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Dualistic Development in the Manufacturing Sector : Japan's Experience

by

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I. Introduction

Much attention has been paid to the rapidity of Japanese growth and several long-term models to explain the economic development of pre- and post-war Japan have been constructed by Economic Planning Agency, Klein, Klein and Shinkai, Ueno, and Ueno and Kinoshita[1]. In these models the entire industry is divided into two sectors: the primary or agricultural sector and the manufacturing sector[2]. The models with this sectoral breakdown are useful to explore the change in Japan's industrial structure as well as the pace of economic growth. However, it was not until the book by Kelley and Williamson[3] was published that the so-called "dualistic structure" of Japan's economy was investigated systematically within the framework of macroeconometric model (except possibly for the quarterly econometric model constructed by the Institute of Social and Economic Research of Osaka University[4]). Using the quantitative estimates of LTES[5], they attempted to construct a closed-economy model of economic dualism and to reinterpret the growth of Meiji Japan.

Although various hypotheses have been presented to explain the "dualism" in Japan, they are closely related to the Ohkawa-Rosovsky framework which emphasizes the co-existence of indigenous and modern activities[6]. On the supply-production side of the economy Rosovsky and Ohkawa find that indigenous industries are much more concentrated in the small-scale sector and their economies of scale are generally much smaller than the national average. On the demand side, their data indicate that indigenous consumer preferences are still very significant and that they have changed rather slowly in spite of rapid modernization in certain parts of the economy. Having established the quantitative expressions, they conclude that the indigenous sectors contributed to provide "total employment" and the efficient use of capital under conditions of capital shortage, though they point out that the problem can only be understood in a long-run dynamic context.

The purpose of this paper is to present a sectoral model of the Japanese economy during her postwar semi-industrial phase, in order to test the Rosovsky-Ohkawa hypotheses using the time series data which have been amassed since their paper was published. In Section II we shall briefly deal with the features of our basic data. We shall examine some properties of the model from the point of view of each equation in Section III. Results obtained are then used to test the role of indigenous sectors in a long-run dynamic context in Section IV. Finally a summary of the main results is given in Section V.

II. The Data

In order to make this type of model suitable for dealing with the structural change of the Japanese economy, the long-term model must be composed of at least five sectors: (1) agriculture, forestry, and fishing (sector A), (2) indigenous manufacturing sector (sector M1), (3) modern manufacturing sector (sector M2), (4) social overhead sector (sector O) or facilitating industries: transportation, communication, and public utilities, and (5) service sector (sector S).

It should be noted that this sectral breakdown calls for more detailed information on finely defined product classes than the sectral breakdown in the growth-theory literature which only distinguishes between capital and consumption good's sectors. In particular from an operational point of view it is difficult to draw a clear line between indigenous and modern manufacturing sectors. In fact the selection of the industries which produce indigenous commodities in the Census of Manufactures calls for data on 4-digit level in the standard industrial classification. However, since indigenous industries are much more concentrated in the small-scale sector, it is possible to characterize industry as indigenous or modern by size of establishments. Moreover this standard of demarcation permits the utilization of the recent results obtained by Ohkawa and Motai which serves for identifying broadly the correspondence as seen between industry and scale of enterprises[7]. Taking the ratio of the number of workers engaged in those enterprises whose number of workers ranges from 1 to 49 to the number of total workers within the selected industries as the indicator, they show that manufacturing industries are grouped into three classes. That is:

Group A (largest share of the small scale, ranging 72.3-51.8%): Wood and wood product, furniture, leathers, clothes, food, metals.

Group B (intermediate share of the small scale, ranging 44.3-35.6%): printing, pulp-paper, ceramics, textiles, general machinery, precision machinery.

Group C (smallest share of the small scale, ranging 19.1-9.0%): rubber, non-ferrous, steel and iron, transportation machinery, electric machinery, petroleum and coal, chemical.

These results say that large-scale industries are much more concentrated in those industries which produce capital and more sophisticated intermediate goods, while small-scale industries mainly produce final goods. Therefore we can also characterize manufacturing industries as indigenous or modern by types of products.

The variables associated with the service sector are currently left as exogenous and no attempt was made to model the monetary sector. Mining, construction, and miscellaneous manufacturing industry as well as service sector are included in other industries (sector R) in the sequel.

The basic time series used in this study were compiled by Japan Economic Research Center (JERC). More specifically, the series on the volume of imports and exports and their price indices are obtained from the Trade Statistics (Ministry of Finance). On the production side, the series on the volume of production and their price indices are obtained from the Census of Manufactures (Ministry of International Trade and Industry).

III. The Structure of the Model

The system includes thirty-five endogenous variables and thirty-three predetermined variables. The behavioural equations conveniently split into seven groups: production functions, domestic demand functions, import functions, export functions, investment functions, price determination equations, and wage adjustment equations.

In order to keep the presentation manageable, it will be useful to examine the results for the first four groups in detail and then to examine the other results in a more summary fashion. Most of them were estimated by the 2SLS procedure[8]. The figures in parentheses beneath the parameter estimates are the absolute values of the corresponding t-ratios, dw is the Durbin-Watson statistics and $\hat{\sigma}$ is the standard error of estimate. The names of variables are as follows:

<u>List of Variables</u>

<u>Endogenous variables</u>

SA	volume of production in sector	A	(1965 prices)
S1	"	M1	(")
S2	"	M2	(")
SO	"	O	(")
DA	domestic demand for sector	A	(")
D1	"	M1	(")
D2	"	M2	(")
DO	"	O	(")
X1	exports of sector	M1	(")
X2	"	M2	(")

