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A Macroeconometric Model of Japan with Rational Expectations

by

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1. Introduction

The literature on rational expectations has criticized traditional macroeconometric models and policy evaluations with them, on the grounds that the models take inadequate account of the effects of alternative policy rules on the expectations formed by the economic agents. Lucas(1976) argues that the problem stems from the static expectations mechanisms embedded in these models, where current and lagged variables are used as proxies for expected variables. He points out that a change in policy rules induces the economic agents to revise their expectations. However the traditional models are simulated under the assumption that agents' expectations for the behavior of shocks to the system are invariant under changes in the true behavior of these shocks. So simulations using these models can provide no useful information as to the actual consequences of alternative economic policies because of the deviations between the prior true model structure and the true structure prevailing after policy changes.

A simple way to model the expectations mechanism is to incorporate the rational expectations hypothesis. The hypothesis is that the agents form subjective expectations of economic variables identical to the objective expectations of the true process generating it conditional on all information available at the time. The "rational expectations approach" to macroeconomic stabilization analysis builds upon three distinct hypothesis: (1) expectations are formed rationally as explained above, (2) price is perfect flexible to move toward its market-clearing value, and (3) aggregate supply is inelastic with respect to expected change in the price level, which is called the natural rate hypothesis.

When the hypothesis (1) is combined with the hypothesis (2) and (3), the expected change in monetary or fiscal policy have no effect on the real output.[1/] In this paper, we present a small macroeconometric model of the Japanese economy based on the hypothesis (1) and (2). However we do not assume the hypothesis (3) a priori.

The basic sample period that is used to estimate the model is 1967:II - 1980:I. The period includes both the fixed exchange rate system and the floating system. The drastic shift of international monetary regime can be imagined to have effect on the economic behavior. We treat the foreign exchange rate as fixed constant during the period prior to 1973:I and as endogenous variable during the period after 1973:II. We conduct policy simulations and reveal the differences among the responses of the model to fiscal or monetary shocks under fixed or floating exchange regime. We also present a macroeconometric model with static expectations hypothesis to compare the dynamic properties between rational and non rational model.

In section 2, the model used in this paper is decribed. Section 3 shows the estimated results. In section 4, we compare and evaluate the effect of policy change on the endogenous variables. Section 5 presents the non rational expectations model and its dynamic properties.

2. The model

The model can be partitioned into the following five models: aggregate supply, aggregate demand, income distribution, financial market and foreign exchange market. The model includes the expected values of some endogenous variables. We assume that the economic agents are rational in the sense that they know the model and use all the available informations in the system in forming their expectations.

A key feature of this model is that the price is taken to be perfectly flexible in the sense of adjusting so as to equate aggregate supply and demand. In this regard, the model differs from the traditional macroeconometric models based on the income-expenditure approach.

All variables are expressed in natural logarithms with the exception of interest rates.

2.1 The aggregate supply

The aggregate production function is Cobb-Douglass with constant returns to scale:

$$Y_t = a_0 + a_1 LH_t + (1 - a_1) K_{t-1} \tag{1}$$

where Y_t is the real output, LH_t is the labor input in manhours, and K_t is the real capital stock at the end of the period. We assume that the labor input is determined by the marginal condition:

$$a_2 + Y_t - LH_t = W_t - P_t \tag{2}$$

where $a_2 = \ln a_1$, W_t is the nominal wage per manhour and P_t is the output price. Solving (1) and (2) we get:

$$Y_t = \frac{a_0 + a_1 a_2}{1 - a_1} + \frac{a_1}{1 - a_1} (P_t - W_t) + K_{t-1} \qquad (3)$$

$$LH_t = \frac{a_0 + a_2}{1 - a_1} + \frac{1}{1 - a_1} (P_t - W_t) + K_{t-1} \qquad (4)$$

Equation (3) and (4) determine the aggregate supply and the labor input, given the capital stock at the end of the previous period, the output price and the wage rate.

We assume a logarithmic first-order adjustment mechanism relating the number of employees to the labor input:

$$L_t - L_{t-1} = b_0 + b_1 (LH_t - LH_{t-1}) \qquad (5)$$

where L_t is the number of employees, b_0 is the time trend factor which reflects the institutional decrease in the average hours per employee. We define the unemployment rate, RU_t, as the function of the number of employees and the working age population:

$$RU_t = c_0 + c_1 L_t + c_2 POP_t \qquad (6)$$

where POP_t is the working age population.

We assume the expectations-augmented Phillips relations for the labor market.

$$W_t - W_{t-1} = d_0 + d_1 (E_{t-1} P_t - P_{t-1}) + d_2 RU_t \qquad (7)$$

where $E_{t-1} P_t$ is the expected value of P_t conditional on the information available at the end of the previous period t-1. If $d_1 = 1$, it provides a vertical Phillips curve postulated by the monetarists. However we leave the question of whether or not d_1 should be equal to unity as an open one and estimate it by the data.

2.2 The aggregate demand

Bilson(1980) estimated the aggregated consumption function based upon the rational expectations - permanent income hypothesis, where the change in consumption is related to the unanticipated change in real income. He demonstrated that the permanent income changes only in response to the innovations in the stochastic income stream which includes a revision in the household's forecasts of future income. In addition he observes that household with high real interest rates reacts more strongly to the unanticipated change in the real income than do those facing low interest rates. Ban(1981) also observes that the change in the real interest rate induces the change in the parameters of consumption function. Accordingly to these facts, we postulate the consumption function:

$$C_t - C_{t-1} = e_0 + e_1 (YDR_t - E_{t-1} YDR_t) + e_2 [RDT_t - (E_{t-1} P_t - P_{t-1})] \quad (8)$$

where C_t is the real consumption expenditures, YDR_t is the real disposable income, $E_{t-1} YDR_t$ is the expected value of YDR_t conditional on the information available at the end of the previous period t-1, and RDT_t is the interest rate of time deposit.

The fixed investment function used in this study is of the following form:

$$I_t = f_0 + f_1 Y_t + f_2 K_{t-1} + f_3 [RL_t - (E_{t-1} P_t - P_t)] \qquad (9)$$

where I_t is the gross fixed investment and RL_t is the corporate bond rate. The presence of the expected real interest rate reflects the rental cost of capital taking account of expected inflation.

