltural sector the curve of marginal productivity of labor is continuously downward sloping to the right with other resources given. For it seems that combinations between labor and land in agriculture are not so rigid as ones between labor and machinery in manufacturing.[18] Because of the rapid increase of labor force in Sector 2 (Assumption III), the supply curve of labor in this sector will be shifting to the right as long as increased labor has to be absorbed within the same sector. Then the real wage rate will have a tendency to decline. Under this condition a great amount of labor will attempt to move towards Sector 1 as far as it is able to get a certain level of real wage. In other words, the supply of labor to Sector 1 is elastic with respect to the real wage rate. For simplicity, we assume a perfectly elastic supply of labor. What is "a certain level of real wage" mentioned above? It seems that the direction and amount of labor-movement in the short run as well as in the long run are not regulated by temporarily high or low wage rate, because both are deeply connected with labor's standard of living.[19] If the latter is based on real wage rates in the past, the supply of labor will be a function of the following normal wage rate. Namely the normal wage rate is a level of real wage rate which corresponds to a wage-earner's earning power valuated by himself on the basis of a series of actual real wage rates over a certain period, which contains high as well as low real wages in the past compared with his moderate level of real wage. Since the main source of labor force is Sector 2, the normal wage rate will depend upon real wage rates in this sector within a certain period of the past. The low real wage rate in Assumption IV is nothing but the low normal wage rate. Although in the advanced country where the new techniques were originated, perhaps the supply curve of labor has such height that it intersects the continuous

[18] Or it is enough for our analysis that we suppose the supply curve of labor in Sector 2 cuts the demand curve for labor in the continuous part of the latter.

[19] If we take M. Friedman's permanent income hypothesis concerning the consumption function, wage-earners as consumers will behave in their demand for consumers' goods according to their permanent income. At the same time, this behavioristic pattern must be reflected in their behaviors as factor-offers. Then the permanent income becomes an important factor in the supply of labor. M. Friedman: *A Theory of the Consumption Function*, 1957. In an unpublished paper, the author has analyzed the demand for money. Then he found that the normal income, which is similar to Friedman's permanent income, is the most important factor in the demand for money. The normal wage rate is an extension of the concept of normal income. It is Professor M. Umemura who takes into account the relationship between consumers' behaviors and labor supply. M. Umemura; *Rodoryoku no Kozo to Hendo* (The Structure and Changes of Labor Force), *Economic Review*, July 1957, pp. 227-233.

portion of the D curve, in our economy it will intersect the discontinuous part of curve D as shown by curve S in Fig. 4. Under this condition the real wage rate is w_0 and employment is N_0 in Sector 1.[20] This is a short run equilibrium. But we may call it equilibrium containing structural disequilibrium in a sense, because we find there that the marginal productivity of labor is greater than the real wage rate.

Thus in the short run equilibrium in Sector 1 and Sector 2, we find the following situation of employment as a whole; the employment in Sector 1 is expanded to the level of full utilization of capital on the one hand, and the remaining labor force continues to stay in Sector 2, in spite of the relatively low productivity of labor, on the other hand.

The structural disequilibrium would disappear either if the price in Sector 1 should sharply drop, or if the money wage rate should increase, or if the marginal productivity of labor in Sector 2 should rise, or if combination of the three should occur. We shall consider the first possibility later. The second might depend on the third. The third condition would be met by a rapid reduction of employment in Sector 2 because of the law of diminishing returns. In our economy, however, there does not exist so large a capacity in Sector 1 as to offer compensating employment opportunities to labor suddenly released from Sector 2. In addition, the labor force in Sector 2 is continuously increasing by Assumption III. Consequently a rapid decrease of employment in Sector 2 is unlikely to occur. But because the rate of profit in Sector 1 is higher than in Sector 2, capital employed in Sector 2 will have a tendency to move into Sector 1, if it is possible. Then we might get ultimately an equality between the value of marginal productivity of labor in Sector 1 and in Sector 2. Sector 2, however, consists of a great number of small scale farms as well as small scale native manufacturing firms which can not be imagined to stop their production in order to transform themselves into large scale manufacturing enterprises. In addition, capital once invested in a work is not easily removed to other works. Therefore capital is not likely to move freely among industries.