IA	imports of primary products (1965 prices)
I1	imports of indigenous manufacturing products (1965 prices)
I2	imports of modern manufacturing products (1965 prices)
ΔK1	net investment in sector M1 (1965 prices)
ΔK2	net investment in sector M2 (1965 prices)
ΔKO	net investment in sector O (1965 prices)
PO1	implicit price deflator for S1 (1965 = 100)
PO2	implicit price deflator for S2 (1965 = 100)
POO	implicit price deflator for SO (1965 = 100)
W1	wages per employee in sector M1

W2	wages per employee in sector M2
WO	wages per employee in sector O
N1	employment in sector M1
N2	employment in sector M2
NO	employment in sector O
K1	net capital stock in plant and machinery in sector M1 (1965 prices)
K2	net capital stock in plant and machinery in sector M2 (1965 prices)
KO	net capital stock in plant and machinery in sector O (1965 prices)
YD	personal disposable income (1965 prices)
PC	implicit price deflator for consumption (1965 = 100)
Q	effective opening-to-application ratio
S	volume of total production (1965 prices)
P	implicit price deflator for S (1965 = 100)
N	employees in employment
ΔK	net domestic fixed capital formation (1965 prices)

Exogenous variables

NA	employment in sector A
NR	employment in all other industries
SR	volume of production in all other industries (1965 prices)
POA	implicit deflator for SA (1965 = 100)
IG	government net fixed investment (1965 prices)
PEIW	price index for world manufactured goods (1965 = 100)
PIA	implicit deflator for IA (1965 = 100)
PI1	implicit deflator for I1 (1965 = 100)
PI2	implicit deflator for I2 (1965 = 100)
ΔKA	net investment in sector A (1965 prices)

ΔKR	net investment in all other industries (1965 prices)
IN	official discount rate
PI	import price index (1965 = 100)
PIM	import price index of mining products (1965 = 100)
PP	price index of public utilities charges (1965 = 100)
NL	total labor force
XA	exports of sector A (1965 prices)
TWMR	world manufacturing export index (1965 = 100)
TIME	trend, in years, beginning with unity in 1954
DUMY	dummy variable which accounts for the changes in import control policy by means of import collateral adjustments adopted until the early 1960s, equal to one before 1960, zero thereafter.

(1) Production Functions

We assume that output in each sector is produced by labor and capital and that the production relations can be approximated by equations of the Cobb-Douglas type. If production functions are homogeneous of degree one, they are also written with labor productivity as a function of capital input per labor input. The estimated production functions incorporating technical changes which are assumed to take place at a constant percentage rate are as follows:

$$(\ell og\ S1 - \ell og\ N1) = \underset{(16.326)}{4.3841} + \underset{(2.955)}{0.2243}\ \{\ell og(K1 + K1_{-1}) / 2 - \ell og\ N1\} + \underset{(5.791)}{0.02786}\ TIME$$

$$\hat{\sigma} = 0.01783, \qquad dw = 0.998$$

$$(\ell og\ S2 - \ell og\ N2) = \underset{(2.385)}{3.1650} + \underset{(1.209)}{0.3744}\{\ell og(K2 + K2_{-1}) / 2 - \ell og\ N2\} + \underset{(2.845)}{0.06452}\ TIME$$

$$\hat{\sigma} = 0.05602, \qquad dw = 1.484$$

$$(\ell og\ SO - \ell og\ NO) = \underset{(3.118)}{1.9860} + \underset{(3.707)}{0.4221}\{\ell og(KO + KO_{-1}) / 2 - \ell og\ NO\} + \underset{(10.233)}{0.04706}\ TIME$$

$$\hat{\sigma} = 0.01728, \qquad dw = 1.321\ .$$

An apparent limitation of the estimated production functions is the omission of variables describing fluctuations in the rate of utilization of capacity. Ueno and Kinoshita have taken the rate of capacity into account but treated it as an exogenous variable. This is because rates of utilization have been assumed to be decided through cartel actions by trade associations and administrative measures by government over pre- and post-war periods. However, this assumption does not seem suitable for our model, since it includes small-scale industries as well as large-scall industries.

It is clear that there is a marked difference in the rate of technical progress between the indigenous and modern manufacturing sectors. The estimated rate of technical change in the indigenous manufacturing sector is about 2.79 per cent per year, which is much lower than 6.45 per cent in the modern manufacturing sector and 4.71 per cent in the social overhead sector. In fact it is lower than the values of the rate of technical progress for the primary sector estimated by Ueno and Kinoshita, and Economic Planning Agency[9].

Finally it should be noted that the level of production is determined through the market clearing conditions, while production functions describe the determination of employment.

(2) Domestic Demand Functions

Domestic demand for the non-primary sector is considered to be a function of personal disposable income, ratio of the implicit deflator for the sector's products to the implicit deflator for private consumption, total net investment in the private sector, capital formation by the public sector and government consumption. On the other hand, domestic demand for the primary sector was related to personal disposable income and price index of primary products. Personal disposable income is deflated by the implicit price deflator for consumption in each equation. Deleting insignificant variables, we have the estimated functions:

$$\ell og\ DA = \underset{(40.423)}{6.6738} + \underset{(8.479)}{0.4949}(\ell og\ YD - \ell og\ PC) - \underset{(1.304)}{0.1261}\ \ell og\ POA$$

$$\hat{\sigma} = 0.02063, \qquad dw = 2.133$$

$$\ell og\ D1 = \underset{(24.938)}{5.2044} + \underset{(7.154)}{0.5910}(\ell og\ YD - \ell og\ PC) + \underset{(3.319)}{0.1101}\ \ell og\ DK - \underset{(4.460)}{0.9950}(\ell og\ PO1 - \ell og\ PC)$$

$$\hat{\sigma} = 0.01519, \qquad dw = 2.796$$

$$\ell og\ D2 = \underset{(12.429)}{2.0171} + \underset{(6.840)}{1.0961}(\ell og\ YD - \ell og\ PC) + \underset{(3.176)}{0.2825}\ \ell og\ DK$$