We formulated the exports and imports functions with partial adjustment mechanism:

$$EX_t = g_0 + g_1 EW_t + g_2 (FXR_t + PEW_t - P_t) + g_3 EX_{t-1} \qquad (10)$$

$$IM_t = h_0 + h_1 Y_t + h_2 (FXR_t + PIM_t - P_t) + h_3 IM_{t-1} \qquad (11)$$

where EX_t is the real exports, EW_t is the real world trade, FXR_t is the foreign exchange rate, PEW_t is the world trade price, IM_t is the real imports and PIM_t is the imports price.

2.3 The income distribution

We consider the determinants of the personal income and its disposable income. The personal income consists of the compensation of employees and proprietors' and rental income. The personal income function is:

$$YP_t = i_0 + i_1 (W_t + LH_t) + i_2 (\ln RDT_t + NW_{t-1}) \qquad (12)$$

where YP_t is the personal income and NW_t is the net worth at the end of the period. The disposable income function is:

$$YD_t = j_0 + j_1 \, YP_t + j_2 \, RTAX_t \tag{13}$$

where YD_t is the disposable income and $RTAX_t$ is the average income tax rate.

2.4 The financial market

The main task of this sector is to determine the short-term and long-term interest rate. These interest rates influence the aggregate demand directly or via the effects on the foreign exchange market.

The LM curve relates the demand for real blances to the real income and the short-term interest rate:

$$M_t - P_t = k_0 + k_1 \, Y_t + k_2 \, RCL_t \tag{14}$$

where M_t is the money supply and RCL_t is the short-term interest rate. Equation (14) characterizes equilibrium in the money market. This determines the nominal short-term interest rate, given M_t, P_t and Y_t.

The term structure relates the long-term interest rate to the current level and most recent history of the short-term interest rate.

$$RL_t = l_0 + l_1 \, RCL_t + l_2 \, RCL_{t-1} + l_3 \, RL_{t-1} \tag{15}$$

2.5 The foreign exchange market

We assume the market-clearing equation in the foreign exchange market to be of the following specific form:

$$FXR_t^* = m_0 + m_1 \, (M_t - USM_t) + m_2 \, (Y_t - USY_t)$$

$$+ m_3 (RCL_t - RTB_t) \quad (16)$$

$$FXR_t - FXR_{t-1} = \delta (FXR_t^* - FXR_{t-1}) \quad (17)$$

where FXR_t is the foreign exchange rate (yen/dollar), FXR_t^* is the desired value, USM_t is the U.S. money supply, USY_t is the U.S. real output and RTB_t is the U.S. short-term interest rate (Treasury bill rate). δ is the partial adjustment coefficient. Equation (16) can be derived from the theory of monetary approach to the foreign exchange rate.[2/]

3. Estimation of the model

The model has 19 endogenous variables, 16 behavioral equations and 3 definitional identities, and 13 exogenous variables. The model includes the expected values of endogenous variables P_t and YDR_t, denoted by $E_{t-1} P_t$ and $E_{t-1} YDR_t$. We use the following procedures to estimate the coefficients of the model, which is proposed by Fair(1979).

(i) The equations (19), (20), (25), (26), (28) and (30) are estimated by ordinary two stage least squares.[3/]

(ii) The equations (18), (21), (27), (29), (31), (32) and (33) are estimated by two stage least squares under the assumption of first-order serial correlation of the error terms. Fair(1970)

(iii) Each of the 13 exogenous variables is regressed on 1 and its first six lagged values, and predicted values of these exogenous variables are obtained.

(iv) An iterative procedure is used to estimate the equation with the rationally expected variables, (22), (23) and (24). First given initial guess for $E_{t-1} P_t$ and $E_{t-1} YDR_t$ which are calculated from a regression of each variables, P_t and YDR_t, on 1, all the lagged endogenous variables in the model and the predicted values of the 13 exogenous variables obtained in (iii), equations (22) - (24) estimated by two satge least squares. Given these estimates, the model is solved for $E_{t-1} P_t$ and $E_{t-1} YDR_t$ with the predicted values of the exogenous variables replacing the actual values. This new set of values for $E_{t-1} P_t$ and $E_{t-1} YDR_t$ is used to obtain a new set of estimates. The iterative procedure is stopped when the successive values of $E_{t-1} P_t$ and $E_{t-1} YDR_t$ are within a prescribed tolerance level. In this case, the convergence occurs after 11 iterations.

The model is estimated using seasonally adjusted quarterly data from the period 1967:II to 1980:I. However we treat the foreign exchange rate as fixed and constant variable during the period prior to 1973:I. So the sample period for the equation (31) is from 1973:II to 1980:I. The sources of data are given in the Appendix. The number in the parenthesis is asymptotic t-value.

3.1 The aggregate supply

$$P_t - W_t = \underset{(7.78)}{-2.4198} + \underset{(2.92)}{0.6754}\,(Y_t - K_{t-1}) \tag{18}$$

$$R^2 = 0.992 \qquad SE = 0.0251 \qquad DW = 1.92 \qquad \underset{(177.4)}{\rho = 0.9957}$$ [4/]

$$LH_t - K_{t-1} = \underset{(12.55)}{0.2757} + \underset{(141.9)}{1.3327}\,(P_t - W_t) \tag{19}$$

$$R^2 = 0.998 \qquad SE = 0.0191 \qquad DW = 1.75$$

Solving the equation (3) for $P_t - W_t$, we get the equation (18). These two equations should be estimated jointly with cross-equation restrictions as indicated in (3) and (4). However we estimated them separately without restrictions for computational ability. So the estimated marginal productivity of labor input in (18) is 0.5969 which differs from that of (19), 0.2496.

$$L_t - L_{t-1} = \underset{(4.40)}{0.00215} + \underset{(6.54)}{0.3328}\,(LH_t - LH_{t-1}) \tag{20}$$

$R^2 = 0.987 \quad SE = 0.00351 \quad DW = 2.45$

$$RU_t = \underset{(1.03)}{-0.1679} - \underset{(3.48)}{0.1159}\, L_t + \underset{(4.80)}{0.1304}\, POP_t \tag{21}$$