One of other factors which will extinguish the disequilibrium is the improvement of production techniques in Sector 2. But at the same time we might have to expect technological progress in Sector 1. And, generally speaking, it seems that progress in the latter is rather more rapid than in the former. If this is true, the disequilibrium will continue with technological change, in so far as the progress makes no change in the situation shown in Fig. 1.

The structural disequilibrium, however, bears within itself seeds of its own destruction. Because of the high rate of profit in Sector 1, firms in this sector will soon invest new capital, if they can obtain it, to expand their capacity, and savings in the other sector will flow into Sector 1. This will mitigate the disequilibrium through the decline of price of products in Sector 1. Since a labor force increase in Sector 2 will tend to strengthen the disequilibrium, it is necessary for the mitigation that G_{k1} is so high that the effect of growth of capital in Sector 1 can over balance that of increase of employment in Sector 2, where G_{k1} is the rate of growth of capital in Sector 1 (similarly we shall express the rate of growth of Y and N in Sector 1 by G_{y1} and G_{n1} and of Y, K and N in Sector 2 by G_{y2}, G_{k2} and G_{n2}). Suppose G_{k1} is greater than G_{n2}. Under the assumed production function in Sector 1 G_{k1} is equal to G_{n1} and G_{y1}, so far as the marginal productivity of labor at full utilization of capital in Sector 1 is greater than the real wage rate in this sector. For simplicity, let us assume that Sector 2 consists only of agriculture where factors used for production are, we suppose,

[20] In order to make the movement of labor smooth, there may occur wage differentials between Sector 1 and Sector 2. But, for simplicity, we neglect them.

land and labor, with supply of land being held constant. Then, because of diminishing marginal productivity of labor on land, G_{n2} is larger than G_{y2}, so that we get $G_{y2}<G_{n2}<G_{k1}=G_{n1}=G_{y1}$. It is evident that $G_{y2}<G_y<G_{y1}$, where G_y is the rate of growth of real income in both Sector 1 and Sector 2. We may assume that the rate of growth of domestic demand for products produced by Sector 1 or imported from abroad is nearly equal to G_y, because it seems that the income elasticity of demand for consumers' goods might be less than or nearly equal to unity. Denote the rate of growth of this demand by G_{d1}.[21] Then we get $G_{d1}<G_{y1}$. When we start with a magnitude of the demand, which is greater than the domestic supply, as the initial condition, we might find some periods later that the supply of products by Sector 1 finally strikes against the ceiling of demand. The time comes when the first condition mentioned above to extinguish the structural disequilibrium comes to our system. The price of products in Sector 1 will decline considerably, so that the real wage rate in this sector will rise. More precisely, we may assume regarding the time-behavior of the price in the process of development that

$$\frac{dp_1}{dt}=g(G_{d1}-G_{y1}), \tag{6}$$

where p_1 is the price of products in Sector 1, $\frac{dp_1}{dt}$ is the rate of change of p_1 per unit of time, g' is positive and g is equal to zero if G_{d1} equals G_{y1}. The meaning of (6) is as follows; (i) so far as the percentage change of domestic supply is equal to that of domestic demand, the domestic supply as well as the supply from abroad equally enjoy opportunities to expand the demand, which are caused by the growth of income as a whole, so that the relative price between them will be maintained constantly, but (ii) if the percentage change of domestic supply is greater than that of domestic demand, the price of domestic products will decline relatively in order to invade the market which had been supplied by imports till then or will be supplied by imports, *vice versa*. Because G_{d1} is less than G_{y1} in the economy as shown above, $\frac{dp_1}{dt}$ is less than zero, *i.e.*, p_1 is declining.

On the other hand, however, by taking advantage of competitive feature of the international market, manufactured products will begin to be exports through the low price.

This is the processes of economic development in the early stage of industrialization. Since we are concerned with this stage, let us stop here and describe some empirical evidences.

IV. *Some Empirical Evidences*

Because of limitation of data, we can not give full empirical support for the above model. Here we shall present a few.