$$\hat{\sigma} = 0.04629, \qquad dw = 2.499$$

$$\ell og\ DO = \underset{(19.189)}{2.4195} + \underset{(13.820)}{1.0144}(\ell og\ YD - \ell og\ PC) + \underset{(2.319)}{0.0951}\ \ell og(DK + IG) - \underset{(2.689)}{0.2671}(\ell og\ POO - \ell og\ PC)$$

$$\hat{\sigma} = 0.01633, \qquad dw = 2.215\ .$$

The estimated income elasticity of modern manufacturing products is much higher than that of indigenous manufacturing products. Comparing the expenditure elasticities for about 100 goods and services, Rosovsky and Ohkawa concluded that indigenous are generally lower than intermediate, and intermediate are lower than modern. They predicted that the demand for modern commodities was expected to outstrip the other groups with rising incomes. The estimates in our model are consistent with this view of the consumer expenditure pattern. It is clear that the large income elasticities for the modern manufacturing sector contributed to a higher rate of growth of this sector than the growth of the whole economy.

(3) Import Functions

The import functions were made functions of the levels of the domestic demand for the sector, implicit price deflators for imports and domestic prices. As for the indigenous manufacturing products, we find that the estimated coefficients of the price variables are not statistically significant. Therefore we dropped these variables from the equation and include the lagged dependent variable and a dummy variable which represents the changes in import control policy by means of import collateral adjustments adopted until the early 1960s. However, the estimated coefficient of the dummy variable is not statistically significant and leave room for improvement. The empirically estimated functions are:

$$\ell og\ IA = \underset{(1.589)}{-5.83247} + \underset{(3.457)}{1.4644}\ \ell og\ DA - \underset{(3.030)}{0.7662}(\ell og\ PIA - \ell og\ POA)$$

$$\hat{\sigma} = 0.05686, \qquad dw = 2.146$$

$$\ell og\ I1 = \underset{(5.780)}{-1.0445} + \underset{(1.969)}{0.2899}\ \ell og\ D1 - \underset{(1.094)}{0.1344}\ DUMMY + \underset{(5.488)}{0.7290}\ \ell og\ I1_{-1}$$

$$\hat{\sigma} = 0.0977, \qquad dw = 1.563$$

$$\ell og\ I2 = \underset{(5.780)}{-21.3566} + \underset{(25.470)}{0.9490}\ \ell og\ D2 + \underset{(4.137)}{4.9573}\ \ell og\ PO2 - \underset{(1.673)}{0.9042}\ \ell og\ PI2$$

$$\hat{\sigma} = 0.0621, \qquad dw = 2.586\ .$$

The percentage change of imports associated with one percent change of domestic demand are 1.070 for indigenous manufacturing products and 0.949 for modern manufacturing products[10]. Although these estimates are not statistically different from one, it should be noted that the value is smaller than unity for modern manufacturing products. Generally speaking, the rapid rise in manufacturing has brought about a faster increase in imports of machinery and equipment, and the trade gap caused by the increased imports of capital goods has reduced the pace of economic growth. The estimated elasticities suggest that import substitution has occured for modern manufacturing products, which has made Japan succeed in escaping from this trap.

(4) Export Functions

Exports of manufacturing products are assumed to be functions of world manufacturing export index and the relative price variable, while exports of primary products are taken to be exogenous to the system. Unfortunately the figures on the price for world trade were not available by the industry classification which is comparable with ours; therefore, the relative price variables are expressed as the price index of Japanese exports for each group of industries divided by the price index of world aggregated manufacturing exports index.

The empirical estimates of the export functions specified in this way are:

$$\ell og\ X1 = \underset{(3.035)}{5.0642} + \underset{(4.425)}{1.9053}\ \ell og\ TWMR - \underset{(2.370)}{2.8690}(\ell og\ PO1 - \ell og\ PEIW)$$

$$\hat{\sigma} = 0.10443, \qquad dw = 0.935$$

$$\ell og\ X2 = \underset{(0.161)}{0.1596} + \underset{(4.033)}{1.4020}\ \ell og\ TWMR - \underset{(8.460)}{0.6162}(\ell og\ PO2 - \ell og\ PEIW) + \underset{(2.233)}{0.3134}\ \ell og\ X2_{-1}$$

$$\hat{\sigma} = 0.02734, \qquad dw = 2.750\ .$$

If we put $X2 = X2_{-1}$ in the export equation for modern manufacturing products, we get a sort of long run elasticity of exports with respect to the foreign activity variable, which turns out to be 2.04. Thus the elasticity of exports with respect to the foreign activity variable is almost 2 in either equation, which seems to be another important factor that makes it possible for the Japanese economy to sustain a high rate of economic growth without causing secular balance of payments difficulties.

(5) Investment Functions

All the investment equations estimated are of the "stock-adjustment" type and the equation for the indigenous manufacturing sector includes interest rate as a cost factor. We will forcus our attention on the expantion of private non-dwellings fixed investment in the non-primary sector, while private fixed investment in the primary sector is currently assumed exogenous.