$R^2 = 0.959 \quad SE = 0.00087 \quad DW = 1.73 \quad \rho = \underset{(19.47)}{0.8810}$

$$W_t - W_{t-1} = \underset{(5.53)}{0.06416} + \underset{(3.68)}{0.4586}\,(E_{t-1} P_t - E_{t-2} P_{t-1}) - \underset{(2.81)}{2.4045}\, RU_t \tag{22}$$

$R^2 = 0.296 \quad SE = 0.0188 \quad DW = 2.64$

The equation (20) indicates that one percent change in labor input induces one-third percent change in the number of employees and the average hours worked decrease about 0.2 percent per quarter. Estimating the eaquation (22), we replaced P_{t-1} in the equation (7) with $E_{t-2} P_{t-1}$, which is the conditional expectation of P_{t-1} on the information available at the end of the period t-2, for the degree of goodness-of-fit. The coefficient of expected inflation is 0.4586 which is significantly different from 1. So the Phillips curve is not vertical in our RE model.

3.2 The aggregate demand

$$C_t - C_{t-1} = \underset{(8.75)}{0.01599} + \underset{(3.00)}{0.2828}\,(YDR_t - E_{t-1} YDR_t) + \underset{(1.22)}{0.1475}\,[RDT_t/400 - (E_{t-1} P_t - E_{t-2} P_{t-1})] \tag{23}$$

$R^2 = 0.280 \quad SE = 0.0129 \quad DW = 2.01$

$$I_t = -4.2492 + 1.5836\, Y_t - 0.3639\, K_{t-1} \qquad \text{t-values: } (2.43)\;(5.10)\;(1.74)$$

$$- 0.2101\, [\, RL_t / 400 - (E_{t-1} P_t - E_{t-2} P_{t-1})\,] \qquad (1.19) \qquad (24)$$

$$R^2 = 0.995 \qquad SE = 0.0265 \qquad DW = 1.31 \qquad \rho = 0.9349\ (19.47)$$

It is noticeable that the consumption function exhibits no serial correlation in the residuals. The absence of serial correaltion is a necessay condition for the validity in the model with the rational expectations - permanent income hypothesis. We replaced P_{t-1} in (8) and (9) with $E_{t-2}\, P_{t-1}$ for the same reason as the wage equation. The twenty eight percent of the unanticipated income change is applied toward the consumption expenditures. The significant level of real interest rates in both equations (22) (23) is low, but the sign condition is satisfied.

$$EX_t = 0.2985 + 0.2996\, EW_t + 0.1276\, (FXR_t + PEW_t - P_t) \qquad (0.57)\;(3.79)\;(3.13)$$

$$+ 0.8184\, EX_{t-1} \qquad (17.99) \qquad (25)$$

$$R^2 = 0.996 \qquad SE = 0.0287 \qquad DW = 1.82$$

$$IM_t = -0.8025 + 0.2067\, Y_t - 0.09878\, (FXR_t + PIM_t - P_t) \qquad (1.55)\;(2.12)\;(3.00)$$

$$+ 0.8316\, IM_{t-1} \qquad (12.17) \qquad (26)$$

$$R^2 = 0.991 \qquad SE = 0.0298 \qquad DW = 1.70$$

The short-run income elasticity of exports is 0.30, while the long-run elasticity is 1.65. The corresponding price elasticities are 0.13 and 0.70. On the other hand the income elasticities of imports are 0.21 in the short-run and 1.23 in the long-run, while the corresponding price elastcities are 0.10 and 0.59.

3.3 The income distribution

$$YP_t = \underset{(3.30)}{0.3587} + \underset{(26.08)}{0.9256} \left(W_t + LH_t \right) + \underset{(1.12)}{0.03757} \left[\ln(RDT_t) + NW_{t-1} \right] \tag{27}$$

$R^2 = 1.000$ SE = 0.0218 DW = 2.34 $\rho = \underset{(6.19)}{0.6634}$

$$YD_t = - \underset{(58.13)}{0.3258} + \underset{(220.9)}{0.9993}\, YP_t - \underset{(55.17)}{0.09874}\, RTAX_t \tag{28}$$

$R^2 = 1.000$ SE = 0.00171 DW = 1.92

3.4 The financial market

$$RCL_t - RN_t = \underset{(20.75)}{3.7479} - \underset{(4.23)}{8.8578} \left(M_t - P_t \right) + \underset{(5.50)}{10.2130}\, Y_t \tag{29}$$

$R^2 = 0.824$ SE = 0.430 DW = 1.81 $\rho = \underset{(15.05)}{0.8983}$

$$RL_t = \underset{(2.79)}{1.4948} + \underset{(7.14)}{0.3175}\, RCL_t - \underset{(3.34)}{0.1986}\, RCL_{t-1} + \underset{(7.45)}{0.7144}\, RL_{t-1} \tag{30}$$

$R^2 = 0.933$ SE = 0.264 DW = 1.94

Solving the market-clearing condition (14) for RCL_t and replacing it with $RCL_t - RN_t$, we get the estimated equation (29). The estimated value of real income ealsticity is 1.15, which is impossible to reject the hypothesis of unit elasiticy at 95 percent significant level.

3.5 The foreign exchange market

$$FXR_t = \underset{(0.05)}{0.1440} + \underset{(2.94)}{0.4022} (M_t - USM_t) - \underset{(0.26)}{0.1588} (Y_t - USY_t)$$

$$+ \underset{(2.35)}{0.01515} (RCL_t - RTB_t) + \underset{(2.94)}{0.5978} FXR_{t-1} \qquad (31)$$

$$R^2 = 0.931 \qquad SE = 0.0405 \qquad DW = 1.79 \qquad \rho = \underset{(3.72)}{0.5909}$$

According to the monetary approach, the system is homogenous of degree one in nominal variables. We estimated the equation with the restriction that the long-run elasticity of money supply for foreign exchange rate is equal to 1. The estimated long-run income elasticity is 0.395 and the interest rate semi-elasticity is 0.038.

