USE OF NATIONAL ACCOUNTS FOR A SHORT-TERM ECONOMETRIC MODEL: 1954–1966

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A quarterly macro-econometric model of Japan's postwar economy has been constructed for the period 1954–1965 FY on the basis of standardized quarterly national income accounts. The model is designed for facilitating short-term economic forecasting and formulating adequate fiscal and monetary policy. Longer-term factors such as labor mobility, technical progress, etc., were also considered in the model.

The model consists of fifty-three equations related to most of the macroeconomic variables in both money and real terms, and the equations were estimated in principle by the limited information maximum likelihood method. Principal exogenous variables related to policy instruments are government expenditures including transfers, parameters of tax functions, interest rate, and prices and fares controlled by the government, etc. In formulating the model, non-linear specifications were used whenever found necessary.

Results of our testing on its predictive capability indicated fairly satisfactory performances for our observation period and also for 1966 FY. Multipliers related to fiscal and monetary policy were also obtained, indicating the dynamic characteristics of the Japanese economy, in particular, represented by dynamic business fixed investment, as compared with corresponding multipliers of the U.S. models.

Although the model is exploratory and to serve as a core for a more disaggregated "Master Model," the usefulness of the model for our purposes and the workability of our quarterly national accounts data for model-building have been recognized. The quarterly data, however, still remain to be improved especially in regard to consistency between income and expenditure and integration with flow-of-funds accounts.

1. INTRODUCTION[1]

The rapid economic growth of the postwar Japan's economy has been accompanied by fairly unstable business fluctuations varying from 3 to 15% in real terms of GNP. The need to stabilize the economy with the aid of more appropriate government policies has increasingly been stressed by various circles. Econometric research has also been dealing with this problem in recent years with quarterly or semi-annual models based on national accounts and the related statistical information [4, 9]. A substantial revision of our national accounts made in 1966 by the Economic Research Institute, Economic Planning Agency (EPA), however, forced the research workers to discontinue their projects on model-building based on the old data and to make a fresh start on this new statistical series. They are superior to the old series in terms of international comparability of concepts, consistency with interindustry tables and statistical accuracy especially related to quarterly movement.

The quarterly model described in the present paper is one of those based on these new data and is designed to serve as a "pilot model" for a more disaggregated "master model" with about a hundred equations. This quarterly

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model project has been under way since 1966 as a joint project of related studies in the Economic Research Institute, EPA. Accordingly, the present paper is of the nature of an interim report on our short-term econometric research project.

At the beginning, it will be convenient to summarize the features of the present model, in comparison with other models of Japan.

1. The present model fully covers the quarterly national income accounts of the EPA, consisting of six transaction accounts based on the UN-SNA formula. All of our previous quarterly models, however, dealt only with expenditures and some price deflators, thus disregarding income distribution, taxes and other transfers. The transactions are all seasonally adjusted at annual rates in view of the convenience in short-term economic forecasting. The transactions related to expenditures are expressed in terms of both current and constant prices, while others are only in current prices, as in the case of the Medium-Term Model of the EPA [1], the Osaka University quarterly model [4] and the several U.S. quarterly models [2, 6, 7, 8].

2. The present model contains fifty-three equations, of which thirty are identities. Thus, the size of the model is almost the same as that of the Medium-Term Model, while the disaggregation is now being done in the "master model", especially for investment, consumption, prices and wage rates, etc.

3. As in the case of the Medium-Term Model, non-linear specifications were used among endogenous variables whenever it was found necessary from theoretical and statistical point of view. The block-wise iteration method was employed to solve the entire system.

4. Although the present model is designed mostly for short-term management of aggregate demand through fiscal and monetary policy, efforts were also made to incorporate longer-run factors such as labor mobility from agriculture to industry, technical progress induced by fixed investment, rate of increase in growth potential, etc.

5. Various tests and simulations were made on the predictive qualities and workability of the model for projection and policy formulation.

II. The Model

First it must be noted that the present model is rather exploratory and that further modification will be made as our research progresses, though its fundamental structure will remain unchanged.

The equations of the model were estimated for the period 1954–1966 covering forty-eight quarters on the Japanese fiscal year basis[2], i.e. from the second quarter of 1954 through the first quarter of 1966.

The estimates were obtained in principle by the limited-information maximum-likelihood (LI), but two-stage least-squares (TSLS) estimates were used exceptionally in cases where the LI estimates were unstable due to multicollinearity[3]. Needless to say, for those equations explained only by exogenous and/

[2]The Japanese fiscal year relates to the twelve months from April to the following March.

[3]Before estimating the structural parameters the equations were grouped into three blocks: (1) expenditure and employment block, (2) price and wage block and (3) income distribution block. Our simultaneous estimation of structural parameters was made separately for each block in view of the large number of exogenous and predetermined variables.

or predetermined variables, ordinary least squares (OLS) were used to derive the estimates.

For all structural equations indicated below, the numbers in parentheses are the standard error estimate of the parameter estimates and R^2 is the coefficient of determination, S is the standard error estimate of the equation, and d is the Durbin-Watson statistic.

A. *Structural Equations*

Methods of estimation

LI: Limited information maximum likelihood

TSLS: Two stage least squares

OLS: Ordinary least squares

(1) Private consumption expenditure (OLS)

$$C = \underset{}{786.15} + \underset{(0.17932)}{0.39366}\left[\frac{1}{4}\sum_{i=0}^{3} C_{-i}\right]_{-1} + \underset{(0.18447)}{0.58221}\left[\frac{Y_w + T_{gp} - S_i}{p_c}\right]_{-1}$$

$$+ \underset{(0.07656)}{0.24416}\left[\frac{Y_r + Y_u - T_p}{p_c}\right]_{-1}. \qquad R^2 = 0.999 \quad S = 93.7 \quad d = 1.55$$

(2) Private housing investment (OLS)

$$I_h = \underset{}{89.88} + \underset{(0.09875)}{0.65776}\, I_{h-1} + \underset{(0.010802)}{0.040513}\left[\frac{Y_d}{p_c}\right]_{-1} - \underset{(105.45)p_c}{273.24}\,\frac{p_h}{}.$$

$$R^2 = 0.995 \qquad S = 23.7 \qquad d = 2.11$$

(3) Gross fixed investment by private enterprises (OLS)

$$\frac{I_p}{V} = \underset{}{0.3710} - \underset{(0.02477)}{0.14771}\left[\frac{1}{4}\sum_{i=0}^{3}\left(\frac{K_p}{V}\right)_{-i}\right]_{-1} + \underset{(0.0999)}{1.1552}\left[\frac{1}{4}\sum_{i=0}^{3}\left(\frac{Y_c + A_c}{pV + A_p + A_g}\right)_{-i}\right]_{-1}$$

$$+ \underset{(0.008223)}{0.031135}\left[\frac{(S_c + A_c + D_p)}{(S_c + A_c + D_p)_{-2}}\right]_{-1} - \underset{(0.013200)}{0.063816}\, i + \underset{(0.016175)}{0.053051}\left[\frac{p}{p_i}\right]_{-2}.$$

$$R^2 = 0.990 \qquad S = 0.0054 \qquad d = 2.11$$

(4) Change in inventories of private enterprises (LI)

$$J_p = \underset{}{5781.2} + \underset{(0.05154)}{0.20700}\,[V + M] - \underset{(0.16269)}{0.57451}\, K_{jp-1} - \underset{(2696.5)}{4014.9}\left[\frac{p_j}{p_{j-1}}\right]$$

$$- \underset{(0.09381)}{0.26219}\left[\sum_{i=0}^{1}(E_c - M_c)_{-i}\right] + \underset{(2172.57)}{3440.13}\left[\frac{1}{4}\sum_{i=0}^{3}\left(\frac{L_c}{pV}\right)_{-i}\right]_{-1}$$

$$- \underset{(529.7)}{1013.9}\, i_{-1} + \underset{(0.08644)}{0.24908}\left[\frac{\epsilon}{p}\right]. \qquad S = 155.6 \qquad d = 1.35$$

(5) Commodity exports (OLS)

$$\log_{10}E_c = \underset{(0.0687)}{-0.37857} + \underset{(0.33249)}{1.8693}\log_{10}T_w - \underset{}{0.30435}\log_{10}\left[\frac{p_e}{p_{ei}{}^w}\right]_{-1}$$

$$+ \underset{(0.17367)}{0.58805}\log_{10}\left[\frac{K_{jp-1}}{V}\right]_{-1}.$$

$$R^2 = 0.991 \qquad S = 0.0214 \qquad d = 1.39$$

(6) Commodity imports (LI)

$$M_c = \underset{(0.01991)}{-215.87} + \underset{(0.408)}{0.11798}\,J_p + \underset{(138.66)}{13.620}(O) - 523.39\,[i - i_{-2}]_{-1}$$

$$- \underset{(10.311)}{28.183}\,t_{ic} + \underset{(235.24)}{341.23}\left[\frac{p_j}{p_m}\right]. \qquad S = 41.9 \qquad d = 1.67$$

(7) Index of mining and manufacturing production (LI)

$$O = \underset{(0.001863)}{-18.61} + \underset{(0.002906)}{0.010696}\,J_p + \underset{(0.001288)}{0.014496}\,E_c + 0.008893\,I_p +$$

$$+ \underset{(0.000796)}{0.005515}\,[C + C_g + I_g + I_h].$$

$$S = 2.57 \qquad d = 1.96$$

(8) Index of capacity utilization (LI)

$$\rho = \underset{(7.925)}{-94.06} + \underset{(0.01236)}{97.595}\left[\frac{O}{O_{-1}}\right] - \underset{(0.03100)}{0.05737}\left[\frac{I_p - I_{p-4}}{I_{p-4}}\right] + 0.94305\,\rho_{-1}$$

$$S = 1.22 \qquad d = 2.17$$

Note: $\dfrac{I_p - I_{p-4}}{I_{p-4}}$: %.

(9) Production function (LI)

$$\log_{10}\left[\frac{V}{hL}\right] = \underset{(0.07043)}{-1.2127} + \underset{(0.000707)}{0.59725}\log_{10}\left[\frac{\rho K_p}{hL}\right] + 0.003164\,t.$$

$$S = 0.0127 \qquad d = 0.97$$

(10) Employees (OLS)

$$L_w = \underset{(0.0013795)}{0.273} - \underset{(0.0049091)}{0.0038341}\,w_{-1} + \underset{(0.08443)}{0.0073697}\,O_{-1} + \underset{(0.01841)}{0.31817}\,N_L + 0.22498\,t.$$

$$R^2 = 0.998 \qquad S = 0.174 \qquad d = 1.11$$

(11) Unemployment (LI)

$$U = \underset{(0.02421)}{-1.942} + \underset{(0.013209)}{0.11673}\,N_L - \underset{(0.001358)}{0.089529}\,L_w - 0.008020\,\rho_{-2}.$$

$$S = 0.044 \qquad d = 1.34$$

(12) Wage income per employee (LI)

$$\left[\frac{w - w_{-4}}{w_{-4}}\right] = \underset{(0.16730)}{-4.637 + 0.19613}\left[\frac{p_c - p_{c-4}}{p_{c-4}}\right] \underset{(2.0021)}{- 8.1520}\left[\frac{\sum_{i=0}^{3} U_{-i}}{\sum_{i=0}^{3} N_{L-i}}\right]_{-2}$$

$$\underset{(0.14618)}{+ 0.33431}\left[\frac{L_{ua}}{N_L}\right]_{-2} \underset{(0.18022)}{+ 1.10845}\left[\frac{\sum_{i=0}^{1} (Y_c + A_c)_{-i}}{\sum_{i=0}^{1} (Y + A_p + A_g)_{-i}}\right].$$

$S = 1.79 \qquad d = 1.96$

Note. All the variables are in percentages.