$$\Delta K1 = \underset{(4.358)}{0.2050}\ S1_{-1} + \underset{(6.867)}{0.7580}\ \Delta K1_{-1} - \underset{(2.690)}{6.5215}\ IN$$

$$\hat{\sigma} = 28.794, \qquad dw = 2.030$$

$$\Delta K2 = \underset{(4.449)}{0.1929}\ S2_{-1} + \underset{(7.242)}{0.7491}\ \Delta K2_{-1}$$

$$\hat{\sigma} = 196.067, \qquad dw = 2.180$$

$$\Delta KO = \underset{(2.328)}{0.7148}\ SO_{-1} + \underset{(6.109)}{0.8086}\ \Delta KO_{-1}$$

$$\hat{\sigma} = 79.229, \qquad dw = 2.848\ .$$

(6) Price Determination Functions

The price determination functions estimated here, which are similar to those in use elsewhere, are basically mark-up equations that relate the index of price of final output to the earnings index and the import price index. Both the implicit price deflator for aggregated imports (PI) and the import price index of mining products (PIM) were tried as import price terms. As for the modern manufacturing sector and the social overhead sector, PIM performed better than PI. The empirical results are:

$$\ell og\ PO1 = \underset{(7.561)}{2.6073} + \underset{(24.364)}{0.2676}\ \ell og\ W1 + \underset{(1.391)}{0.0910}\ \ell og\ PI$$

$$\hat{\sigma} = 0.01529, \qquad dw = 1.657$$

$$\ell og\ PO2 = \underset{(11.353)}{3.2342} + \underset{(2.856)}{0.0434}\ \ell og\ W2 + \underset{(5.036)}{0.2403}\ \ell og\ PIM$$

$$\hat{\sigma} = 0.01889, \qquad dw = 1.155$$

$$\ell og\ POO = \underset{(9.185)}{2.5527} + \underset{(17.381)}{0.2642}\ \ell og\ WO + \underset{(1.778)}{0.0815}\ \ell og\ PIM$$

$$\hat{\sigma} = 0.01839, \qquad dw = 1.215\ .$$

It should be noted that the equation for the modern manufacturing sector has a weak wage term, whereas the equations for other sectors have highly significant wage elasticities.

(7) Wage Adjustment Functions

The estimated forms of the wage adjustment functions are based on the Phillips Curve, which relates changes in wage rates to excess demand in the labor market. As a measure of labor market tightness we took effective opening-to-application ratio. Changes in the implicit price deflator for consumption are also introduced as a factor of cost-of-living adjustments. The actual estimated equations are:

$$\ell og\ W1 - \ell og\ W1_{-1} = \underset{(2.611)}{0.03222} + \underset{(2.704)}{0.9277}(\ell og\ PC - \ell og\ PC_{-1}) + \underset{(1.927)}{0.05306}\ 1/Q$$

$$\hat{\sigma} = 0.01978, \qquad dw = 1.895$$

$$\ell og\ W2 - \ell og\ W2_{-1} = \underset{(3.077)}{0.04298} + \underset{(1.503)}{0.5834}(\ell og\ PC - \ell og\ PC_{-1}) + \underset{(1.228)}{0.03826}\ 1/Q$$

$$\hat{\sigma} = 0.02239, \qquad dw = 2.479$$

$$\ell og\ WO - \ell og\ WO_{-1} = \underset{(3.114)}{0.03658} + \underset{(2.530)}{0.8262}(\ell og\ PC - \ell og\ PC_{-1}) + \underset{(1.365)}{0.03577}\ 1/Q$$

$$\hat{\sigma} = 0.01883, \qquad dw = 1.665\ .$$

We now present three technical equations, four market equilibrating equations, and seven identities required to close the model.

Technical Equations

$$\ell og\ Q = -.7186 - 16.466\ \frac{N - NL}{NL}$$
$$\quad (4.249) \quad (8.793)$$

$$\hat{\sigma} = 0.2212, \qquad dw = 0.808$$

$$\ell og\ YD = -5.6286 + 0.4647\ \ell og\ V + 0.5154\ \ell og\ V_{-1}$$
$$\quad (22.648) \quad (2.064) \qquad (2.236)$$

$$\hat{\sigma} = 0.03546, \qquad dw = 0.949$$

$$\ell og\ PC = -1.8188 + 0.4376\ \ell og\ P + 0.9549\ \ell og\ PP$$
$$\quad (7.742) \quad (2.416) \qquad (6.037)$$

$$\hat{\sigma} = 0.02295, \qquad dw = 0.539\ .$$

Market Equilibrium Conditions

$$DA = SA + IA - XA$$

$$D1 = S1 + I1 - X1$$

$$D2 = S2 + I2 - X2$$

$$DO = SO\ .$$

Identities

$$K1 = K1_{-1} + \Delta K1$$

$$K2 = K2_{-1} + \Delta K2$$

$$KO = KO_{-1} + \Delta KO$$

$$S = SA + S1 + S2 + SO + SR$$

$$P = (POA*SA + PO1*S1 + PO2*S2 + POO*SO + POR*SR) / S$$

$$N = NA + N1 + N2 + NO + NR$$

$$\Delta K = \Delta KA + \Delta K1 + \Delta K2 + \Delta KO + \Delta KR\ .$$

IV. The Dynamic Properties of the Model

The model can now be simulated as a complete system. We begin with an ex post, or "historical", simulation. The simulation begins in 1954 and runs forward until 1968. Given historical values in 1954 as initial conditions for the endogenous variables, and given historical series for the exogenous variables, the model is solved using a Gauss-Seidel algorithm. Although it is often pointed out that solution problems are associated with annual systems, there has been no problem in obtaining convergence and the simulated series seem to reproduce the general behavior of the actual series. The results of the historical simulations are summarized in tables 1 ~ 12.

We can also use our model to examine the economic consequences that would have resulted from changes in the rate of growth of some exogenous variables. Although the analysis in the previous section provides a partial insight into the impact of these changes, it takes no account of the fact that variables interact with each other across equations and over time. The full dynamic structure of the model becomes evident only if the model is solved simultaneously through time. We perform the following five simulation experiments. The first four experiments correspond to changing the value of only one exogenous variable, while the last experiment corresponds to changing two exogenous variables at a time.

Experiment 1: In this experiment, the rate of growth of world manufacturing export is set at 9 percent, while the rates of growth of all other exogenous variables are set at their historical rates of growth.