3.6 Miscellaneous equations and identities

$$PC_t - PC_{t-4} = \underset{(1.51)}{0.01427} + \underset{(10.01)}{0.9226} (P_t - P_{t-4}) \qquad (32)$$

$$R^2 = 0.952 \qquad SE = 0.0096 \qquad DW = 1.95 \qquad \rho = \underset{(9.58)}{0.8352}$$

$$K_t - K_{t-1} = \underset{(28.89)}{0.09120} + \underset{(21.55)}{0.03486} (I_t - K_{t-1}) \qquad (33)$$

$$R^2 = 0.962 \quad SE = 0.00148 \quad DW = 2.05 \quad \rho = 0.3986 \tag{3.10}$$

The equations (32) and (33) determine the consumption price deflator PC_t and the real capital stock K_t respectively. These are so-called statistical equations in our model.

$$Y_t = \ln\ (\ \exp(C_t) + \exp(I_t) + \exp(G_t) + \exp(EX_t) - \exp(IM_t) + \exp(Z_t)\ ) \tag{34}$$

$$YDR_t = YD_t - PC_t \tag{35}$$

$$NW_t = \ln\ (\ \exp(YD_t) - \exp(C_t + PC_t) + \exp(NW_{t-1})\ ) \tag{36}$$

Identities (34), (35) and (36) determine the aggregate demand, the real disposable income and the net worth respectively.

4. Simulation analysis

4.1 Solution of the model

The model can be considered as a block recursive system which consists of two blocks. Each block has 19 endogenous variables. The first block is solved using the predicted values of all the exogenous variables in place of the actual values.[5/] It produces the expected values of P_t and YDR_t, $E_{t-1}\ P_t$ and $E_{t-1}\ YDR_t$. The expected values of these endogenous variables and the actual values of all the exogenous variables are used to solve the second block. When the dynamic simulation is conducted, the predicted values of the lagged endogenous variables which are soultions of the second block in the previous period are used in place of the actual values.

We carry out two simulation experiments to test the ex-post predictive performances, which are the one-period static prediction and the full--period dynamic prediction over the within-sample period 1967:II - 1980:I. The Theil's inequality coefficients of representative variables, Y_t, P_t, RCL_t and FXR_t are 0.00057, 0.0274, 0.0315 and 0.00252 respectively for the one-period static prediction, and 0.00231, 0.2259, 0.0936 and 0.00505 respectively for the full-period dynamic prediction. The discrepancy between the actual value and the predicted value of P_t is very large as compared with the other variables in the case of dynamic prediction. This fact might throw doubt on the hypothesis that the price is perfectly flexible in the sense of adjusting so as to equate the aggregate supply and the aggregate demand immediately.

4.2 The short-run aggregate supply and demand schedules

We reveal the short-run aggregate supply and demand schedules in our model, which are relationships between the quantity of output and the level of price. The traditional approach to macroeconomic stabilization analysis assumes that the short-run aggregate supply is quite flat for the reason that an expansion in output has relatively little effect on costs and prices in the short-run. So a rightward shift of aggregate demand schedule, which is caused by the expansionary fiscal policy in the form of increased government spending, leads to an increase in the real output. However the "rational expectations approach" insists that the anticipated change in fiscal or monetary policy has no effect on the real output. Because the short-run aggregate supply schedule is vertical when the policy change is anticipated. So the expansionary policy leads only to an increase in the price level.

In Figure 1, we show the short-run aggregate supply and demand schedules embedded in our model every fifth year. We have derived these schedules as follows: (i) The supply schedule is the locus of points generated by the intersection of the aggregate supply and demand schedules when we vary the level of real government expenditures arbitrarily given the supply schedule. The solid line of the supply schedule is based on the assumption that the change in real government expenditures is unanticipated by the economic agents at the end of the previous period. On the other hand, the chain line is based on the assumption that the change is anticpated. (ii) The demand schedule is the locus of points generated by the intersection of the aggreagate supply and demand schedules when we vary the constant term of price equation (18) arbitrarily given the demand schedule.

The price elasticity for the aggregate supply is invariable as years go on. The value is 1.318 in the unanticipated case and 0.714 in the anticipated case. The short-run aggregate supply schedule is not vertical in our model, even if the policy change is anticipated. The price elasticity for the aggregate demand is 0.090 in 1970:I, and 0.098 in 1975:I and 1980:I. This implies that the price elasticity for the aggregate demand is a little higher in the floating exchange rate regime than in the fixed exchange rate regime. However the aggregate demand is inelastic for the change in the price level in general. So an upward shift of aggregate supply schedule caused by an external shock such as the oil crisis may lead to a very high inflation unless the aggregate demand schedule is moved to the left by the cut of government spendings. Figure 1 also implies that the first oil crisis in 1973-74 shifted the short-run aggregate supply schedule in the unanticipated case, but the second oil crisis in 1979-80 did not shift it so far.

4.3 The dynamic effects of policy change

We investigate the effects of fiscal and monetary policy on the economy with the innovation-simulation technique where innovations from time series process of policy variable are used in conducting simulation experiments.[6/] The procedure is essentially as follows: for example, let the exogenous policy variable G_t be an autoregressive process of order n.

$$G_t = \sum_{i=1}^{n} \phi_i G_{t-i} + u_t \qquad (37)$$

where u_t is a white-noise error process. G_t is shocked upwards at time T from its historical value by an amount $\tilde{u}$. It is clear that the difference between the shocked path of G_{T+i} and the control path of G_{T+i}, $\tilde{u}$, $\phi_1\tilde{u}$, $\phi_1^2\tilde{u} + \phi_1\phi_2\tilde{u}$ and so on, follows the time series process decribed by (37). Because the time series process of policy variables is not altered by this procedure, a simulation experiment using the above shocked path of G_{T+i} would be less likely to change the strucure of the model even if the static expectations mechanisms are implicitly embedded in the model. Figure 2 traces out the responses of the fiscal and monetary policy variables, G_t and M_t, to a 1 trillion innovation at time 0.[7/] Figures 3-6 illustrate the responses of selected endogenous variables during the first 28 quarters to an innovation in the fiscal and monetary policy described above.[8/] Simulation experiments are carried out on the two different assumptions about the foreign exchange rate system: the floating exchange rate system and the fixed exchange rate system. In the case of fixed exchange rate system, we treat the foreign exchange rate as the exogenous variable.[9/] The paths of G.FXR and M.FXR in the figures indicate the responses of each endogenous variable to the fiscal and monetary innovation respectively in the floating exchange rate system. On the other hand, the paths of G and M in the figures indicate the responses of each endogenous variable in the fixed exchange rate system.