(13) Implicit deflator for private consumption expenditure (LI)

$$\left[\frac{p_c - p_{c-4}}{p_{c-4}}\right] = \underset{(0.05151)}{-0.985 + 0.33454}\left[\frac{w - w_{-4}}{w_{-4}}\right] \underset{(0.03516)}{- 0.06811}\left[\frac{\eta - \eta_{-4}}{\eta_{-4}}\right]$$

$$\underset{(0.08679)}{+ 0.17165}\left[\frac{p_p - p_{p-4}}{p_{p-4}}\right] \underset{(0.05288)}{+ 0.16976}\left[\frac{p_j - p_{j-4}}{p_{j-4}}\right]_{-1}$$

$$\underset{(0.09095)}{+ 0.35967}\left[\frac{p_p - p_{c-4}}{p_{c-4}}\right]_{-1}. \qquad S = 0.94 \qquad d = 1.53$$

Note. The variables are in percentages.

(14) Implicit deflator for general government expenditure (TSLS)

$$p_{cg} = \underset{(0.0000338)}{0.0374 + 0.0025772}\, w \underset{(0.15640)}{+ 0.26655}\, p_j. \qquad S = 2.33 \qquad d = 0.94$$

(15) Implicit deflator for private housing investment (LI)

$$\left[\frac{p_h - p_{h-4}}{p_{h-4}}\right] = \underset{(0.14591)}{-4.164 + 0.60140}\left[\frac{w - w_{-4}}{w_{-4}}\right] \underset{(0.01266)}{+ 0.48548}\left[\frac{p_i - p_{i-4}}{p_{i-4}}\right]$$

$$\underset{(0.08776)}{+ 0.45327}\left[\frac{p_h - p_{h-4}}{p_{h-4}}\right]_{-1}. \qquad S = 3.38 \qquad d = 1.42$$

Note. The variables are in percentages.

(16) Implicit deflator for gross fixed investment by private enterprises (OLS)

$$p_i = \underset{(0.05881)}{0.4987 - 0.20097}\left[\frac{4K_p}{\sum_{i=0}^{3} V_{-i}}\right]_{-2} \underset{(0.050586)}{+ 0.080444}\left[\frac{\sum_{i=0}^{3} w_{-i}}{\sum_{i=0}^{3} \eta_{-i}}\right]_{-1}$$

$$\underset{(0.11936)}{+ 0.73378}\left[\frac{p_m M}{V}\right] \underset{(0.05730)}{+ 0.70122}\, p_{i-1}.$$

$R^2 = 0.988 \qquad S = 0.86 \qquad d = 1.06$

(17) Implicit deflator for gross fixed investment by government (TSLS)

$$\left[\frac{p_{ig}-p_{ig-4}}{p_{ig-4}}\right] = \underset{}{-3.510} + \underset{(0.08619)}{0.50386}\left[\frac{w-w_{-4}}{w_{-4}}\right] + \underset{(0.09264)}{0.70492}\left[\frac{p_i-p_{i-4}}{p_{i-4}}\right]$$

$$+ \underset{(0.09937)}{0.19285}\left[\frac{p_{ig}-p_{ig-4}}{p_{ig-4}}\right]_{-1}. \qquad S = 1.64 \qquad d = 1.44$$

Note. The variables are in percentages.

(18) Implicit deflator for inventories of private enterprises (OLS)

$$p_j = \underset{}{0.5586} - \underset{(0.04035)}{0.09554}\left[\frac{4K_p}{\sum_{i=0}^{3} V_{-i}}\right]_{-2} - \underset{(0.08012)}{0.36379}\left[\frac{4K_{jp}}{\sum_{i=0}^{3} V_{-i}}\right]_{-1}$$

$$+ \underset{(0.05262)}{0.16489}\left[\frac{\sum_{0}^{3} w_{-i}}{\sum_{0}^{3} \eta_{-i}}\right]_{-2} + \underset{(0.10615)}{0.76725}\left[\frac{p_m M}{V}\right] + \underset{(0.06182)}{0.49971}\, p_{j-1}.$$

$$R^2 = 0.920 \qquad S = 0.64 \qquad d = 0.83$$

(19) Implicit deflator for exports of goods and services and factor income from abroad (OLS)

$$\left[\frac{p_e-p_{e-4}}{p_{e-4}}\right] = \underset{}{0.313} + \underset{(0.01604)}{0.12522}\left[\frac{(p_m M/V)-(p_m M/V)_{-4}}{(p_m M/V)_{-4}}\right]$$

$$+ \underset{(0.07672)}{0.12781}\left[\frac{\left(\sum_{i=0}^{3} w_{-i}\Big/\sum_{i=0}^{3}\eta_{-i}\right)-\left(\sum_{i=0}^{3} w_{-i}\Big/\sum_{i=0}^{3}\eta_{-i}\right)_{-4}}{\left(\sum_{i=0}^{3} w_{-i}\Big/\sum_{i=0}^{3}\eta_{-i}\right)_{-4}}\right]_{-4}$$

$$+ \underset{(0.016885)}{0.075318}\left[\frac{I_p-I_{p-4}}{I_{p-4}}\right]_{-4}.$$

$$R^2 = 0.765 \qquad S = 1.66 \qquad d = 1.76$$

Note. The variables are in percentages.

(20) Personal rental interest income (excluding dividends) (LI)

$$Y_r - D_i = \underset{}{-351.70} + \underset{(0.046200)}{0.094358}\, Y + \underset{(2.0238)}{1.8853}\, t. \qquad S = 44.7 \qquad d = 0.41$$

(21) Personal dividends (LI)

$$D_i = \underset{}{-0.698} + \underset{(0.007600)}{0.023038}\,(Y_c - T_c) + \underset{(0.02456)}{0.94876}\, D_{i-1}.$$

$$S = 10.1 \qquad d = 2.42$$

(22) Corporate income (OLS)

$$\left[\frac{Y_c + A_c}{Y + A_p + A_g}\right] = \underset{}{-0.095166} - \underset{(0.09335)}{0.13219}\left[\frac{Y_w}{pV}\right] + \underset{(0.02829)}{0.25885}\left[\sum_{i=0}^{1}\left(\frac{I_p}{V}\right)_{-i}\right]_{-1}$$

$$- \underset{(0.015356)}{0.028080}\left[\sum_{i=0}^{1} i_{-i}\right] + \underset{(0.08062)}{0.36230}\left[\frac{\left(\sum_{i=0}^{2} 0_{-i}\right)}{\left(\sum_{i=0}^{2} 0_{-i}\right)_{-1}}\right]$$

$$- \underset{(0.11735)}{0.21633}\left[\frac{K_{jp}}{V}\right].$$

$$R^2 = 0.926 \qquad S = 0.0066 \qquad d = 1.04$$

(23) Inventory valuation adjustment in private incorporated enterprises (OLS)

$$A_c = \underset{}{-12.208} + \underset{(0.03869)}{0.73886}\, A_p.$$

$$R^2 = 0.888 \qquad S = 49.2 \qquad d = 2.06$$

(Equation for reference)

Direct taxes and charges on households and private non-profit institutions.

$$T_p = \underset{}{-199.61} + \underset{(0.01509)}{0.13378}\, Y_{w-1} + \underset{(0.010643)}{0.042476}\left[\sum_{i=0}^{2}(Y_u + Y_r)_{-i}\right]_{-3} - T_p'$$

$$R^2 = 0.999 \qquad S = 21.9 \qquad d = 1.82$$

Note. Only used for extrapolation and multiplier simulation, instead of Equation (46).

Identities:

(24) $E = E_0 + E_c$

(25) $M = M_0 + M_c$

(26) $V = C + C_g + I_h + I_p + I_g + J_p + J_g + E - M$

(27) $L = N_L - U$

(28) $L_u = L - L_w$

(29) $K_p = K_{p-1} + \frac{1}{4}I_p - \frac{1}{4}R$

(30) $K_{jp} = K_{jp-1} + \frac{1}{4}J_p$

(31) $K_{jg} = K_{jg-1} + \frac{1}{4}J_g$

(32) $A_p = 4[p_j K_j - (p_j K_j)_{-1}] - p_j J_p$

(33) $A_g = 4[p_{jg} K_{jg} - (p_{jg} K_{jg})_{-1}] - p_{jg} J_g$

(34) $pV = p_c C + p_{cg} C_g + p_h I_h + p_i I_p + p_{ig} I_g + p_j J_p + p_{jg} J_g + p_e E - p_m M$

Note. $p_{cg}C_g$, $p_{jg}J_g$ and $p_{ig}I_g$ are exogenous variables.

(35) $Y_w = w \cdot L_w$

(36) $Y_u = Y - Y_w - Y_r - Y_c - Y_g$

(37) $S_c = Y_c - T_c - D_i$

(38) $Y = pV - T_i + S_b - D_p - D_g - D_h - \epsilon$

(39) $Y_p = Y_w + Y_u + Y_r + T_{gp} + T_{ap}$

(40) $Y_d = Y_p - T_p - S_i - T_{pa}$

(41) $S_p = Y_p - (p_c C + T_p + S_i + T_{pa})$

(42) $D_p = \alpha_1 \cdot (p_i K_p)_{-1}$

(43) $D_h = \alpha_2 \cdot (p_h K_h)_{-1}$

(44) $p_i K_p = (p_i K_p)_{-1} + \frac{1}{4} p_i I_p - \frac{1}{4} D_p$

(45) $p_h K_h = (p_h K_h)_{-1} + \frac{1}{4} p_h I_h - \frac{1}{4} D_h$

(46) $T_p = \beta_1 \cdot Y_p$

(47) $T_c = \beta_2 \cdot Y_c$

(48) $T_i - S_b = \beta_3 \cdot pV$

(49) $S = (T_i - S_b + T_c + T_p + Y_g + S_i + T_{ag}) - (p_{cg} C_g + T_{gp} + T_{ga})$

(50) $B_g = (S_g + D_g) - (p_{ig} I_g + p_{jg} J_g)$

(51) $B_a = p_e E - p_m M$

(52) $B_c = (S_c + D_p) - (p_i I_p + p_j J_p)$

(53) $\eta = \dfrac{V}{L}$

B. *List of Variables*

A_c: Inventory valuation adjustment in private incorporated enterprises, in current thousand million yen

A_g: Inventory valuation adjustment in government enterprises, in current thousand million yen

A_p: Inventory valuation adjustment in private enterprises, in current thousand million yen

B_a: Current balance in international balance of payments, in current thousand million yen

B_c: Balance of saving and capital formation in private enterprises, in current thousand million yen

B_g: Balance of saving and capital formation in government, in current thousand million yen

C: Private consumption expenditure, in 1960 thousand million yen

C_g: General government consumption expenditure, in 1960 thousand million yen

$*D_g$: Capital consumption allowances in government enterprises, in current thousand million yen

D_h: Capital consumption allowances for private dwellings, in current thousand million yen

D_i: Personal dividends, in current thousand million yen

D_p: Capital consumption allowances in private enterprises, in current thousand million yen

E: Exports of goods and services and factor income from abroad, in 1960 thousand million yen

E_c: Commodity exports, in 1960 thousand million yen

*E_0: Exports of services and factor income from abroad, in 1960 thousand million yen

*h: Index of total hours worked, 1960 = 100

*i: Average interest rate on loans of all banks (interest rate per diem) $\frac{1}{10000}$ (day)