<u>Experiment 2</u>: The second experiment is the same as the first, except that the rate of growth of world manufacturing export is set at 3 percent.

<u>Experiment 3</u>: In this experiment the labor supply (NL) is assumed to grow at 3 percent per year, while the other exogenous variables are assumed to follow the same paths as in the historical simulation.

<u>Experiment 4</u>: The fourth experiment is the same as the third, except that the rate of growth of the labor supply is set at 1 percent per year.

<u>Experiment 5</u>: In this last experiment it is assumed that the aggregated import price index (PI) grows at 1 percent per year, import price index of mining products grows at 3 percent per year, and all other exogenous variables grow at their historical rates of growth.

The simulations presented here are essentially mechanical ones. For example the actual values of NA and NR are used, while the rate of growth of NL is changed. Fully realistic simulations need to take account of the existence of the unspecified relationships among these exogenous variables. The main results of these experiments are shown in tables 1 ~ 12. Since the central issue of this paper is the strategy and mechanism of industrialization in semi-industrialized phase, in particular the process of the reallocation of resources from the indigenous manufacturing sector to the modern manufacturing sector, the results are shown mainly in terms of the ratio between the indigenous manufacturing sector and the modern manufacturing sector.

The results of all these experiments indicate that output grows faster in the modern manufacturing industries than in the indigenous manufacturing industries (table 1). On the other hand the ratio of N2 to N1 increased up to 1964, and began to decrease (table 2). Comparing the third and fourth experiments in table 2, it can be seen that the more rapid growth of labor supply results in the more slowly growing S2/S1 and N2/N1. Similarly the more rapid growth in world manufacturing exports leads to more rapid growth in the labor demand, which in turn results in greater increases in S2/S1 and N2/N1. These results indicate that the indigenous manufacturing sector contributed much to the absorption of the surplus labor force. The reason for this effect is, of cource, that the estimated coefficient of capital input per man in the production function is greater for the modern manufacturing sector than for the indigenous manufacturing sector, namely that the input coefficients demonstrate less labor-absorptive capacity in the modern manufacturing industries. In addition, these phenomena are more apparent if the modern manufacturing sector and the social overhead sector are aggregated together (tables 3 and 4).

Although more rapid growth in S2/S1 for the first and third experiments results in an decrease in PO2/PO1 (table 7), which might promote the import substitution with respect to modern manufacturing products (the secondary import substitution), the imports of modern manufacturing products grows faster for the first and third experiments than for the second and the fourth (table 10).

This is because more rapid growth of modern manufacturing sector leads to greater increase in imports of machinery and equipment. In other words, the indigenous manufacturing sector plays an important role in the efficient use of capital goods.

The results for the fifth experiment are also presented in these tables. The increases in the rates of growth of PI and PIM result in a smaller decrease in PO2/PO1, which in turn cause the export of modern manufacturing products to decrease (table 12). Furthermore the import of modern manufacturing goods increases drastically, which might increase the deficit in the balance of trade. Thus it might be said that Japan was much benefited from the stability of the prices of imported goods during her semi-industrialized phase.

The results in table 5 indicate that the wage differential in manufacturing (if we take the ratio of wages in the modern manufacturing sector to wages in the indigenous manufacturing sector) which was 1.4 in 1955 narrowed in 1968 for all the experiments. In 1968 the differential is wider for experiments 2 and 4 than for experiments 1 and 3, which implies that wage differentials are wider when a labor surplus situation prevails.

Table 5 also shows that wage differentials remained almost stable up to 1960, and then began to narrow rapidly. This is in accordance with the changes in N2/N1 presented in table 2. Therefore wage differentials seem to narrow when the demand for labor in the modern manufacturing sector is more active.

V. Summary

It has been shown that in the framework developed in this paper: (1) There is a marked difference in the rate of technical progress between the indigenous and modern manufacturing sectors. (2) The rapidity of the rate of technical progress in the modern manufacturing sector contributes to promote the import substitution with respect to modern manufacturing products. Thus, as stated in Section II, the estimated percentage change of imports associated with one percent change of domestic demand is smaller than unity for modern manufacturing products, which seems to be the most important factor that makes it possible for the Japanese economy to sustain a high rate of economic growth without causing serious balance of payments difficulties. (3) As was pointed out in the previous section, the constancy of the prices of imported goods is another important factor that made Japan succeed in escaping from serious balance of payments difficulties. (4) It is changes on the demand side in the main that have caused changes in the structure of Japanese industries. That is the estimated income elasticity of modern manufacturing products is much higher than that of indigenous manufacturing products. Thus the center of gravity of the industrial sector has gradually shifted in the direction of the modern manufacturing sector. (5) The indigenous manufacturing sector contributed both to greater employment and to the efficient use of capital goods. (6) In the face of the rapid expansion of the modern manufacturing sector wage differentials between modern and indigenous manufacturing sectors narrowed more rapidly.

It is, of course, true that the industrialization strategy of semi-industrialized countries of richer natural resources, such as Latin American countries differs from that of East Asian countries. However, our quantitative investigations of Japan's postwar economy have thrown some light upon many leading development issues common to all the semi-industrialized countries.

Footnotes

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[1] Economic Planning Agency, "Long-Term Model II," in Econometric Models for Medium Term Economic Plan 1964-1968, A Report by the Committee on Econometric Methods (Tokyo: Ōkurashō Insatsukyoku, 1965); L. Klein, "A Model of Japanese Economic Growth, 1878-1937," Econometrica 29 (July 1961) 19-44; L. Klein and Y. Shinkai, "An Econometric Model of Japan, 1930-1959," International Economic Review 4 (Jan. 1963) 277-292; H. Ueno, "A Long-Term Model of the Japanese Economy, 1920-1958," International Economic Review 4 (May 1963) 171-193; H. Ueno and S. Kinoshita, "A Simulation Experiment for Growth with a Long-Term Model of Japan," International Economic Review 9 (Feb. 1968) 114-148.