Figure 3 shows that an innovation in the fiscal policy has a sharp immediate expansionary effect on the real output, and its effect is damped but continued during the subsequent quarters. According to the "rational expectations approach" to macroeconomic stabilization analysis, an unanticipated expansionary policy change obtains most of its effect in the first quarter by raising the price level of output which brings about a higher real output, but fairly soon the price level is caught up by the nominal wage rate and the real output falls to the previous level in the absence of the expansionary policy innovation. This neutrality proposition rests mainly on the natural rate hypothesis which presumes the real wage rate to be unaffected by the nominal variables. However it seems that the natural rate hypothesis does not hold in our model. The effect on the nominal wage rate is relatively smaller than the corresponding effect on the price level. So an expansionary fiscal policy can increase real output through less real wage rate.

The effect of fiscal policy under the floating exchange rate system is a little larger and longer lasting than the corresponding effect under the fixed exchange rate system. On the other hand, monetary expansion is more effective in raising the real output under the floating exchange rate system, where it is supported by an induced exchange rate depreciation illustrated in Figure 6, than under the fixed exchange rate system.

The IS schedule embedded in our model is nearly vertical. So the expansionary monetary policy which causes the LM schedule to shift rightwards results in lower interest rate only and has little effect on the equilibrium of real output and price level in the short-run. These characteristics in our model differs from that of the monetarist model where monetary innovation is the dominant factor contributing to economic fluctuations and fiscal innovation has only a transitory impact on economic activity.[10/]

5. The model with non rational expectations model

We present the macroeconometric model with non rational static expectations. What differs from the rational expectations model in the previous section is that the rationally expected variables, $E_{t-1}\ YDR_t$, $E_{t-1}\ P_t$ and $E_{t-2}\ P_{t-1}$, are replaced by YDR_{t-1}, P_{t-1} and P_{t-2} respectively. The estimation results by two stage least squares are:

$$W_t - W_{t-1} = \underset{(4.79)}{0.04699} + \underset{(5.83)}{1.0585} (P_{t-1} - P_{t-2}) - \underset{(3.74)}{1.9499}\ RU_t \qquad (37)$$

$$R^2 = 0.564 \qquad SE = 0.0148 \qquad DW = 2.87$$

$$C_t - C_{t-1} = \underset{(5.33)}{0.01099} + \underset{(5.10)}{0.3309} (YDR_t - YDR_{t-1})$$

$$+ \underset{(2.24)}{0.3218} [RDT_t/400 - (P_{t-1} - P_{t-2})] \qquad (38)$$

$$R^2 = 0.436 \qquad SE = 0.0114 \qquad DW = 2.44$$

$$I_t = - \underset{(2.82)}{4.8371} + \underset{(5.28)}{1.6786}\ Y_t - \underset{(1.98)}{0.4140}\ K_{t-1}$$

$$- \underset{(1.47)}{0.9481} [RL_t/400 - (P_{t-1} - P_{t-2})] \qquad (39)$$

$$R^2 = 0.986 \qquad SE = 0.0267 \qquad DW = 1.39 \qquad \rho = \underset{(17.17)}{0.9141}$$

The coefficient of expected inflation is 1.0585. So the natural rate hypothesis seems to be supported in this non rational expectations model. The degree of goodness-of-fit in (37) and (38) is better than that of the rational expectations version (22) and (23). However the performance of the non rational expectations model is worse than that of the rational expectations model. The Theil's inequality coefficients of representative variables, Y_t, P_t, RCL_t and FXR_t are 0.00060, 0.0282, 0.0311 and 0.00251 respectively for the one-period static prediction, and 0.00306, 0.2975, 0.1098 and 0.00620 respectively for the full-period dynamic prediction over the within-sample period 1967:II - 1980:I.

Figures 7-10 illustrate the responses of selected endogenous variables during the first 28 quarters to an innovation in the fiscal and monetary policy decribed in the previous section. Figure 7 shows that an innovation in the fiscal policy has a sharp immediate expansionary effect on the real output. However the output price level is caught up by the nominal wage rate and the real output falls sharply below the level in the absence of the expansionary policy innovation. This phenomenon which supports the neutrality proposition of the "rational expectations approach" is quite different from that of the estimated rational expectations model in the previous section. The impact of the money expansion on the real output also becomes negative after three years. The fiscal innovation raises the price level to a peak after two or three years and then reduces it, while the monetary innovation raises the price level continually though the impact on the real output turns to negative.

6. Conclusions

The purpose of this paper is to present a small macroeconometric model of the Japanese economy when expectations are formed rationally. The estimated results imply that the natural rate hypothesis does not hold in our model: that is, there exists a Phillips curve tradeoff between the real output and the price level. So the systematic part of policy has real effect on the economy though the anticipated policy action is less effective than the unanticipated. On the other hand, we present another macroeconometric model when expectations are formed non-rationally. The natural rate hypothesis holds in this non-rational expectations model, which contrasts in a striking way with the rational expectations model. This fact implies the following paradoxical proposition that an expansionary policy action has persistent positive real effect on the economy in the case of the rational expectations model, while it has transitorily positive but negative real effect in the long-run in the case of the non-rational expectations model. The rational expectations is itself no reason to conclude that we should give up on stabilization policy.

However the results of this paper should be interpreted with the usual degree of causion. They are dependent on the particular model which may not be a good representation of the economy. The model does not include the future expectations variables for simplification. In spite of these caveats, it appears from the present result that the introduction of rational expectations to a macroeconometric model does not always make it more classical or monetarist in its behavior.