I_g: Gross fixed investment by government, in 1960 thousand million yen

I_h: Private housing investment, in 1960 thousand million yen

I_p: Gross fixed investment by private enterprises, in 1960 thousand million yen

*J_g: Change in inventories of government enterprises, in 1960 thousand million yen

J_p: Change in inventories of private enterprises, in 1960 thousand million yen

K_{jg}: Inventories of government enterprises, in 1960 thousand million yen

K_{jp}: Inventories of private enterprises, in 1960 thousand million yen

K_p: Gross capital stock of private enterprises, in 1960 thousand million yen

L: Employment in million of persons

*L_c: Stock of cash currency and short-term deposits in private corporate enterprises, in current thousand million yen

L_u: Self-employed (including family workers), in millions of persons

*L_{ua}: Self-employed (including family workers) in agriculture and forestry in millions of persons

L_w: Employees, in millions of persons

M: Imports of goods and services and factor income paid abroad, in 1960 thousand million yen

M_c: Commodity imports, in 1960 thousand million yen

*M_0: Imports of services and factor income paid abroad, in 1960 thousand million yen

*N_L: Labor force, in millions of persons

O: Index of mining and manufacturing production, 1960 = 100

p: GNP implicit deflator, 1960 = 1.0

p_c: Implicit deflator for private consumption expenditure, 1960 = 1.0

p_{cg}: Implicit deflator for general government consumption expenditure, 1960 = 1.0

p_e: Implicit deflator for exports of goods and services and factor income from abroad, 1960 = 1.0

*$p_{ei}{}^w$: Export price index of manufactured goods of eleven leading industrial countries, 1960 = 1.0

p_h: Implicit deflator for private housing investment, 1960 = 1.0

p_hK_h: Net capital stock of private dwellings, in current thousand million yen

p_i: Implicit deflator for gross fixed investment by private enterprises, 1960 = 1.0

p_iK_p: Net capital stock of private enterprises, in current thousand million yen
p_{ig}: Implicit deflator for gross fixed investment by government, 1960 = 1.0
p_j: Implicit deflator for inventories of private enterprises, 1960 = 1.0
*p_{jg}: Implicit deflator for inventories of government enterprises, 1960 = 1.0
*p_m: Implicit deflator for imports of goods and services and factor income paid abroad, 1960 = 1.0
*p_p: Index of prices and charges government can control, 1960 = 1.0
*R: Replacement of fixed capital of private enterprises, in 1960 thousand million yen
*S_b: Current subsidies, in current thousand million yen
S_c: Savings of private incorporated enterprises, in current thousand million yen
S_g: Saving of general government, in current thousand million yen
*S_i: Contributions to social security, in current thousand million yen
*t: Trend, 1952. 2Q = 1
*T_{ag}: Transfers from abroad to general government, in current thousand million yen
*T_{ap}: Transfers from abroad to households and private non-profit institutions, in current thousand million yen
T_c: Direct taxes and charges on private corporations, in current thousand million yen
*T_{ga}: Transfers from general government to the rest of the world, in current thousand million yen
*T_{gp}: Transfers from general government to households and private non-profit institutions, in current thousand million yen
T_i: Indirect taxes, in current thousand million yen
*t_{ic}: Customs (including tonnage duty) ratio for imported commodities, in per cent
T_p: Direct taxes on households and private non-profit institutions, in current thousand million yen
*T_p': Personal tax reduction accumulated since 1953, in current thousand million yen
*T_{pa}: Transfers from households and private non-profit institutions to the rest of the world, in current thousand million yen
*T_w: Exports from the non-Communist world to the total world, in 1960 thousand million U.S. dollars (deflated by total export price index)
U: Unemployment, in millions of persons
V: Gross national product, in 1960 thousand million yen
w: Wage income per employee, in current thousand yen
Y: National income, in current thousand million yen
Y_c: Corporate income, in current thousand million yen
Y_d: Personal disposable income, in current thousand million yen
*Y_g: Surplus of government enterprises (less interest on the public debt), in current thousand million yen
Y_p: Personal income, in current thousand million yen
Y_r: Personal rental and interest income (less interest on consumer's debt), in current thousand million yen

Y_u: Proprietor's income, in current thousand million yen
Y_w: Compensation of employees, in current thousand million yen
$*\alpha_1$: Rate of depreciation for private fixed capital defined as $D_p/(p_i K_p)_{-1}$
$*\alpha_2$: Rate of depreciation for private dwellings, defined as $D_h/(p_h K_h)_{-1}$
$*\beta_1$: Rate of direct taxes on households and private non-profit institutions, defined as T_p/Y_p
$*\beta_2$: Rate of direct taxes and charges on private corporations, defined as T_c/Y_c
$*\beta_3$: Rate of indirect taxes (less current subsidies), defined as $(T_i - S_b)/pV$
$*\epsilon$: Statistical discrepancy, in current thousand million yen
ρ: Index of capacity utilization of manufacturing, 1960 = 100
η: Labor productivity

Note. 1. "*" indicates exogenous variable
2. All variables are seasonally adjusted and expressed in annual rates.

C. *Discussion of the equations*

In the following we discuss briefly the nature of the principal equations.

1. *Consumption*

Private consumption expenditure is made dependent on two different income groups lagged by one quarter, i.e., (a) wages and salaries and (b) other personal income with relatively low propensity to consume, and average consumption of the past four quarters. As regards personal tax and transfers, different effects on consumption of these policy variables are also considered, but obviously this treatment should be regarded as temporary. A more elaborate distinction of these variables between wage and non-wage groups is to be made as further detailed data become available.

The long-run marginal propensity to consume is about 0.96 for the wage income group and 0.40 for the non-wage income group. In the past the average propensity to consume out of the total disposable income has continued to be stable, i.e., about 85%, despite the rising share of the wage income group. This clearly reflects the fact that the rising tendency of the propensity to consume has been cancelled by the rapid growth of disposable income in real terms.

2. *Investment*

First, housing investment is explained by personal disposable income, relative price and the investment in the previous quarter. The long-term elasticity, after adjustment of the distributed lag, is 1.86 with respect to disposable income and -1.12 with respect to relative price, at the average level of each variable.

Our fixed business investment function is specified as an investment ratio to the GNP. Needless to say, this function plays the most dynamic role in analysing the Japanese economy, as will be seen later in our simulation analysis; and the investment ratio changes widely from 11 to 22% in real terms during the past twelve years.

In specifying our theoretical formula, we first started from the following capital demand function which is based on the familiar Cobb-Douglous production function ($V = AK^{\alpha}L^{1-\alpha}$), as indicated in Equation 9, and profit-maximum condition as a long-run equilibrium.

$$\frac{K}{V} = \alpha \frac{p}{r} \tag{1}$$

where V = GNP, K = capital stock, α = relative factor share of capital, r = price of capital service, p = price of output. This type of function can be transformed and dynamized as below by incorporating the speed of adjustment and replacement approximated by lagged stock-output ratio and supply conditions represented by availability of internal and external funds.

$$\frac{I}{V} = f\left[\frac{P}{pV}, \frac{p}{r}, \left(\frac{K}{V}\right)_{-1}, \frac{\Delta S}{S}, i\right]^{4} \tag{2}$$

where I = gross investment, P = profit, S = internal cash flow i.e. corporate gross saving, i = interest rate. Needless to say, the first and second terms are derived from equation (1), the third term represents depreciation and the speed of adjustment in capital demand, the fourth term cash-flow effect, and the last term external availability.

In our final version, Equation 3, the share of profit and the price of capital service are approximated respectively by the share of corporate profit and the price deflator for fixed business investment. The inclusion of the cash flow in our function has two advantages. First, a policy effect of raising the depreciation ratio as an incentive to investment can be explicitly taken into account, which in turn tends to increase the replacement of fixed assets thus leading to a further rise in investment. Second, the effect of corporate tax reduction can be properly incorporated in our model without exaggerating the tax effect on investment. Thus Equation 3 has four policy instruments directly related to investment: corporate tax, depreciation, replacement and interest rate.

Inventory investment in Equation 4 is made dependent on seven explanatory variables but the error is relatively high. As easily expected, the difficulties in obtaining a good estimate of this function are largely due to the basic data, especially in the case of quarterly series, speculative behaviors and other random elements. The first two variables (K_j and $V + M$) are of ordinary stock-adjustment type and the next two (p_j and $E_c - M_c$) are related to unexpected change in inventories. Due to the high dependency on foreign trade in Japan, the impact of the net increase in exports is negatively associated with the change in inventories. As financial variables affecting inventory investment, we included the liquidity of corporate enterprises

$$\left[\frac{1}{4}\sum_{i=0}^{3}\left(\frac{L_c}{pV}\right)_{-i}\right]_{-1}$$

and the rate of interest (i_{-1}) as a proxy of external funds availability. The

[4]Needless to say, $I/V = [K - (1 - r)K_{-1}]/V$, where r = replacement ratio to gross capital stock.

elasticities with respect to these two variables are 0.66 and -3.78 respectively. This lag structure implies that the effect of monetary policy is almost cancelled in the first quarter by the unexpected change in inventories and then becomes significant in the second quarter through the changes in the interest rate and liquidity and that the effect of the latter tends to continue longer than that of the former. The last explanatory variable, "statistical discrepancy" (ϵ), is added to improve the fit of our function by associating the random fluctuations of the data with a residual between the product and income accounts.

3. *Foreign Trade*

The estimation of the export function was started as a demand function for Japanese exports but later it was modified by introducing a supply factor, i.e., the inventory-output ratio. The low price elasticity no doubt reflects this modification. Accordingly, an increase in exogenous expenditure reduces exports through a fall of the inventory-output ratio so that resources are shifted from exports to domestic uses. Our import function uses two policy variables, tariff rate and interest rate, in addition to the ordinary explanation variables such as industrial output, inventory investment and relative price. The import elasticities are 1.07 with respect to output and 0.23 with respect to relative price.

4. *Production*

The industrial production index (in Equation 7) is made dependent upon four types of final demand, of which commodity exports have the highest coefficient and those of investment are the next. These results are fairly consistent with those of interindustry analysis. Our production function of the real GNP (Equation 9) is of the usual Cobb-Douglous type with time trend and indicates that the share of capital, after adjustment for capacity utilization and working hours, is 0.53 and the rate of technical progress is about 4% annually[5]. It is noted that this function is used only for deriving the "production gap" as a difference between actual and potential GNP; and the latter is estimated by assuming a normal trend of working hours and capacity utilization. The potential GNP thus obtained does not feed back into our entire system, unlike some other quarterly models.

5. *Factor Shares*

Corporate profit is one of the most important and dynamic variables and also serves as an appropriate indicator of business cycle. In Equation 22, we explicitly specify this function instead of treating it as a residual between the value of total output and the wage bill. In this latter treatment, various marginal errors are likely to be accumulated in corporate profits and eventually to affect fixed business investment. In our Equation 22 corporate profit is a function of (a) the fixed investment ratio of the past two quarters (indicating embodied

[5]The gross capital stock data on a quarterly basis were estimated by the Economic Research Institute on the basis of 1955 and 1960 National Wealth Censuses.

technical progress), (b) the rate of increase in industrial output and the inventory-output ratio (reflecting market conditions), and (c) labor and capital cost, approximated by the labor share and the interest rate. In view of its lower statistical reliability, income of unincorporated business is treated as a residual. Because of a lower marginal propensity to consume, the errors of this income group have little effect on other endogenous variables.