[2] Ueno and Kinoshita subdivided the manufacturing sector into two subsectors: textile industry and heavy industry.

[3] A. C. Kelley, and J. G. Williamson, Lessons from Japanese Development: An Analytical Economic History (Chicago: University of Chicago Press, 1973).

[4] S. Ichimura, L. Klein, S. Koizumi, K. Sato, and Y. Shinkai, "A Quarterly Econometric Model of Japan, 1952-1959," Osaka Economic Papers 14 (Nov. 1964) 19-44.

[5] K. Ohkawa, M. Shinohara, and M. Umemura, _Estimates of Long Term Economic Statistics of Japan since 1868_ (Tokyo: Tōyō Keizai Shinpō Sha, 1966-72).

[6] H. Rosovsky and K. Ohkawa, "The Indigenous Components in the Modern Japanese Economy," _Economic Development and Cultural Change_ 9 (April 1961) 476-501.

[7] K. Ohkawa and S. Motai, _Small-Medium Scale Manufacturing Industry: Further Notes on Japan's Case_ (Tokyo: International Development Center of Japan, 1978).

[8] For investment functions endogenous variables affect other endogenous variables only with a time lag, and ordinary least squares is used to estimate these equations.

[9] See also K. Yoshihara, "Long-Term Models of the Japanese Economy," _Economic Studies Quarterly_ 20 (Dec. 1969) 41-64, in which a systematic survey of these contributions is given.

[10] As for indigenous manufacturing goods, the short-run income elasticity of imports is simply 0.2899, while the long-run elasticity is 0.2899 / (1 - 0.7290) = 1.070.

TABLE 1

SIMULATION RESULTS (S2/S1)

	Actual Values	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.342	—	—	—	—	—	—
1954	1.370	—	—	—	—	—	—
1955	1.361	1.394	1.395	1.385	1.395	1.393	1.380
1956	1.558	1.382	1.384	1.346	1.384	1.380	1.393
1957	1.701	1.478	1.483	1.399	1.481	1.475	1.497
1958	1.604	1.594	1.621	1.507	1.599	1.584	1.604
1959	1.820	1.676	1.743	1.571	1.684	1.652	1.655
1960	2.213	1.896	1.999	1.786	1.918	1.868	1.863
1961	2.305	2.106	2.259	1.974	2.150	2.052	2.066
1962	2.284	2.380	2.645	2.219	2.449	2.252	2.324
1963	2.293	2.615	2.953	2.402	2.744	2.394	2.533
1964	2.548	2.949	3.475	2.674	3.149	2.599	2.875
1965	2.521	3.001	3.580	2.665	3.292	2.616	2.929
1966	2.652	3.034	3.627	2.644	3.354	2.614	2.956
1967	2.920	3.106	3.748	2.666	3.457	2.656	3.009
1968	3.189	3.097	3.781	2.603	3.477	2.655	2.986

TABLE 2

SIMULATION RESULTS (N2/N1)

	Actual Values	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.954	—	—	—	—	—	—
1954	1.905	—	—	—	—	—	—
1955	1.865	1.753	1.757	1.730	1.758	1.750	1.724
1956	1.957	1.583	1.587	1.508	1.586	1.580	1.597
1957	2.058	1.650	1.661	1.507	1.654	1.647	1.690
1958	2.054	1.754	1.818	1.551	1.758	1.699	1.734
1959	2.092	1.736	1.861	1.552	1.743	1.708	1.698
1960	2.189	1.979	2.181	1.778	2.004	1.914	1.912
1961	2.229	2.185	2.468	1.962	2.238	2.109	2.114
1962	2.221	2.454	2.890	2.315	2.500	2.288	2.365
1963	2.152	2.584	3.034	2.284	2.690	2.335	2.467
1964	2.175	2.805	3.467	2.473	2.955	2.449	2.729
1965	2.164	2.582	3.181	2.226	2.815	2.250	2.523
1966	2.115	2.366	2.881	1.988	2.590	2.047	2.312
1967	2.153	2.209	2.691	1.801	2.405	1.961	2.141
1968	2.191	2.044	2.511	1.652	2.229	1.775	1.966

TABLE 3

SIMULATION RESULTS ([S2:SO]/S1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.730	—	—	—	—	—	—
1954	1.765	—	—	—	—	—	—
1955	1.745	1.771	1.772	1.764	1.772	1.770	1.756
1956	1.961	1.771	1.773	1.740	1.774	1.768	1.783
1957	2.119	1.877	1.881	1.801	1.881	1.873	1.894
1958	2.030	2.011	2.032	1.922	2.017	1.998	2.021
1959	2.253	2.099	2.161	1.994	2.109	2.072	2.080
1960	2.579	2.334	2.436	2.223	2.360	2.302	2.303
1961	2.766	2.566	2.723	2.430	2.618	2.504	2.528
1962	2.758	2.871	3.154	2.699	2.952	2.721	2.815
1963	2.770	3.130	3.496	2.901	3.283	2.872	3.047
1964	3.044	3.502	4.082	3.205	3.736	3.093	3.430
1965	3.035	3.558	4.200	3.195	3.898	3.105	3.489
1966	3.173	3.593	4.250	3.174	3.970	3.099	3.519
1967	3.454	3.677	4.384	3.206	4.091	3.149	3.583
1968	3.748	3.663	4.413	3.137	4.110	3.142	3.555