Figure 1. Short-run aggregate supply and demand schedules

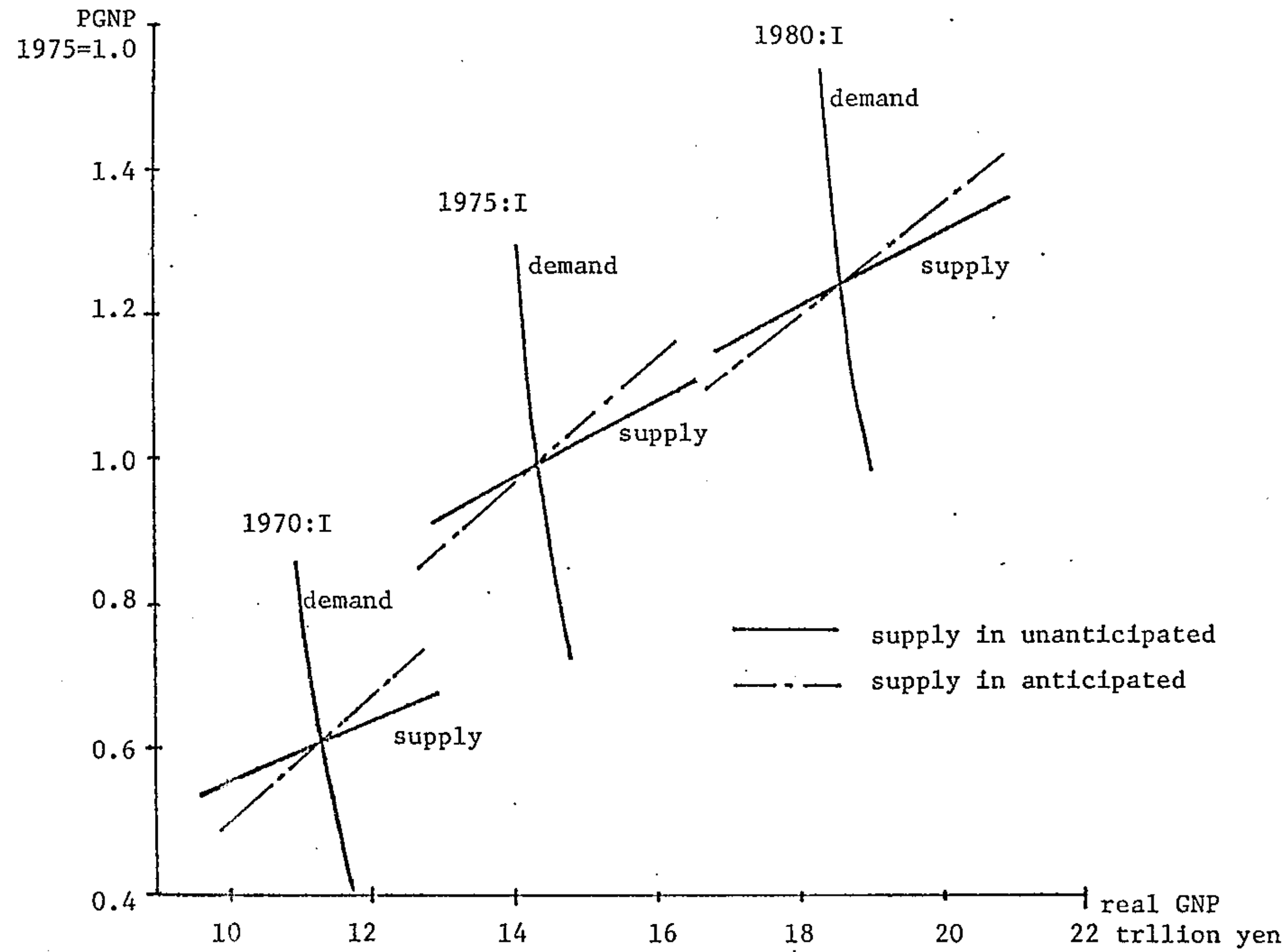


Figure 2. Responses of the G and M to a 1 trillion innovation

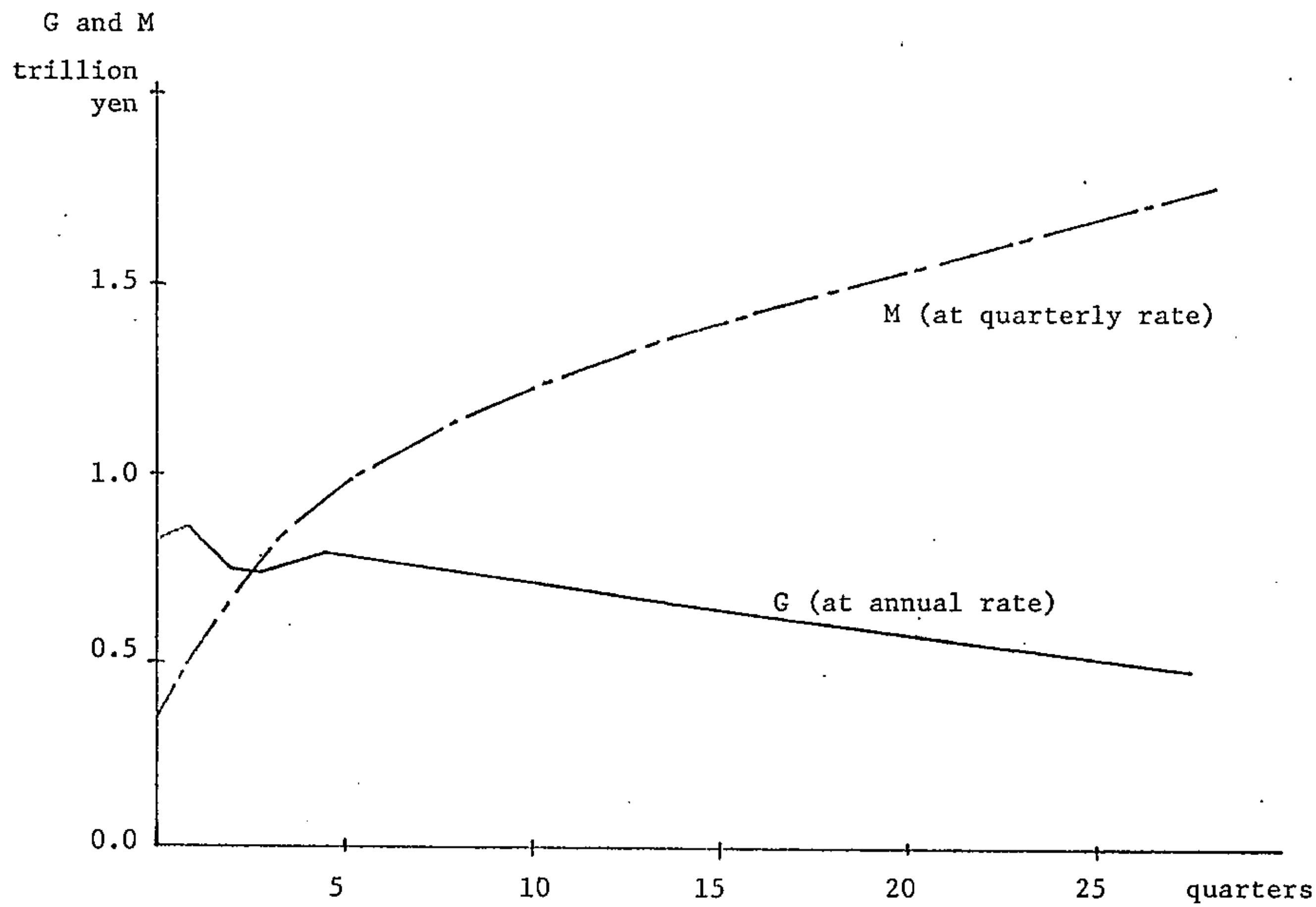