6. *Employment and Wages*

As regards employment in Equation 10, we started by specifying labor demand for employees as a function of the output level and the wage rate. In view of the imperfection of labor market which has especially been the case with Japan, we modified our original version by adding a supply factor, total labor force, to our equation. Unemployment in Equation 11 is regressed negatively on labor demand approximated by total employees and positively on total labor force and capacity utilization of Equation 8. This implies that the number of self-employed and family workers are obtained as a residual, given the total labor force as exogenous. This treatment reflects the existence of a certain amount of hidden unemployment still prevailing in unincorporated business in Japan and it also corresponds to the treatment of its factor share as a residual.

As regards wage rate, Equation 12 is almost a standard Phillips-type function, except that it introduces labor mobility from agriculture to other sectors as an additional explanatory variable. The implication of this variable is that a fairly rapid migration from agriculture has contributed in the past to check a further wage increase due to tightening labor market which is represented by a falling trend of open unemployment. In other words, the wage level in our model is affected in two ways: first through adjustment of open unemployment and second through increased mobility in agricultural migration to other industries. Since the elasticity of wages with respect to this ratio of agricultural employment is 0.33 and the ratio is at present about 25%, a policy toward modernization of agriculture will considerably serve to lighten wage pressure and the wage-cost spiral through increased labor mobility [10].

7. *Prices*

Since most of our price equations are self-explanatory, we will only discuss the important specifications on prices. First, an attempt was made to include in our functions capacity utilization (K_p/V) in the past four to five quarters. Short-run market conditions of output, represented by K_j/V, were also taken into account in the equation of wholesale price (or inventory price deflator) in Equation 18. This factor is also introduced indirectly in the consumer price function of Equation 13. As regards cost, all equations are functions of wages (w) or unit labor cost (wL/V). A special emphasis is given to export price in regard to embodied technical progress, which is approximated by the rate of fixed business investment four quarters before. Special consumer prices and fares controlled by the government, such as prices of rice, liquors and tobacco, railway fares, etc., are treated as exogenous and play an important role in our model as a policy variable in determining price level.

TABLE 1

SHORT-RUN *Ex Post* FORECAST ERRORS, IN TERMS OF MEAN ABSOLUTE ERROR AND STANDARD DEVIATION AS PERCENT OF MEAN ACTUAL

	pV		V		C		I_p	
	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)
1Q	215.6	1.8	198.7	1.8	63.4	1.0	78.8	3.9
2Q	198.3	1.7	196.8	1.7	70.5	1.1	70.5	3.3
3Q	180.6	1.6	193.4	1.7	77.2	1.2	75.6	3.5
4Q	188.3	1.5	188.7	1.6	80.4	1.2	75.4	3.2
(1st year)	(92.2)	(0.8)	(124.9)	(1.0)	(50.5)	(0.9)	(47.0)	(2.1)
5Q	232.0	1.8	220.3	1.8	84.9	1.3	83.2	3.6
6Q	248.4	2.0	249.7	2.0	94.9	1.3	84.1	3.7
7Q	259.1	1.9	266.4	2.0	100.4	1.4	90.3	4.0
8Q	258.5	1.8	277.9	2.0	102.1	1.5	102.9	4.3
(2nd year)	(188.1)	(1.3)	(192.3)	(1.5)	(87.5)	(1.2)	(71.7)	(3.1)

	J_p		E		M		O	
	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)
1Q	154.0	35.8	42.3	4.0	45.2	3.7	1.66	2.3
2Q	147.6	34.5	42.7	3.7	46.1	3.6	1.55	2.1
3Q	151.3	33.2	44.1	3.6	47.8	3.6	1.64	2.1
4Q	151.9	32.7	45.1	3.6	51.0	3.7	1.77	2.2
(1st year)	(81.2)	(17.4)	(31.0)	(2.6)	(31.9)	(2.3)	(0.97)	(1.4)
5Q	168.4	36.3	52.8	4.4	58.1	4.2	1.99	2.6
6Q	174.9	37.3	57.4	4.6	57.4	4.0	1.96	2.6
7Q	172.9	36.7	62.6	4.6	57.4	3.8	2.02	2.5
8Q	186.6	38.1	66.0	4.7	60.3	3.8	2.34	2.7
(2nd year)	(115.1)	(23.0)	(46.2)	(3.4)	(38.1)	(2.6)	(1.60)	(1.8)

	p		p_c		w		L_ω	
	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)	Mean Absolute Error	Standard Deviation (%)
1Q	0.76	1.0	0.79	1.0	3.84	1.8	0.12	0.8
2Q	0.95	1.2	1.05	1.3	3.73	1.7	0.10	0.7
3Q	1.02	1.3	1.12	1.3	3.60	1.6	0.10	0.6
4Q	1.07	1.3	1.12	1.3	3.78	1.7	0.10	0.6
(1st year)	(0.75)	(0.9)	(0.70)	(0.9)	(2.01)	(0.9)	(0.06)	(0.4)
5Q	1.24	1.4	1.13	1.4	4.13	1.7	0.10	0.6
6Q	1.31	1.6	1.22	1.6	4.19	1.7	0.10	0.6
7Q	1.35	1.6	1.31	1.6	4.87	1.8	0.10	0.6
8Q	1.39	1.5	1.32	1.6	5.14	1.9	0.10	0.6
(2nd year)	(1.07)	(1.3)	(0.99)	(1.2)	(3.08)	(1.2)	(0.06)	(0.3)

Note: For GNP and its components, the figures are in billion yen; for p, p_c and O in terms of index numbers (1960 = 100); for w (wage rate) in thousand yen; and for Lw in million persons.

III. *Ex Post* Forecasts, 1954–1965—Model Performance

A. Short-run ex post forecast

In order to test the predictive ability of our model, we first started with short-run *ex post* forecasts for two years. The test was done as usually by solving our entire equation system for each successive quarter on the basis of initial values and exogenous variables for eight quarters. All lagged endogenous variables were those derived from the model rather than actual values. Since we are interested in its pure predictive nature, no adjustment was made for the constant terms of our equations in connection with serial correlations or deviation from initial values. In estimating the errors of our *ex post* projection, we made forty cases of this 8-quarter simulation over our observation period, as done by Klein and Evans with their Wharton-EFU model [7].

Major results of our test are shown in Table 1, in which most of the errors tend to increase as the model estimates for a longer period. This is obviously due to the increasing tendency of serial correlation, but the extent of such accumulated errors appears to be not so serious as usually expected. The errors of current and real GNP are mostly 1.5 to 2% over the period, those of other variables also being under 5% in most cases. The lowest percentage errors are those for private consumption. However, the errors for the change in inventories are exceptionally high, reflecting its dynamic nature and the weakness of the statistical data.

As regards annual average, most of the errors indicate smaller values because of cancellation of the quarterly errors. The errors of GNP are only 0.8 and 1.3% in current prices for the first and the second years respectively, while those in constant prices were also 1.0 and 1.5% respectively. This probably indicates the advantage of using our quarterly model for short-run annual forecasting rather than ordinary annual models.

In Table 2, the performance of our model is compared in terms of standard deviation as percent of mean actual with that of a U.S. model, i.e. Wharton-EFU quarterly model with seventy-six equations based on sample period, 1948.1–1964.4. Needless to say qualifications are needed in comparing the two models especially in regard to differences in economic structure, rate of economic growth and fluctuation as well as those in specification of the models. The table indicates that except for the first quarter the GNP errors of our model are smaller than those of the U.S., in both constant and current prices. Generally, the U.S. model indicates a more rapidly increasing tendency of errors as they become more distant from the starting period. As regards GNP components, most of the errors of the Japanese model are again smaller in percentage than those of the U.S. model. For exports, however, the U.S. errors are smaller for the first three quarters and for consumption the differences between the two are negligible. The errors of GNP deflator and disposable income, on the other hand, are much smaller in the U.S. model. The larger errors of the price deflator of the Japanese model seem to reflect a wider use of distributed lag, which probably needs to be improved.

In most cases the *ex post* projections of the turning point of the business cycle with our model were not unsatisfactory. In Chart 1 we indicate six cases of

ex post forecasts covering our entire period in successive order. Here, each forecast covers eight quarters. Out of seven turning points (i.e. four upturns and three downturns), six turning points (three upturns and three downturns) were projected by our model in the neighborhood of the actual turning points in terms of GNP. A failure in timing occurred in the upturn in 1965. This is mostly due to errors in inventory investment and exports. Thus the recession in this year was somewhat underestimated in terms of its length. However, if business fixed investment is taken as a measure of the turning point, all turning points are closely followed. Though to a lesser extent, our estimates of inventory investment also follow the business fluctuations fairly closely except for the upturn in 1965.

TABLE 2

COMPARISON OF SHORT RUN *Ex Post* FORECAST ERRORS BETWEEN EPA SHORT-TERM MODEL AND WHARTON-EFU MODEL, IN TERMS OF STANDARD ERROR AS PERCENT OF MEAN ACTUAL

	V		pV		p_cC		p_iI_p		pI_h	
	EPA	Wharton-EFU	EPA	Wharton-EFU	EPA	Wharton-EFU	EPA	Wharton-EFU	EPA	Wharton-EFU
1Q	1.8	1.6	1.8	1.7	1.4	1.5	3.7	2.2	4.3	4.8
2Q	1.7	1.8	1.7	1.9	1.5	1.6	3.3	4.3	4.8	4.8
3Q	1.7	1.8	1.6	1.8	1.4	1.5	3.5	4.5	4.7	4.8
4Q	1.6	2.0	1.5	1.9	1.5	1.5	3.4	4.5	4.4	5.5
5Q	1.8	2.2	1.8	2.0	1.4	1.4	3.9	5.2	3.8	6.2
6Q	2.0	2.5	2.0	2.2	1.6	1.5	4.0	5.7	3.9	6.8
7Q	2.0	2.7	1.9	2.2	1.5	1.5	4.3	6.4	4.5	7.2
8Q	2.0	2.8	1.8	2.2	1.4	1.5	4.5	6.9	4.8	7.4

	p_eE		p_mM		Y_d		p	
	EPA	Wharton-EFU	EPA	Wharton-EFU	EPA	Wharton-EFU	EPA	Wharton-EFU
1Q	4.6	3.7	3.8	3.9	2.1	1.1	1.0	0.3
2Q	4.3	3.9	3.6	4.0	2.1	1.2	1.2	0.6
3Q	4.2	4.1	3.6	4.0	2.0	1.0	1.3	0.7
4Q	4.1	4.5	3.7	4.1	1.9	1.0	1.3	0.7
5Q	4.5	4.8	4.2	4.4	2.1	1.0	1.4	0.8
6Q	4.6	5.0	4.0	4.3	2.2	1.1	1.6	0.8
7Q	4.7	5.3	3.7	4.2	2.1	1.1	1.6	0.9
8Q	4.8	5.6	3.8	4.0	2.0	1.1	1.5	0.8

In general, the turning points were better projected, as usually expected, by a shorter-run simulation, such as two or three quarters before the actual turning points. Since the projections described so far are purely *ex post* ones and there were no adjustments of constant terms, it is clear that analysis of serial correlation and initial values and the resultant adjustments of the constant terms could give a still closer projection as far as the model is estimated properly. In view of the short-run performance of our model described above we can

tentatively conclude that the model is fairly workable for the short-run *ex ante* forecasts as well, especially for the annual estimation.

B. Long-run ex post forecast

It is also interesting to examine the long-run performance of our model for analytical and policy uses. To test our model for this end, we simulated it over a long stretch of the sample period, i.e. forty-eight quarters from 1954.2 through 1966.1, thus covering three and a half cycles. As in the case of the short-run *ex post* forecasts, all lagged endogenous variables were obtained by the model rather than actual values.