TABLE 4

SIMULATION RESULTS ([N2:NO]/N1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	2.853	—	—	—	—	—	—
1954	2.777	—	—	—	—	—	—
1955	2.718	2.806	2.808	2.792	2.813	2.801	2.772
1956	2.811	2.644	2.649	2.583	2.650	2.639	2.669
1957	2.915	2.713	2.721	2.563	2.719	2.707	2.749
1958	2.944	2.852	2.902	2.618	2.859	2.789	2.832
1959	2.996	2.816	2.940	2.593	2.827	2.773	2.779
1960	3.082	3.097	3.321	2.851	3.128	3.006	3.031
1961	3.130	3.375	3.709	3.093	3.449	3.272	3.305
1962	3.114	3.750	4.297	3.596	3.821	3.519	3.697
1963	3.014	3.943	4.527	3.555	4.104	3.589	3.820
1964	3.075	4.258	5.138	3.834	4.487	3.749	4.195
1965	3.072	3.980	4.786	3.546	4.330	3.494	3.940
1966	3.007	3.707	4.399	3.232	4.049	3.217	3.672
1967	3.064	3.514	4.146	3.042	3.817	3.122	3.463
1968	3.100	3.271	3.874	2.791	3.555	2.851	3.209

TABLE 5

SIMULATION RESULTS (W2/W1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.395	—	—	—	—	—	—
1954	1.392	—	—	—	—	—	—
1955	1.400	1.419	1.419	1.420	1.417	1.420	1.417
1956	1.445	1.423	1.413	1.414	1.410	1.415	1.416
1957	1.444	1.404	1.404	1.406	1.399	1.408	1.408
1958	1.405	1.411	1.410	1.417	1.404	1.419	1.412
1959	1.402	1.410	1.407	1.416	1.401	1.420	1.408
1960	1.405	1.406	1.399	1.416	1.390	1.423	1.405
1961	1.366	1.380	1.356	1.359	1.348	1.414	1.379
1962	1.292	1.326	1.264	1.356	1.268	1.402	1.327
1963	1.266	1.258	1.162	1.305	1.170	1.385	1.260
1964	1.259	1.192	1.067	1.256	1.080	1.378	1.191
1965	1.236	1.139	1.007	1.212	1.012	1.351	1.138
1966	1.250	1.109	0.977	1.186	0.973	1.333	1.107
1967	1.255	1.095	0.961	1.174	0.949	1.328	1.091
1968	1.190	1.071	0.939	1.151	0.920	1.311	1.068

TABLE 6

SIMULATION RESULTS [W2:WO]/W1

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.506	—	—	—	—	—	—
1954	1.512	—	—	—	—	—	—
1955	1.542	1.558	1.558	1.561	1.556	1.560	1.558
1956	1.573	1.563	1.563	1.569	1.559	1.566	1.566
1957	1.572	1.551	1.550	1.561	1.546	1.556	1.553
1958	1.516	1.554	1.548	1.567	1.545	1.565	1.556
1959	1.503	1.551	1.542	1.564	1.540	1.563	1.553
1960	1.496	1.537	1.523	1.552	1.519	1.557	1.540
1961	1.447	1.507	1.475	1.529	1.471	1.546	1.511
1962	1.382	1.447	1.370	1.485	1.381	1.534	1.454
1963	1.346	1.373	1.257	1.431	1.273	1.520	1.383
1964	1.340	1.299	1.147	1.376	1.172	1.513	1.305
1965	1.323	1.252	1.090	1.342	1.103	1.494	1.257
1966	1.336	1.227	1.063	1.323	1.066	1.484	1.231
1967	1.327	1.215	1.049	1.315	1.044	1.482	1.220
1968	1.286	1.195	1.029	1.298	1.018	1.474	1.200

TABLE 7

SIMULATION RESULTS (PO2/PO1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	1.363	—	—	—	—	—	—
1954	1.218	—	—	—	—	—	—
1955	1.230	1.245	1.244	1.246	1.244	1.246	1.286
1956	1.349	1.312	1.312	1.313	1.310	1.314	1.275
1957	1.336	1.310	1.310	1.313	1.307	1.313	1.263
1958	1.243	1.262	1.260	1.262	1.256	1.264	1.253
1959	1.241	1.213	1.211	1.218	1.206	1.221	1.244
1960	1.185	1.180	1.174	1.185	1.168	1.191	1.231
1961	1.140	1.142	1.126	1.153	1.120	1.165	1.204
1962	1.098	1.086	1.042	1.107	1.050	1.138	1.160
1963	1.059	1.019	0.960	1.052	0.964	1.105	1.106
1964	1.040	0.960	0.823	1.003	0.890	1.084	1.046
1965	1.000	0.919	0.828	0.971	0.834	1.060	1.002
1966	0.962	0.891	0.801	0.938	0.799	1.039	0.975
1967	0.938	0.865	0.776	0.918	0.769	1.018	0.956
1968	0.892	0.843	0.754	0.896	0.742	0.997	0.935

TABLE 8

SIMULATION RESULTS (YD)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	4081.7	—	—	—	—	—	—
1954	4552.5	—	—	—	—	—	—
1955	5160.5	4343.0	4345.1	4328.2	4342.5	4343.3	4362.9
1956	5627.8	5018.3	5023.1	4946.4	5018.1	5018.6	5020.6
1957	6217.4	5734.3	5746.8	5558.0	5733.0	5735.3	5682.2
1958	6652.4	6452.2	6520.5	6166.8	6449.1	6431.1	6397.7
1959	7460.5	7075.4	7259.7	6741.1	7070.6	7063.5	7088.3
1960	8634.7	8168.1	8505.8	7744.9	8174.7	8124.2	8220.6
1961	10160.4	9904.4	10428.5	9396.2	9917.9	9828.1	10039.7
1962	11656.0	12008.3	12755.3	11411.7	12007.7	11883.4	12267.4
1963	13595.6	14192.1	15140.1	13494.5	14174.5	14032.1	14622.3
1964	15583.1	16628.8	17791.9	15802.3	16582.4	16461.8	17295.5
1965	17628.8	19096.0	20412.4	18029.1	19028.6	18992.5	19966.3
1966	20205.3	21105.8	22475.9	19831.7	20992.1	21167.0	22103.7
1967	23636.3	23117.5	24656.6	21653.1	23012.7	23339.4	24294.4
1968	27380.9	25606.2	27282.5	23781.3	25412.6	25835.4	26809.2