Figure 3. Response of the real GNP to a 1 trillion innovation in the fiscal and monetary policy - RE model -

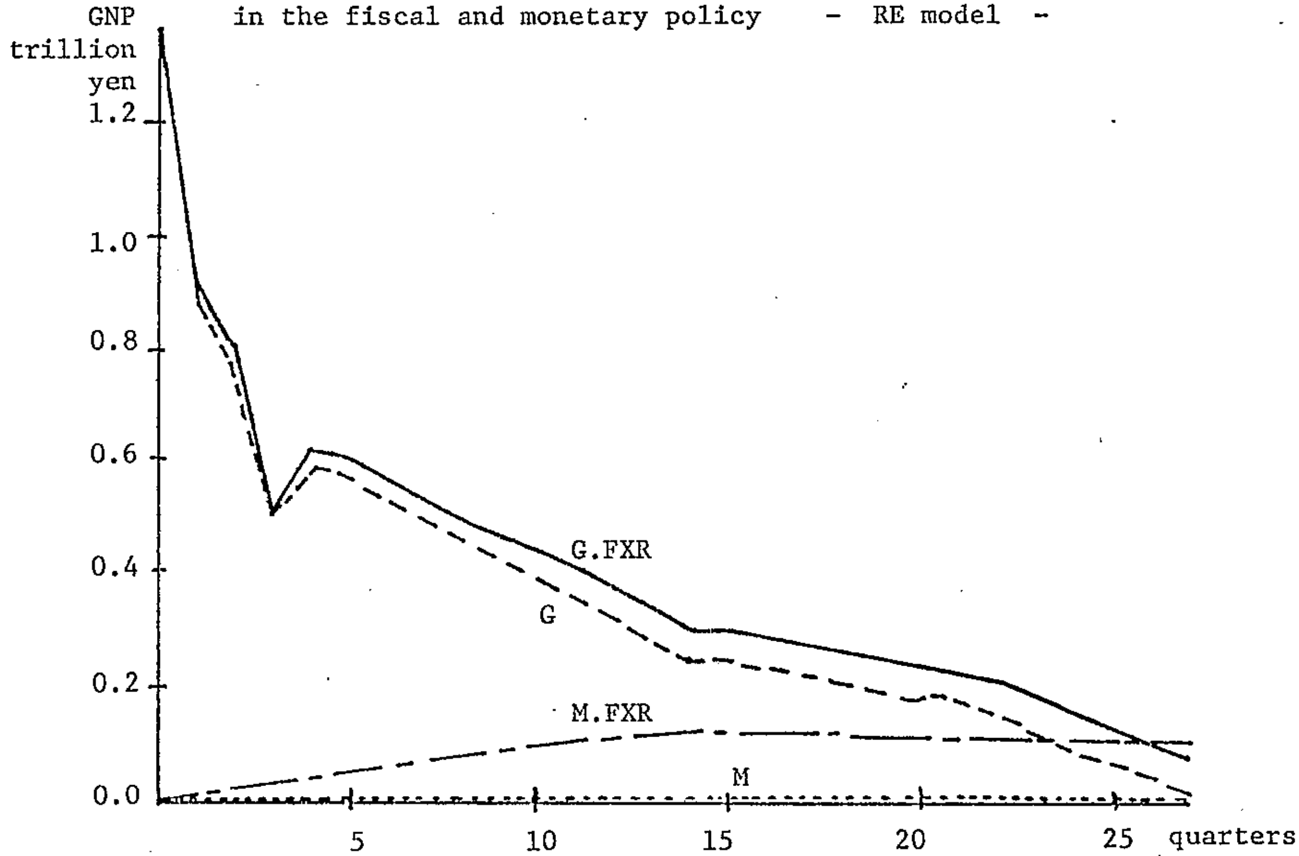


Figure 4. Response of the GNP defaltor to a 1 trillion innovation in the fiscal and monetary policy - RE model -