Our result is shown in Table 3A and Chart 2. Undoubtedly the errors of this long-run simulation are larger than those of short-run simulation described earlier, but the differences are not so great as usually expected. If these quarterly errors are aggregated into annual errors, as indicated in Table 3B, we cannot find any significant differences between the long-run forecasts and the short-run forecasts given in Table 1. This would imply that accumulated forecasting errors in our model do not tend to rise seriously even during a long period. In other words the model can be used to some extent for medium-term *ex ante* forecasting as well.

As regards the business-cycle turning point, our chart indicates that the 1954 and 1958 recessions are well picked out by the model, but the 1962 and 1964–1965 recession are depicted less accurately, in particular for the upturn. This tendency of the model is more or less similar to the earlier case of the short-run simulations. There is a slight long-run bias in recent years as indicated in the average error in Table 3A which is largely due to the bias of business fixed investment. As for GNP components, change in inventories again shows the highest percentage errors, accounting for rather insensitive decline in inventories in 1962, whereas consumption has the lowest percentage errors.

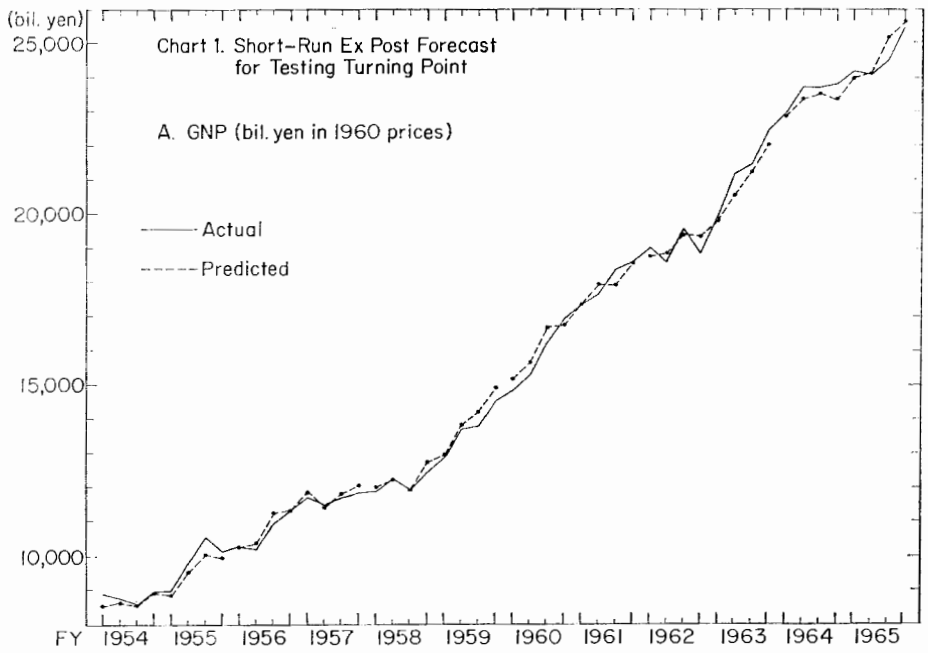
In Table 4 the errors of our model are compared with the two U.S. quarterly models, Wharton-EFU Model and Brookings Model. The latter model has 177 equations and is estimated for the period 1948–1960. Although qualifications are also needed similar to Table 2, the errors of leading variables in our model are a little smaller than those in the U.S. models except for business fixed investment and disposable income.

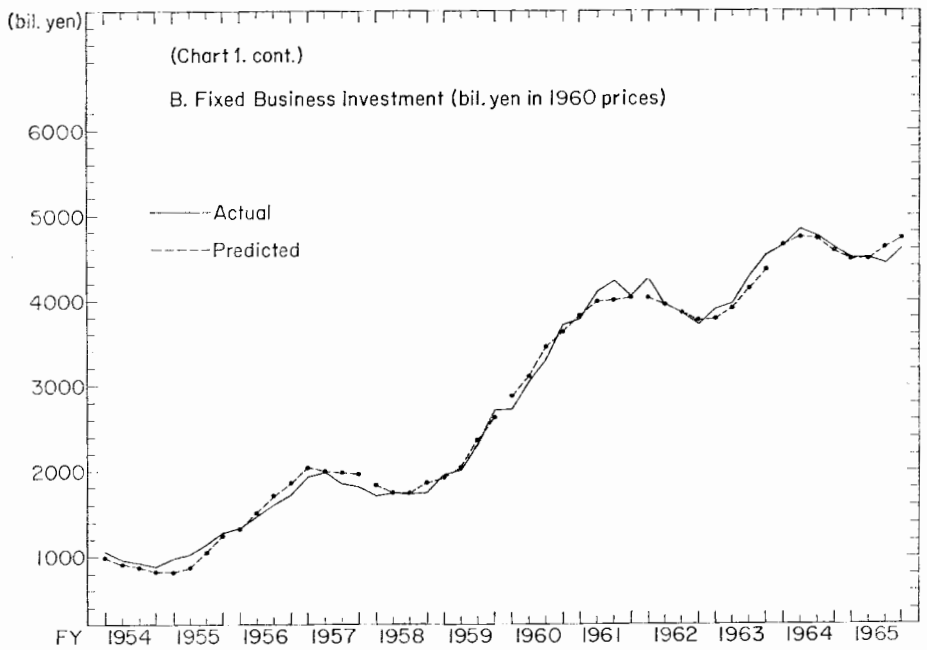
IV. Forecast for 1966 FY and 1967 FY

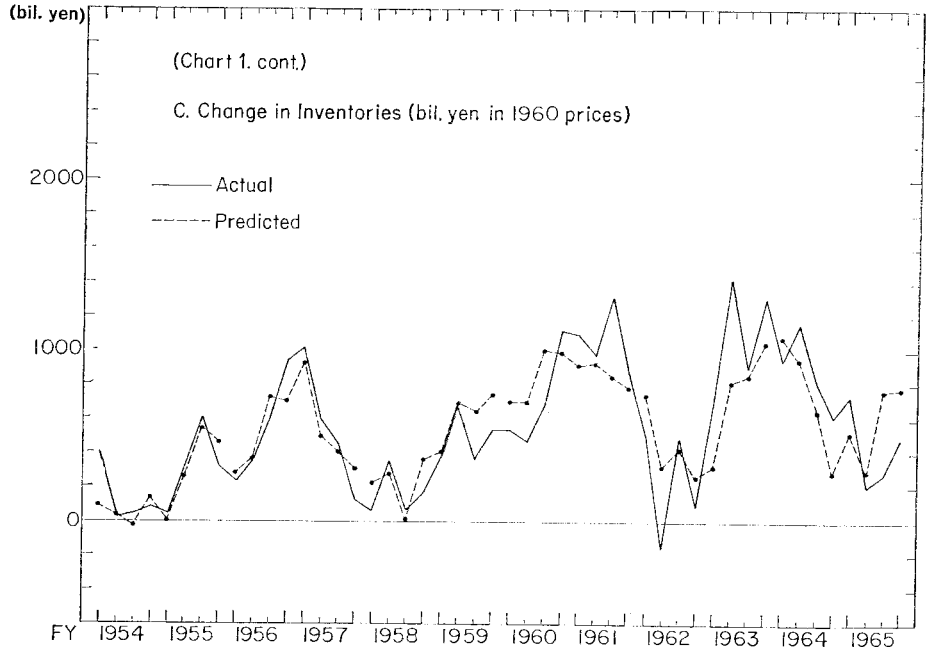
A. *Forecast for 1966 FY*

After testing our model for short- and long-run *ex post* forecasts, we extrapolated the model beyond our sample period for *ex ante* forecasts for the fiscal years (FY) of 1966 and 1967. The forecast for 1966 FY, however, is not a genuine *ex ante* forecast, since all the exogenous variables except those for the first quarter of 1967 are already known. Thus it should be regarded as a test of the model's performance for short-run forecasting beyond sample period.

Unlike our *ex post* forecasts described before, we made slight adjustments of our constant terms in view of the existence of serial correlation, deviation of initial


(bil. yen)
25,000
20,000
15,000
10,000
Chart 1. Short-Run Ex Post Forecast for Testing Turning Point
A. GNP (bil. yen in 1960 prices)
Actual
Predicted
FY 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965


(bil. yen)
6000
5000
4000
3000
2000
1000
(Chart 1. cont.)
B. Fixed Business Investment (bil. yen in 1960 prices)
Actual
Predicted
FY 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965


(bil. yen)
(Chart 1. cont.)
C. Change in Inventories (bil. yen in 1960 prices)
Actual
Predicted
2000
1000
0
FY 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965

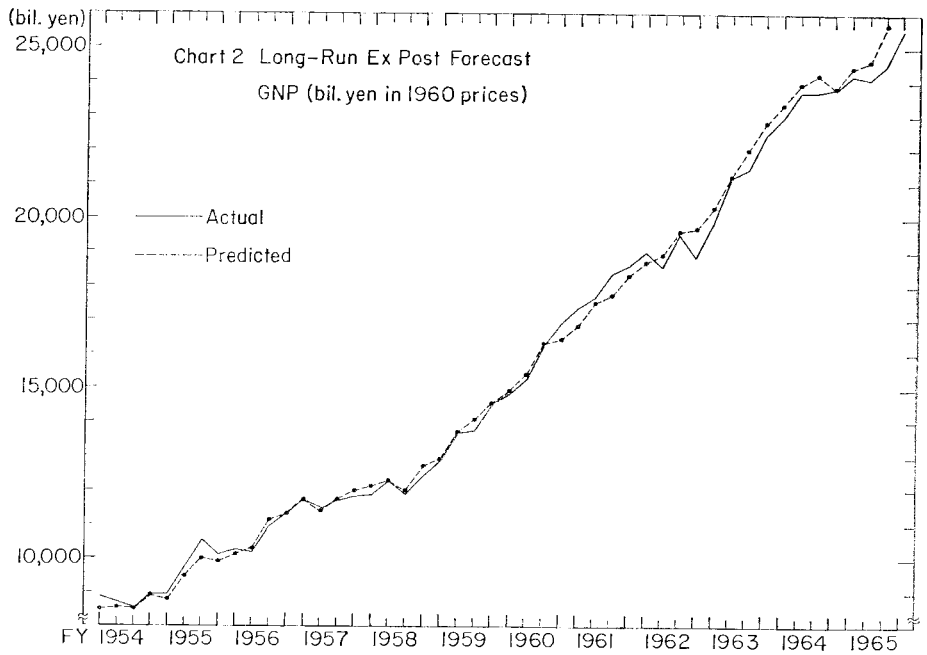

(bil. yen)
25,000
Chart 2 Long-Run Ex Post Forecast
GNP (bil. yen in 1960 prices)
Actual
Predicted
20,000
15,000
10,000
FY 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965

TABLE 3

LONG-RUN *Ex Post* FORECAST, 1954.2Q—1966.1Q

A. *Quarterly Estimates*

	pV	V	C	I_p	J_p	E	M	p	p_c	w	O
1. Mean absolute error (%)	2.0	1.6	0.9	7.7	43.7	2.9	4.3	1.2	1.0	1.7	3.4
2. Standard deviation[a]	480.9	349.3	106.5	283.8	212.0	81.7	83.1	1.41	1.45	6.80	3.79
3. Average error[b]	−64.7	−88.2	−42.5	−52.2	−17.1	0.9	−10.9	0.30	0.55	−0.04	− 0.80

B. *Annual Estimates*

	pV	V	C	I_p	J_p	E	M	p	p_c	w	O
1. Mean absolute error (%)	1.6	1.3	0.7	7.3	30.7	2.3	3.4	0.9	0.9	1.5	2.7
2. Standard deviation[a]	415.3	269.8	85.8	263.4	142.5	53.5	62.4	1.10	1.15	5.46	3.15

[a]For GNP and its components, the figures are in billion yen; for p, p_c and O in terms of index numbers (1960 = 100); and for w (wage rate) in thousand yen.