At first, in the section III we assumed the existence of some amount of initial liquid funds. Where did it come from? One of sources is the commutation bonds issued by government in 1874–1877 to compensate for the abolition of the hereditary stipend system of the feudal order. The issue of these bonds amounted to 191 million yen, which was 48 percent of national income in 1878. Therefore a great amount of funds came into the hands of

[21] Because we simplified our analysis by representing the supply of products by Sector I by means of real income, here we must assume that the demand can be expressed by a magnitude corresponding to the real value added.

the warrior class. At the same time national banks, which were a kind of commercial bank, could issue bank notes up to 80 percent of their capital by means of giving bonds to the government as security, where 25 percent of the issue had to be reserved by currency. The highest yearly average issue of bank notes was 34.4 million yen in 1881. Furthermore it seems that accumulated savings in the commercial sector had great effect upon establishing new industries, though we are not able to make clear the size of it.[22]

Secondly, according to our estimation, real producers' durable equipments and construction in the cotton spinning industry as a representative of newly established industries grew as follows.[23] Before 1900, the annual growth rate was tremendously high, *i.e.*, 25.7 percent. On the other hand, after 1900 it was 5.9 percent. Consequently we can suppose that until 1900 this industry enjoyed the above described first stage of development. After 1900 the tendency to weed out small and weak firms appeared. That is, while in the end of June, 1903, the number of corporations in this industry was 54, it decreased to 31 by the end of June, 1912.

Thirdly, let us compare the relative share of labor in the Japanese cotton spinning industry with one in cotton goods industry in the United States. Because of limitation of data, our estimation of relative share of labor in the value added in the former is concerned with the period after 1907.[24, 25] Even in this period, however, it is interesting to compare internationally the relative share. Though the U. S. cotton goods industry might include other sectors than cotton spinning, for example, cotton weaving, we are able to roughly estimate the difference between the relative shares in two countries.

TABLE 4.
RELATIVE SHARE OF LABOR IN JAPANESE COTTON SPINNING INDUSTRY

1907–1910	35.1%
1910–1915	44.4
1915–1920	26.6
1920–1925	34.3
1925–1930	38.7
1930–1935	29.6
1935–1937	26.7

Since 1907, the labor's relative share in the Japanese cotton spinning industry had been 25–40 percent except 1910–1915. On the other hand, according to J. Steindl's estimation labor in the U. S. cotton goods industry enjoyed shares of 50–60 percent of the value added.[26] The decisively low share of labor in the former supports our analysis.

Finally, let us investigate empirically the statement that Japan became an exporter of manufactured goods after being an importer at first. Here too, we pick up cotton yarns for the sake of convenience.[27] In Fig. 5 we find that the ratio of import-price p_i to export-price of cotton yarns p_e was greater than unity (1.5–2.5) at least until the beginning of 1920's. On

[22] In his coming book, *Business Cycles in Japan—An Theoretical, Statistical and Historical Analysis of the Process of Cyclical Development* (in Japanese), the author will analyze the effect brought about by the accumulated savings in the commercial sector via the banking system for establishing new industries.

[23] Because of tremendously complicated processes carried by us to estimate the series of real producers' durable equipments and construction in the cotton spinning industry, we are not able to briefly summarize our method of estimation. The fundamental source of data is Dai Nippon Boseki Rengokai: *Menshi Boseki Jijo Sankosho* (Ststistics of Japanese Cotton Spinning Industry).

[24] Here again we can not summarize in a few words our method of estimation of the series of relative shares of labor in the cotton spinning industry. Figures in Table 5 are now being revised, so that they are our first estimation. The fundamental source of data is *Menshi Boseki Jijo Sankosho.*

[25] Only after 1930 is it possible to estimate accurately the relative share of labor in manufacturing as a whole in Japan by use of the production census.

[26] J. Steindl: *Maturity and Stagnation in American Capitalism*, 1952, p. 92.

[27] The data are taken from Toyo Keizai Shinposha: *Foreign Trade in Japan*, 1935.