TABLE 9

SIMULATION RESULTS (I1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	130.2	—	—	—	—	—	—
1954	136.3	—	—	—	—	—	—
1955	133.1	122.1	122.1	122.0	122.1	122.1	122.0
1956	113.8	114.5	114.6	114.1	114.4	114.6	114.5
1957	101.0	112.3	112.3	111.2	112.1	112.4	112.5
1958	107.8	113.8	114.1	111.8	113.5	114.1	113.7
1959	96.5	117.3	118.2	114.3	116.8	117.7	116.7
1960	110.8	123.9	125.8	120.3	123.2	124.4	123.0
1961	145.0	134.1	136.6	129.9	132.7	134.9	133.1
1962	157.3	146.8	148.9	142.8	144.3	149.2	146.1
1963	196.9	183.6	184.9	179.9	178.3	190.1	183.6
1964	231.9	220.0	217.7	217.6	210.3	234.1	220.8
1965	268.0	256.1	249.0	255.4	239.7	280.3	257.9
1966	314.8	290.0	277.9	291.1	266.2	326.1	292.9
1967	344.5	321.4	304.4	323.9	289.9	370.3	325.3
1968	376.0	352.1	330.6	355.7	312.6	413.3	356.6

TABLE 10

SIMULATION RESULTS (I2)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	246.8	—	—	—	—	—	—
1954	231.3	—	—	—	—	—	—
1955	221.9	217.7	212.8	212.1	212.8	212.7	256.3
1956	335.5	284.2	284.9	277.8	284.3	284.0	240.3
1957	532.1	352.1	353.0	330.7	352.3	351.9	278.6
1958	367.7	425.7	431.2	392.1	425.9	424.0	432.7
1959	458.2	388.2	405.2	352.9	388.5	383.2	465.9
1960	571.2	463.1	495.4	425.2	466.1	455.7	608.8
1961	830.4	586.0	639.0	538.8	592.9	572.0	822.0
1962	742.4	746.0	832.4	687.5	755.7	715.2	1120.6
1963	858.0	895.9	1008.0	823.8	915.1	846.2	1465.6
1964	1005.2	1063.5	1222.9	975.2	1092.2	989.6	1833.4
1965	873.7	1185.7	1364.3	1074.6	1232.4	1109.1	2065.2
1966	987.3	1290.9	1474.0	1156.3	1342.4	1209.8	2301.5
1967	1367.9	1334.8	1520.8	1181.0	1388.8	1253.8	2524.0
1968	1432.9	1403.6	1608.6	1227.1	1466.0	1323.2	2693.8

TABLE 11

SIMULATION RESULTS (X1)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	108.5	—	—	—	—	—	—
1954	138.8	—	—	—	—	—	—
1955	185.5	186.7	192.0	152.9	186.2	187.0	183.7
1956	191.7	221.5	218.5	155.8	220.3	222.5	225.4
1957	202.8	226.3	242.5	156.7	224.4	227.9	233.3
1958	232.6	201.8	287.8	165.4	199.3	206.2	198.2
1959	296.2	241.3	332.4	170.9	237.0	247.0	231.5
1960	281.1	264.9	370.7	171.3	257.1	271.8	253.2
1961	269.6	267.9	391.2	168.6	251.6	283.4	255.1
1962	257.6	253.4	365.0	159.0	230.0	292.4	242.7
1963	266.2	257.9	347.4	147.1	218.3	333.8	248.8
1964	304.2	260.9	301.6	134.3	207.0	385.0	246.3
1965	347.6	274.0	297.0	126.1	199.6	433.5	258.5
1966	386.7	285.9	315.0	121.4	199.7	476.0	269.3
1967	384.9	291.8	343.6	119.9	198.0	498.7	273.4
1968	425.0	326.4	368.8	116.5	215.5	570.1	305.6

TABLE 12

SIMULATION RESULTS (X2)

	Actual Value	Historical Simulation	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1953	325.5	—	—	—	—	—	—
1954	456.9	—	—	—	—	—	—
1955	571.1	579.5	591.8	500.1	579.5	579.5	566.2
1956	693.7	699.2	696.7	513.5	699.1	699.3	708.8
1957	766.7	781.9	822.4	534.1	781.7	782.1	808.9
1958	768.0	762.9	1007.5	578.2	762.6	763.3	769.3
1959	895.4	893.4	1240.2	629.3	892.9	894.1	873.7
1960	1062.8	1053.8	1509.0	677.5	1052.8	1054.7	1009.6
1961	1159.7	1193.4	1820.6	723.9	1191.2	1195.5	1128.0
1962	1370.2	1328.8	2183.3	770.9	1324.8	1334.4	1241.4
1963	1533.0	1591.6	2621.5	1224.3	1583.5	1604.1	1467.3
1964	1881.2	1936.2	3132.2	872.7	1922.0	1960.0	1768.3
1965	2434.6	2370.5	3731.3	922.8	2346.3	2407.2	2157.7
1966	2922.2	2810.5	4459.1	977.0	2776.4	2860.1	2549.1
1967	3138.8	3189.9	5352.9	1038.6	3147.0	3250.6	2868.4
1968	3957.0	3849.2	6406.7	1100.4	3793.3	3926.5	3444.0