[b] Average error $= \frac{1}{T} \cdot \sum_{t=1}^{T} (X_t^{\text{actual}} - X_t^{\text{pred.}})$.

values, unusual factors, etc. The results of this forecast given in Table 4 indicate a fairly satisfactory performance of our model. The industrial production index (O), the quickest and the most widely used indicator of business conditions, was estimated almost exactly except for the fourth quarter of 1966. The actual values for GNP and its components are all preliminary figures that are subject to further revisions. Thus the comparison between actual and predicted values of the GNP should also be regarded as rather tentative. Generally there is a slight underestimation for the third quarter and some overestimation for the fourth quarter, which reflects mostly the errors in both fixed and inventory investment. Consumption, on the other hand, was predicted with a small margin of error. For price deflators and wage rate, the model also indicates a fairly good performance.

TABLE 4

LONG-RUN *Ex Post* FORECAST ERRORS
(Mean absolute percentage error)

	EPA	Wharton-EFU	Brookings
V	1.58	2.32	2.03
pV	1.97	2.79	2.70
p	1.16	1.56	1.46
I_p	7.72	—	8.49
$p_I I_p$	8.39	6.28	—
C	0.93	—	1.55
$p_c C$	1.39	3.19	—
Y_d	1.93	2.90	1.75

Note: Mean absolute percentage error $= \frac{1}{T} \sum_{t=1}^{T} \left| \frac{X_t^{\text{actual}} - X_t^{\text{pred.}}}{X_t^{\text{actual}}} \right| \times 100$

B. *Forecast for* 1967 *FY*

A genuine *ex ante* forecast was made for 1967 FY on the basis of two alternative exogenous variables. Our Simulation A assumes a constant level in interest rate, while Simulation B assumes its rise reflecting a more restrictive monetary policy in response to a rising trend of business investment.

This time we started our simulation from the first quarter of 1967. As shown in Table 5, both simulations indicate a high rate of economic growth, with continuous rising trend of business fixed investment and consumption. However, the inventory accumulation reaches its peak in the third quarter of 1967 and starts to decline gradually afterward. The rate of increase in fixed business investment also indicates a leveling-off in the second half of 1967 FY. The rate of increase in exports also declines substantially due to the change in world trade and that for government investment slightly falls in real terms as compared with the previous year. The price level continues to rise almost at the same pace, whereas the wage rate increases a little faster, reflecting a rapid increase in corporate profits and a rising tendency of consumer prices. As regards the balance of payments, a substantial surplus in 1967 has declined about thirty percent, but

there still remains a certain amount of surplus on current account. Finally, the production gap, defined as a difference between actual and potential real GNP derived from our production function of Equation 9, tends to be narrowed as the economy continues a rapid expansion in both simulations.

TABLE 5

FORECAST FOR 1966 F.Y.

		1966			1967	1966 F.Y.	Rate of increase
		2Q	3Q	4Q	1Q		%
O	P_r	190.7	198.4	207.7	212.9	202.4	14.7
(1960 = 100)	A_c	189.3	200.0	209.0	218.1	204.1	15.6
V	P_r	26,006.3	26,845.2	27,915.3	28,112.5	27,219.8	10.6
(bil. yen)	A_c	26,049.1	27,260.6	27,419.8	28,089.6	27,204.7	10.3
C	P_r	13,969.8	14,346.2	14,648.1	14,983.1	14,486.8	8.2
(bil. yen)	A_c	13,893.8	14,316.6	14,658.0	14,855.5	14,431.0	7.8
I_p	P_r	4,695.1	4,888.2	5,328.3	5,541.5	5,113.3	13.3
(bil. yen)	A_c	4,726.4	4,961.2	5,162.2	5,419.6	5,067.4	12.3
J_p	P_r	608.8	767.9	971.7	916.7	816.3	87.7
(bil. yen)	A_c	436.4	968.8	862.0	1,350.0	904.3	107.9
E	P_r	4,147.3	4,317.7	4,521.8	4,551.0	4,384.5	15.1
(bil. yen)	A_c	4,164.4	4,364.9	4,499.1	4,339.3	4,341.9	14.2
M	P_r	3,564.4	3,684.1	3,865.2	3,949.4	3,765.8	16.9
(bil. yen)	A_c	3,468.4	3,667.4	3,915.1	3,934.0	3,746.2	16.3
pV	P_r	34,232.3	35,699.3	37,387.2	38,187.1	36,376.5	16.2
(bil. yen)	A_c	34,203.9	35,908.5	36,909.5	38,205.5	36,306.9	15.8
Y_c	p_r	2,814.9	3,326.3	3,737.4	3,785.5	3,416.0	29.4
(bil. yen)	A_c	2,918.2	3,466.4	3,753.2	—	—	—
p	p_r	131.6	133.0	133.9	135.8	133.6	5.1
(1960 = 100)	A_c	131.3	131.7	134.6	136.0	133.5	5.0
p_c	p_r	135.7	136.7	137.9	139.5	137.5	5.0
(1960 = 100)	A_c	136.2	136.4	137.2	139.4	137.3	4.8
w	p_r	546.9	563.6	571.4	580.5	565.6	11.3
(thousand yen)	A_c	548.1	561.8	569.4	—	—	—

Note: P_r = Predicted value, A_c = Actual figure (preliminary estimate).

The difference between our Simulations A and B reflects purely the difference in monetary policy. Thus Simulation B indicates a slightly lower rate of economic growth especially in inventory investment and fixed business investment mostly after the latter half of 1967 FY. A larger amount of surplus in the current account of the balance of payments no doubt reflects the effect of this monetary policy. A rapid and continuous expansion of industrial output is also affected after the fourth quarter of 1967. Similarly, the levelling off of economic expansion causes a larger deficit in the fiscal budget and a wider production gap, while the price levels are hardly affected by this policy measure.

V. MULTIPLIERS FOR FISCAL AND MONETARY POLICY

In order to analyze the dynamic properties of our model and to measure the effects of exogenous variables for policy-making, we calculated several

types of multipliers for the twenty-four-quarter period, 1966–1971 FY. For the most important exogenous variables we also calculated long-run multipliers for 1966–1988 FY.

TABLE 6

FORECAST FOR 1967 FY

		1967				1968	1967 F.Y.	Rate of increase
		1Q	2Q	3Q	4Q	1Q		%
O	A	213.1	219.2	227.2	236.4	240.4	230.8	13.8
(1960 = 100)	B	213.1	219.2	227.2	235.6	237.8	230.0	13.4
V	A	28,081.3	29,027.2	29,929.5	30,952.7	31,468.4	30,344.4	11.6
(bil. yen)	B	28,081.3	29,027.2	29,929.5	30,876.1	31,260.1	30,273.2	11.4
C	A	14,933.6	15,236.5	15,547.1	15,998.7	16,318.5	15,775.2	9.5
(bil. yen)	B	14,933.6	15,236.5	15,547.1	15,998.7	16,311.8	15,773.5	9.5
C_g	A	2,052.8	2,005.6	2,014.0	2,025.7	2,031.7	2,019.2	3.3
(bil. yen)	B	2,052.8	2,005.6	2,014.0	2,026.8	2,037.5	2,021.0	3.4
I_p	A	5,569.2	5,631.0	6,064.7	6,498.7	6,585.1	6,194.9	21.4
(bil. yen)	B	5,569.2	5,631.0	6,064.7	6,427.5	6,401.9	6,131.3	20.1
I_g	A	2,822.8	2,992.4	3,080.5	3,091.7	3,187.5	3,087.0	9.1
(bil. yen)	B	2,822.8	2,992.4	3,080.5	3,093.0	3,191.0	3,089.2	9.2
J_p	A	919.0	1,044.5	1,105.7	1,206.2	1,144.5	1,125.2	38.8
(bil. yen)	B	919.0	1,044.5	1,105.7	1,183.9	1,044.9	1,094.8	35.1
E	A	4,575.6	4,683.2	4,772.6	4,882.1	4,978.9	4,829.2	9.7
(bil. yen)	B	4,575.6	4,683.2	4,772.6	4,882.1	4,985.1	4,830.8	9.8
M	A	3,951.2	4,100.3	4,230.0	4,376.2	4,448.6	4,288.8	14.4
(bil. yen)	B	3,951.2	4,100.3	4,230.0	4,361.9	4,387.0	4,269.8	13.9
pV	A	38,090.2	40,033.7	41,351.6	43,456.5	44,816.0	42,414.5	16.9
(bil. yen)	B	38,090.2	40,033.7	41,351.6	43,362.3	44,526.0	43,318.4	16.7
Y_c	A	3,709.3	4,218.8	4,319.4	4,707.4	4,889.8	4,533.8	31.0
(bil. yen)	B	3,709.3	4,218.8	4,319.4	4,645.8	4,702.4	4,471.6	29.2
p	A	135.6	137.9	138.2	140.4	142.4	139.7	4.8
(1960 = 100)	B	135.6	137.9	138.2	140.4	142.4	139.7	4.8
p_c	A	139.4	143.0	143.1	146.2	148.6	145.2	5.8
(1960 = 100)	B	139.4	143.0	143.1	146.2	148.5	145.2	5.7
w	A	582.3	611.1	628.1	643.4	661.4	636.0	12.5
(thousand yen)	B	582.3	611.1	828.1	642.9	659.3	635.4	12.4
B_g	A	−635.9	−1,218.6	−1,262.6	−1,126.0	−1,141.4	−1,187.1	−12.4
(bil. yen)	B	−635.9	−1,218.6	−1,262.3	−1,159.7	−1,244.5	−1,221.3	−9.9
B_a	A	472.5	395.2	325.8	239.3	240.4	300.2	−35.4
(bil. yen)	B	472.5	395.2	325.8	253.7	305.8	320.1	−31.1
Production gap	A	1,206.1	900.7	724.2	470.3	739.1	708.6	−35.3
(bil. yen)	B	1,206.1	900.7	724.2	540.5	924.7	772.5	−29.5

Note: The rate of interest assumed in A and B are as below.

	1967 1Q	2Q	3Q	4Q	1968 1Q
A —	7.43	7.43	7.43	7.43	7.43
B —	7.43	7.43	7.43	7.53	7.64

Since our model, being non-linear, can give different multipliers depending on the level of capacity utilization and unemployment, we first calculated "a standard simulation" or "control solution" mostly based on the exogenous variables used for our five-year economic plan 1966–1971 FY. The multiplier

effects were then calculated by assuming a sustained unit increase in the exogenous variables in current prices over the simulation period. Since detailed discussion of the multipliers would take considerable space, we shall confine ourselves only to the principal features of our multipliers.

As indicated in Table 7A, the multiplier of government investment, defined as the ratio of the increased expenditure in current prices to the increased GNP in 1960 prices, is 1.08 for the first quarter and then rises gradually up to 2.96 in the eighth quarter, and declines afterwards. On an annual basis, the first year multiplier is 1.68, the second 2.84 and the third 2.62. If these multipliers are expressed in terms of the GNP in current prices, they are raised to 2.17, 4.27 and 5.01 for each year. As regards components of the GNP, the rise in inventories is the most responsive to the rise in the multiplier for the first and the second quarters; gradually it is replaced by the fixed business investment, which reaches its peak in the ninth quarter and starts to fall gradually. Private consumption, on the other hand, starts rising slowly from the second quarter but continues to rise steadily up to the eleventh quarter. Housing investment takes a time path similar to that of fixed business investment, not due to a kind of stock-adjustment mechanism but rather to an increase in the relative price of housing construction. Exports first decline by 0.07 and then recover, continuing to rise over our simulation period. This reflects a shift from an excess demand for the first nine quarters due to the rise in government investment to an excess supply, i.e., an export drive, for the rest of our period. A similar tendency can also be observed for imports which rise rapidly in the first quarter in response to the excess demand and then follow a similar time path to the real GNP. Thus, the time path of our multiplier mentioned before is a joint effect of the different time patterns of these GNP components.