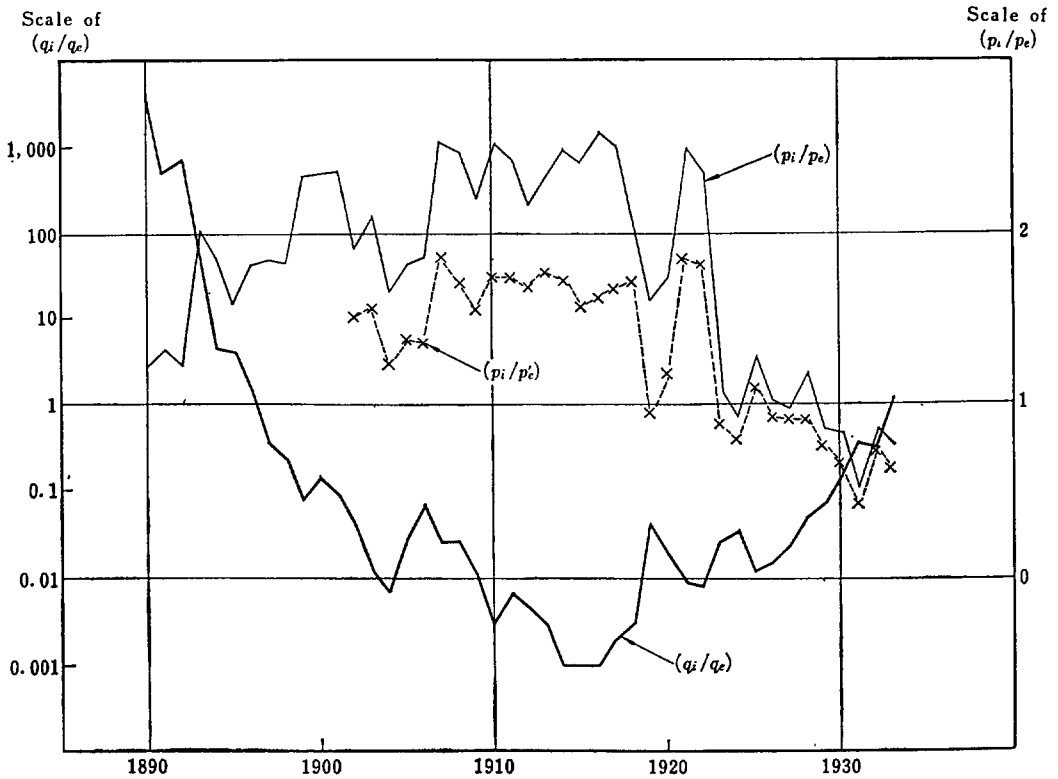

FIG. 5

the other hand, the ratio of imported quantity q_i to exported quantity of cotton yarns q declined sharply from 3,431.0 in 1890 to 0.001 in 1914. It is evident that the ratio (q_i/q_e) behaved inversely to the ratio (p_i/p_e). Although (q_i/q_e) rose as (p_i/p_e) declined after the latter half of 1920's, in 1933 the imported quantity of cotton yarns was only 10,614 M. T. compared with the domestic production, 570,354 M. T..[28] It seems that this rise of (q_i/q_e) was induced by the high price caused by the monopolistic condition in the domestic market of cotton yarns.[29]

Regarding the above of import-export structure, there may occur one question. That is to say, the high ratio of p_i to p_e might be caused by a difference of quality between imports and exports. To clarify this point, we calculated the export-price of cotton yarns which are higher than No. 20 count (we shall denote it by p_e'). Since we can not estimate the corresponding import-price, let us observe the ratio of p_i to p_e'. In general, the ratio is higher than 1.5 until the beginning of 1920's so that we can conclude that our assertion is not changed even after taking into consideration the difference of quality.

[28] Concerning steel products, we can also find that relatively low price of domestic products or exports gradually made the import decrease in the latter stage of economic development in the pre-war period. Shozaburo Fujino: Tekkogyo no Shijokozo to Keiki Junkan (The Market Structure and Business Cycles in the Japanese Iron-Steel Industry), *Analyst*, Jan. 1956, pp. 13–25 & Feb. 1956, pp. 48–55.

[29] The monopolistic condition in the domestic market of cotton yarns in the period after about 1915 was analyzed by author's paper, Shijokozo to Keiki Junkan (Market Structures and Business Cycles), *Nippon Keizai no Bunseki*, Vol. 2, edited by S. Tsuru & K. Ohkawa, 1955, pp. 319–354.