For the first year, about two-thirds of the multiplier value is accounted for by inventory investment and business fixed investment and the rise in the private consumption and others is offset by the increase in the foreign trade deficit which amounts to about twenty percent of the multiplier value. The further increase in the multiplier value for the second year is mostly due to the rise in consumption and fixed business investment, whereas the share of inventory investment declines substantially. In the third year the share of both fixed and inventory investment declines while those of consumption and housing investment continue to increase.

What would then be the long-run time path and the features of the Japanese multipliers? Our Table 8 indicates this time pattern for the period 1966–1988. There is a marked long-run, but damping, cycle of about nine years, which is mostly generated by our fixed investment function. Our long-run equilibrium value in this table seems to be about 1.8 to 2.0 in real terms which will converge eventually after more than 25 years. A result of comparison of this with the U.S. value in the table seems to suggest an interesting, salient feature of our multiplier distinctive to the Japanese economy. Although qualifications are needed as to the differences in specification of the models[6], and economic institutions [3],

[6] If the interest rate (i) is treated as an endogenous variable and monetary feedbacks are explicitly taken into account, our multiplier value will no doubt be reduced. Similarly, treatment of labor supply as endogenous will also reduce the value. A low multiplier value of the Osaka model is due partly to its inclusion of the interest rate as endogenous [5].

TABLE 7

MULTIPLIERS FOR MAJOR EXOGENOUS VARIABLES 1966–1971 FY

A. Government Investment (100 billion yen increase in current prices)

	1 ΔV	2 ΔC	3 ΔI_p	4 ΔI_g	5 ΔJ_p	6 ΔE	7 ΔM	8 $\Delta(pV)$	9 Δp	10 Δw	11 ΔB_g	12 ΔB_a
1Q	108.3	0.0	19.5	75.7	29.7	0.0	15.8	134.5	−0.03	0.29	−73.3	−16.2
2Q	150.4	17.7	46.1	74.2	43.0	−8.5	22.2	192.0	−0.02	0.68	−62.3	−31.2
3Q	189.6	28.9	73.4	72.5	51.2	−10.2	28.2	245.1	−0.02	0.89	−49.1	−39.2
4Q	224.9	37.5	103.1	69.9	54.7	−10.7	33.2	296.1	−0.01	1.04	−38.8	−45.0
5Q	261.5	47.7	135.4	66.0	57.0	−10.5	38.3	358.5	0.02	1.64	−21.2	−52.3
6Q	281.5	58.9	153.9	60.6	54.7	−9.8	40.5	412.6	0.10	2.46	−2.9	−56.8
7Q	295.5	67.5	168.7	55.7	49.7	−7.4	41.7	456.6	0.17	3.00	12.0	−58.9
8Q	296.2	73.0	173.8	51.5	40.7	−4.5	40.5	480.5	0.23	3.36	19.4	−58.2
9Q	289.7	76.5	174.4	47.3	30.1	−1.0	38.2	499.0	0.30	4.08	24.9	−55.9
10Q	274.4	79.9	167.1	43.1	18.2	2.7	34.6	508.9	0.39	4.89	27.1	−50.4
11Q	255.9	82.1	154.9	40.4	6.8	6.2	30.6	508.0	0.46	5.27	27.8	−44.2
12Q	229.7	80.5	136.4	39.1	−4.9	9.4	25.5	489.0	0.49	5.38	22.3	−36.3
13Q	196.8	76.7	112.9	38.6	−16.7	12.2	19.6	461.7	0.54	5.85	13.0	−27.4
14Q	161.9	73.3	85.8	38.6	−27.3	14.7	13.6	429.9	0.58	6.30	2.5	−17.7
15Q	129.2	69.3	57.6	40.3	−35.2	16.6	8.2	391.9	0.60	6.24	−8.5	−8.8
16Q	95.3	62.3	28.2	43.3	−41.5	17.5	2.8	343.2	0.59	5.92	−23.4	0.1
17Q	60.8	54.3	−1.3	46.5	−46.5	17.8	−2.5	294.4	0.59	5.96	−39.9	8.6
18Q	30.0	47.8	−29.6	49.9	−49.3	17.7	−7.0	249.3	0.58	5.98	−54.6	16.5
19Q	5.5	41.7	−54.9	54.3	−49.2	16.7	−10.3	204.2	0.54	5.52	−67.6	22.3
20Q	−14.6	33.9	−76.3	59.5	−47.1	15.0	−12.8	156.5	0.48	4.87	−81.8	26.7
21Q	−33.1	26.2	−94.8	64.0	−44.3	12.8	−14.9	115.7	0.44	4.61	−96.0	30.3
22Q	−45.0	21.3	−109.4	68.0	−39.8	10.5	−15.9	84.9	0.40	4.42	−105.6	32.7
23Q	−49.4	17.4	−118.8	72.1	−33.4	7.8	−15.8	58.1	0.34	3.82	−112.1	32.5
24Q	−49.3	12.4	−122.7	75.7	−26.2	4.8	−14.9	32.7	0.27	3.10	−118.6	31.2

Note: (1)–(7) 1.0 billion yen in 1960 prices.
(8), (11), (12) 1.0 billion yen in current prices.
(9) 1960 = 100.
(10) Thousand yen in current prices.

B. Transfer Payments (100 billion yen increase in current prices)

	1 ΔV	2 ΔC	3 ΔI_p	4 ΔI_g	5 ΔJ_p	6 ΔE	7 ΔM	8 $\Delta(pV)$	9 Δp	10 Δw	11 ΔB_g	12 ΔB_a
1Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	−100.0	0.0
2Q	64.5	42.8	11.6	−0.6	17.7	0.0	9.4	83.1	−0.01	0.18	−83.6	−9.7
3Q	99.3	57.7	29.4	−1.3	28.2	−5.1	14.6	130.1	−0.00	0.43	−74.6	−20.2
4Q	136.0	70.3	50.7	−2.4	37.0	−6.8	20.3	180.6	0.00	0.61	−63.0	−27.7
5Q	171.6	82.4	73.8	−3.7	43.0	−8.0	25.4	231.8	0.00	0.79	−51.9	−34.4
6Q	210.7	96.1	101.4	−6.1	48.5	−8.8	31.0	292.4	0.02	1.23	−36.8	−42.2
7Q	238.3	108.4	122.2	−9.7	50.2	−9.1	34.6	348.2	0.07	1.81	−20.7	−48.3
8Q	259.5	118.4	139.5	−13.2	48.8	−8.1	37.0	397.6	0.13	2.30	−6.2	−52.1
9Q	271.7	126.0	151.6	−16.7	44.2	−6.4	37.8	435.0	0.17	2.77	5.3	−54.4
10Q	276.3	131.7	159.4	−20.6	37.3	−3.9	37.5	463.4	0.24	3.39	13.7	−54.6
11Q	274.1	137.2	161.2	−24.4	28.9	−0.9	36.0	488.2	0.31	4.04	20.7	−52.3
12Q	265.1	140.8	157.0	−27.2	19.4	2.1	33.5	502.4	0.38	4.51	24.9	−48.4
13Q	248.1	141.3	146.5	−29.2	8.9	5.1	29.8	500.6	0.43	4.93	25.0	−43.2
14Q	224.5	139.9	131.3	−30.8	−2.1	8.1	25.3	486.3	0.48	5.37	20.2	−36.4
15Q	197.8	138.5	111.6	−31.7	−12.4	10.9	20.4	469.4	0.53	5.75	14.1	−28.5
16Q	168.8	135.6	88.3	−31.0	−21.6	13.3	15.3	444.5	0.57	5.90	6.0	−20.0
17Q	137.6	130.4	63.1	−29.6	−29.6	14.9	10.0	409.2	0.59	5.98	−4.6	−11.8
18Q	104.6	123.9	36.4	−27.7	−36.6	16.1	4.8	366.0	0.59	6.04	−18.4	−3.2
19Q	73.4	118.1	9.3	−25.2	−41.6	16.8	−0.0	325.9	0.60	6.01	−31.5	5.1
20Q	45.9	111.7	−16.7	−21.4	−44.3	16.7	−4.1	285.3	0.59	5.77	−44.5	12.3
21Q	20.7	104.2	−40.6	−17.1	−45.2	15.9	−7.6	241.0	0.56	5.48	−58.4	18.2
22Q	−2.3	96.7	−62.4	−12.9	−44.8	14.6	−10.7	195.7	0.52	5.22	−72.4	23.3
23Q	−20.8	90.6	−81.5	−8.7	−42.8	12.9	−12.9	158.6	0.48	4.92	−84.1	27.4
24Q	−32.9	84.9	−96.1	−4.3	−38.8	10.8	−14.0	127.0	0.44	4.46	−93.6	30.0

Note: (1)–(7) 1.0 billion yen in 1960 prices.
(8), (11), (12) 1.0 billion yen in current prices.
(9) 1960 = 100.
(10) 1.0 thousand yen in current prices.

C. Interest Rate on Loans of All Banks (0.365% decrease)

	1 ΔV	2 ΔC	3 ΔI_p	4 ΔI_g	5 ΔJ_p	6 ΔE	7 ΔM	8 $\Delta(pV)$	9 Δp	10 Δw	11 ΔB_g	12 ΔB_a
1Q	214.4	0.0	202.6	−4.8	61.9	0.0	40.2	253.4	−0.11	1.48	82.3	−39.9
2Q	353.3	21.4	293.3	−20.2	238.4	−17.4	147.3	510.3	0.18	4.88	161.4	−155.1
3Q	514.9	50.0	439.9	−37.3	291.9	−28.5	177.5	798.3	0.45	7.80	263.4	−197.2
4Q	711.5	69.0	596.0	−47.1	293.1	−27.7	144.4	1069.1	0.45	9.34	350.9	−171.4
5Q	808.3	88.3	730.2	−58.6	258.2	−24.0	151.9	1242.4	0.54	12.23	388.9	−192.9
6Q	903.8	118.1	847.7	−79.4	238.3	−10.3	163.1	1481.5	0.90	17.27	442.9	−199.3
7Q	974.3	157.5	934.7	−101.1	214.4	−0.7	169.4	1709.0	1.31	21.75	505.2	−210.6
8Q	996.5	184.4	975.9	−117.1	180.3	11.5	167.8	1855.1	1.64	24.58	552.5	−210.5
9Q	969.7	195.3	989.5	−135.1	135.1	25.9	158.8	1948.4	2.00	28.47	578.4	−200.5
10Q	909.5	206.8	976.8	−155.9	84.0	42.4	144.9	2027.6	2.48	33.60	591.8	−180.6
11Q	836.1	220.9	939.9	−172.7	35.2	59.0	129.3	2089.5	2.94	37.49	607.8	−155.8
12Q	739.9	220.1	877.6	−179.3	−12.0	73.1	110.6	2078.1	3.25	39.49	604.5	−123.8
13Q	605.0	204.5	788.1	−183.2	−61.7	84.7	86.5	2004.1	3.53	42.53	578.0	−87.4
14Q	450.5	189.6	680.2	−187.9	−109.6	96.0	60.4	1914.0	3.86	46.32	541.6	−44.9
15Q	300.3	176.2	562.7	−186.8	−148.4	105.1	35.7	1816.7	4.12	48.46	508.7	−2.9
16Q	150.8	151.0	436.5	−174.9	−178.5	110.0	11.9	1666.6	4.24	48.75	461.9	39.4
17Q	−9.5	115.9	306.2	−163.3	−204.1	111.3	−12.5	1487.6	4.32	50.21	402.3	80.1
18Q	−168.9	85.1	176.2	−154.1	−223.8	111.1	−35.8	1320.7	4.42	52.34	342.8	121.5
19Q	−305.3	59.7	53.4	−141.1	−232.4	108.1	−55.0	1171.4	4.46	52.85	296.1	156.0
20Q	−418.1	26.8	−55.7	−120.5	−229.9	101.5	−69.7	1002.3	4.39	51.82	245.5	184.5
21Q	−522.2	−10.2	−151.2	−102.2	−222.0	92.1	−82.2	838.9	4.30	52.17	189.6	208.1
22Q	−611.8	−37.2	−233.0	−90.0	−209.5	81.8	−92.1	715.7	4.24	53.47	147.0	227.0
23Q	−668.6	−56.2	−294.1	−77.6	−188.4	70.4	−96.7	636.4	4.16	53.37	125.3	237.0
24Q	−692.3	−78.5	−330.0	−61.2	−159.0	57.2	−95.8	562.5	4.01	52.07	106.7	240.1

Note: (1)–(7) 1.0 billion yen in 1960 prices.
(8), (11), (12) 1.0 billion yen in current prices.
(9) 1960 = 100.
(10) Thousand yen in current prices.

it can safely be stated that the faster economic expansion accompanied by higher rate of capacity utilization, keener competition and stronger factor-substitution in Japan are likely to cause a shorter adjustment of actual to desired capacity output, thus giving a highly dynamic and fluctuating propensity to invest and a long-run swing of output and investment. The length of time needed for the convergence of our multiplier seems to be about thirty years while in the U.S. it is only 5 to 10 years, although the long-run equilibrium values do not differ very much. It should also be noted that this "Jugler" type investment cycle in Japan would have become more unstable had it not been for the higher leakage

TABLE 8

LONG-RUN EFFECT OF MULTIPLIER OF GOVERNMENT INVESTMENT IN REAL TERMS

	EPA Model (1966–1988 FY)				Wharton-EFU Model (1966–1975)	
Year	V	C	I_p	J_p	V	I_p
1	2.30	0.29	0.83	0.61	2.37	0.24
2	4.85	1.06	2.70	0.86	1.77	0.34
3	6.18	1.88	3.72	0.30	1.90	0.38
4	3.63	1.75	1.77	−0.75	—	—
5	0.39	0.84	−0.77	−0.91	2.05	0.33
6	−0.63	0.28	−1.59	−0.51	—	—
7	−0.35	0.10	−1.39	−0.09	—	—
8	0.58	0.17	−0.69	0.25	—	—
9	1.90	0.42	0.33	0.47	—	—
10	3.28	0.82	1.38	0.47	2.02	0.27
11	3.86	1.18	1.78	0.16	—	—
12	3.00	1.18	1.06	−0.26	—	—
13	1.57	0.86	−0.06	−0.43	—	—
14	0.70	0.53	−0.71	−0.32	—	—
15	0.53	0.34	−0.80	−0.13	—	—
16	0.81	0.29	−0.55	0.05	—	
17	1.32	0.35	−0.14	0.17	—	—
18	1.85	0.48	0.26	0.19	—	—
19	2.21	0.61	0.50	0.13	—	—
20	2.25	0.68	0.50	0.02	—	—
21	2.02	0.67	0.29	−0.07	—	—
22	1.70	0.60	0.04	−0.10	—	—
23	1.49	0.52	−0.12	−0.07	—	—

associated with her higher marginal propensity to save and higher marginal propensity to import. In summing up, we can roughly say that the Japanese multiplier is more investment-oriented and dynamic while the U.S.'s is more consumption-oriented and stable. This more dynamic response of our multiplier to the exogenous stimuli suggests, on the other hand, the need for stronger policy measures to counteract wider business fluctuation and instability, which is discussed later.

As regards to other fiscal policy measures, the multiplier of transfer payments is shown in Table 7B. As expected, the multiplier value is much smaller than that

of government investment in the first year, but becomes almost at the same level in second year and surpasses the government investment multiplier in the third year. This clearly reflects a slow but continuous rise in consumption over the first four years, though it tends to decline slowly afterwards. We also note that the share of fixed investment is again larger than in the U.S. case for the earlier period. As easily expected from the specification of our consumption function the multiplier of personal tax reduction has a slightly smaller value, though it follows a time pattern similar to transfer payments.

Lastly we shall discuss the multiplier of monetary policy, which is approximated by interest rate on loans of all banks. Over the past period, changes in the interest rate have frequently been made by the central bank, mostly through its discount rate and control of money stock, to counteract the wide fluctuations of business fixed investment and the international balance of payments. Table 7C indicates a fairly sensitive response to the change in monetary condition, which is explained largely by the traditional heavy reliance of Japanese firms on external funds associated with the high ratio of business fixed investment to corporate profits and a rapid increase in aggregate demand. As shown in the table, the rise in the interest rate affects business fixed investment, inventory investment and the balance of payments through an increase in imports in the first quarter. This quick response of fixed investment to changes in the interest rate and the gradual rise over time up to the eighth quarter will reflect behavioral and institutional characteristics of our fixed investment. The elasticity of the real GNP with respect to the interest rate is about -0.35 for the first year according to this simulation. From the view point of monetary policy it should also be noted that the effect is higher in the second than in the first year as in the case of other multipliers. A similar tendency is also found in the U.S. model for monetary policy, though in a much smaller degree [7]. Thus a recession of our economy experienced in 1964–1965 can be explained largely by this time lag of monetary and fiscal policy. A tight money policy, starting in early 1964, continued for one year, and brought about a stronger contracting effect in 1965 than in the previous year. Since fiscal policy in 1964–1965 was not fully prepared for this, government expenditure was not sufficient to cause the economy to recover to the normal output level by the end of 1965. Thus, our simulation analysis suggests the importance of intertemporal consideration of monetary and fiscal policy in particular for a rapidly growing economy with fairly sensitive business investment.

VI. Data Problems

As noted in the preceding sections, our quarterly model has encountered many difficulties in the statistical data.

First it must be noted that the "statistical discrepancy", obtained as residual between the income and expenditure accounts, tends to be greater on the quarterly basis than on the annual basis. The quarterly errors are usually about 1.7% of the GNP in mean absolute, while the annual ones are only 0.6%. These errors represent various elements, but the most significant are those due to change in inventories, difference between cash and accrual basis of government

expenditure, and sampling errors in particular of small business and farmers' income. As noted earlier, we used this discrepancy as one of the explanatory variables in the inventory investment function in view of its strong association with the data errors in inventory statistics. Needless to say this treatment to prevent exaggerated influence of inventory change on other variables will have to be replaced by the use of a more reliable statistical estimate of this item.

Second, the quarterly GNE needs to be checked against an alternative estimate obtained from value added data. This estimation is now being studied by the Economic Research Institute, EPA. The results will greatly serve not only as an alternative estimate for total output but also for improvement of the present GNE estimates, especially for eliminating volatile fluctuations of inventories due to data errors.

Lastly, in our experience with model-building, the inventory valuation adjustment was found to be rather inappropriate especially in explaining the changes in corporate profit itself or fixed business investment correlated with the profit. The adjustment is certainly useful for estimating inventory change, but for other purposes it mostly tends to obscure actual business behavior and to miss a critical turning point of the business cycle.

VII. Concluding Remarks

Our experiment in model-building and its use for short-run quarterly forecasting, described so far, seems to indicate the usefulness of our new quarterly national income accounts for projection and policy-making, despite certain weaknesses inherent in the quarterly accounts. It has been emphasized that the usefulness of these accounts especially for fiscal and monetary policy is enhanced when they are employed for econometric model-building together with other related data. As concluding remarks, we shall make in the following a few comments on the relationship between these accounts and other types of accounts for short-run forecasting.

First, as to the information on the detailed industrial breakdown of total output, our national accounts model can serve as a macro-economic basis for these analyses. The input-output model developed by the Planning Bureau of the EPA is already available for annual forecasting on a calender year basis regarding output and imports at the 60-sector level and employment, investment and capital stock at the 20-sector level. Once the aggregate final demand and its components are estimated by our quarterly model, the input-output model can break them down into further details, which can also serve as quite useful information for business planning and market research. In view of the highly dynamic nature of our business fixed investments, such an integrated use of the aggregate and sectoral models will help business to lighten the future risk, thus stabilizing the economy in line with our fast growing production potential.

For financial variables, the weakness of our model reflects largely the present position of our flow-of-funds accounts. The accounts have not yet been fully integrated with our national income accounts either statistically or conceptually, though the former are also available on quarterly basis. Thus it seems a little

premature to have a completely integrated econometric model including both types of accounts.

As mentioned earlier, our present model is designed as a pilot for a more detailed master model. In the latter model, major emphasis is now being placed on the link between the government and monetary sectors to include more explicitly the interaction between fiscal and monetary policy. Financial variables are also being estimated partly by employing the flow-of-funds accounts. As noted before, variables on wages and prices are to be disaggregated further in line with the break-down of consumption, exports and imports, etc. This block of wage and prices in the master model will be very useful in formulating medium-term structural policy dealing with specific sectorial prices, employment, productivity, etc.

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Un modèle macro-économétrique trimestriel de l'économie japonaise de l'après-guerre a été construit pour la période comprenant les années fiscales 1954 à 1965 sur la base de comptes trimestriels standardisés du revenu national. Le modèle est conçu de manière à faciliter la prévision économique à court terme et à permettre la formulation de politiques monétaires et fiscales adéquates. Des facteurs à plus long terme tels que la mobilité des travailleurs, le progrès technique, etc., ont également été pris en considération.

Le modèle consiste en cinquante trois équations reliées à la plupart des variables macro-économiques, aussi bien en termes monétaires qu'en termes réels; en principe, les équations ont été estimées par la méthode de la plus grande vraisemblance sur l'information minimale. Les principales variables exogènes liées à des instruments de politique économique sont les dépenses gouvernementales (transferts compris), des paramètres de fonctions d'imposition, le taux d'intérêt, les prix et tarifs contrôlés par l'autorité gouvernementale, etc. Dans la formulation du modèle, des relations non-linéaires ont été introduites chaque fois que cela est apparu indispensable.

La capacité de prévision du modèle a été soumise à un test dont les résultats se sont avérés être satisfaisants pour la période considérée ainsi que pour l'année fiscale 1966. Des multiplicateurs reliés aux politiques monétaires et fiscales ont également été obtenus, et indiquent les caractéristiques dynamiques de l'économie japonaise, représentées en particulier par l'investissement dynamique fixe des entreprises, en comparaison avec les multiplicateurs correspondants des modèles americains.

Bien que ce modèle soit exploratoire et soit sensé servir de coeur à un « Modèle Patron » moins aggregatif, son utilité pour nos propos a été reconnue, ainsi que celle des données trimestrielles de notre comptabilité nationale pour la construction de modèles. Cependant, ces données trimestrielles doivent encore être améliorées, particulièrement en ce qui concerne l'accord entre le revenu et la dépense et l'intégration avec les comptes de flux des fonds.