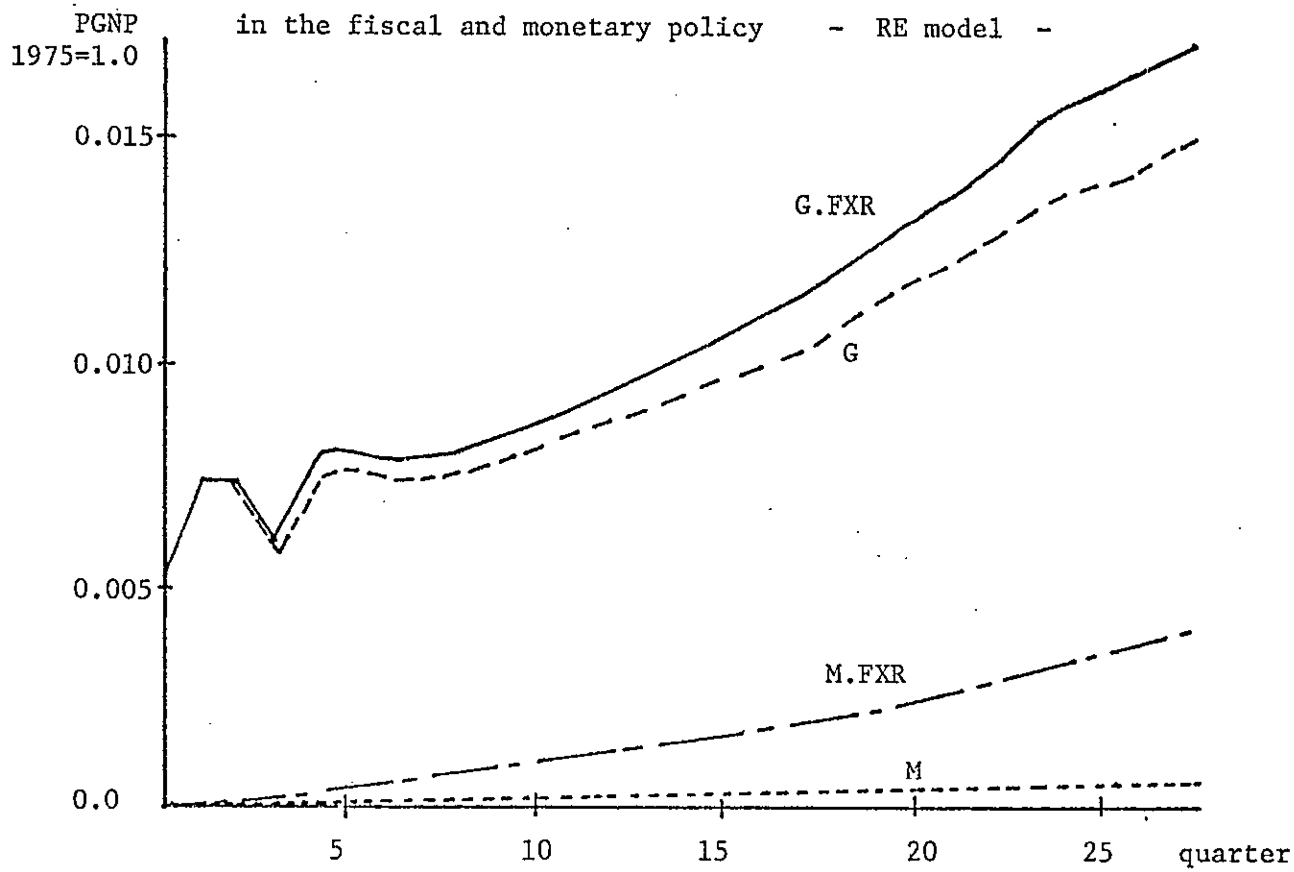


Figure 5. Response of the RCL to a 1 trillion innovation in the fiscal monetary policy - RE model -

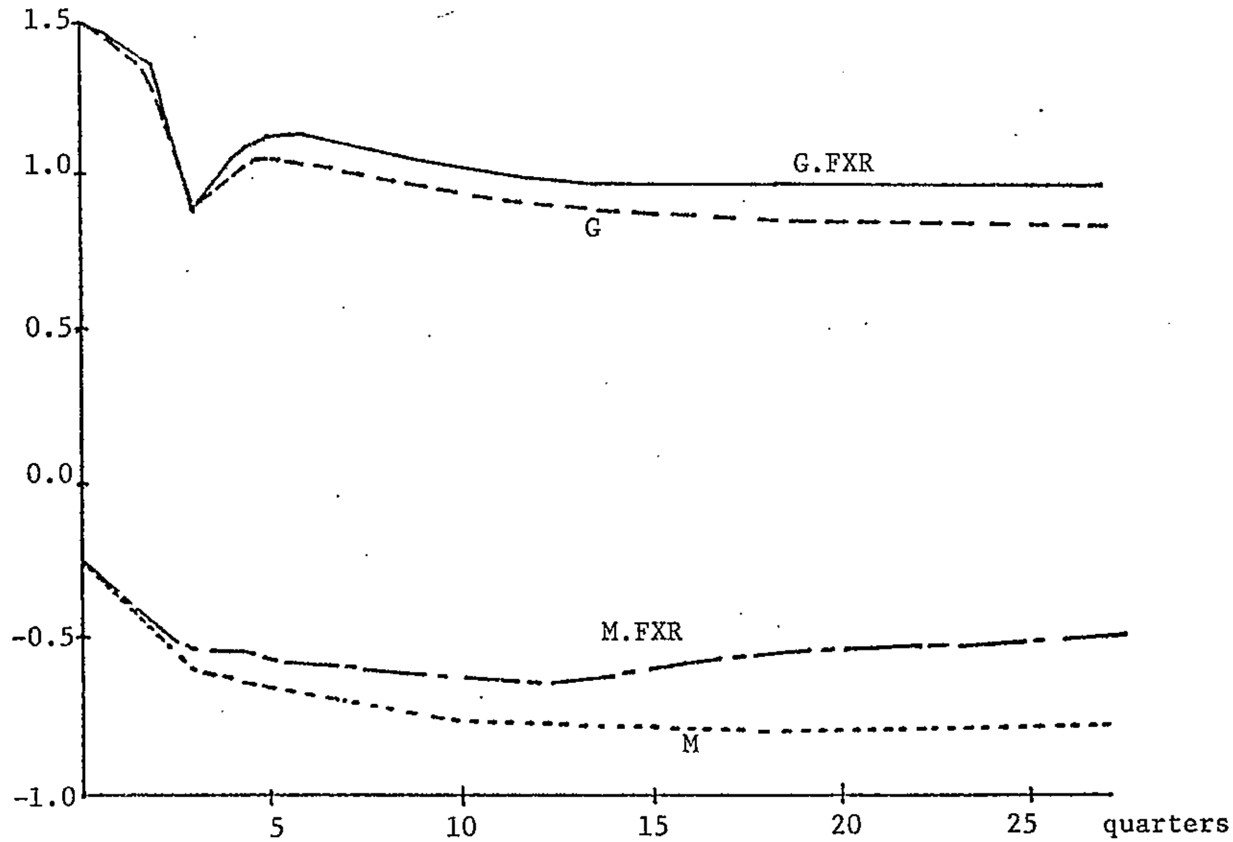


Figure 6. Response of the FXR to a 1 trillion innovation in the fiscal and monetary policy - RE model -

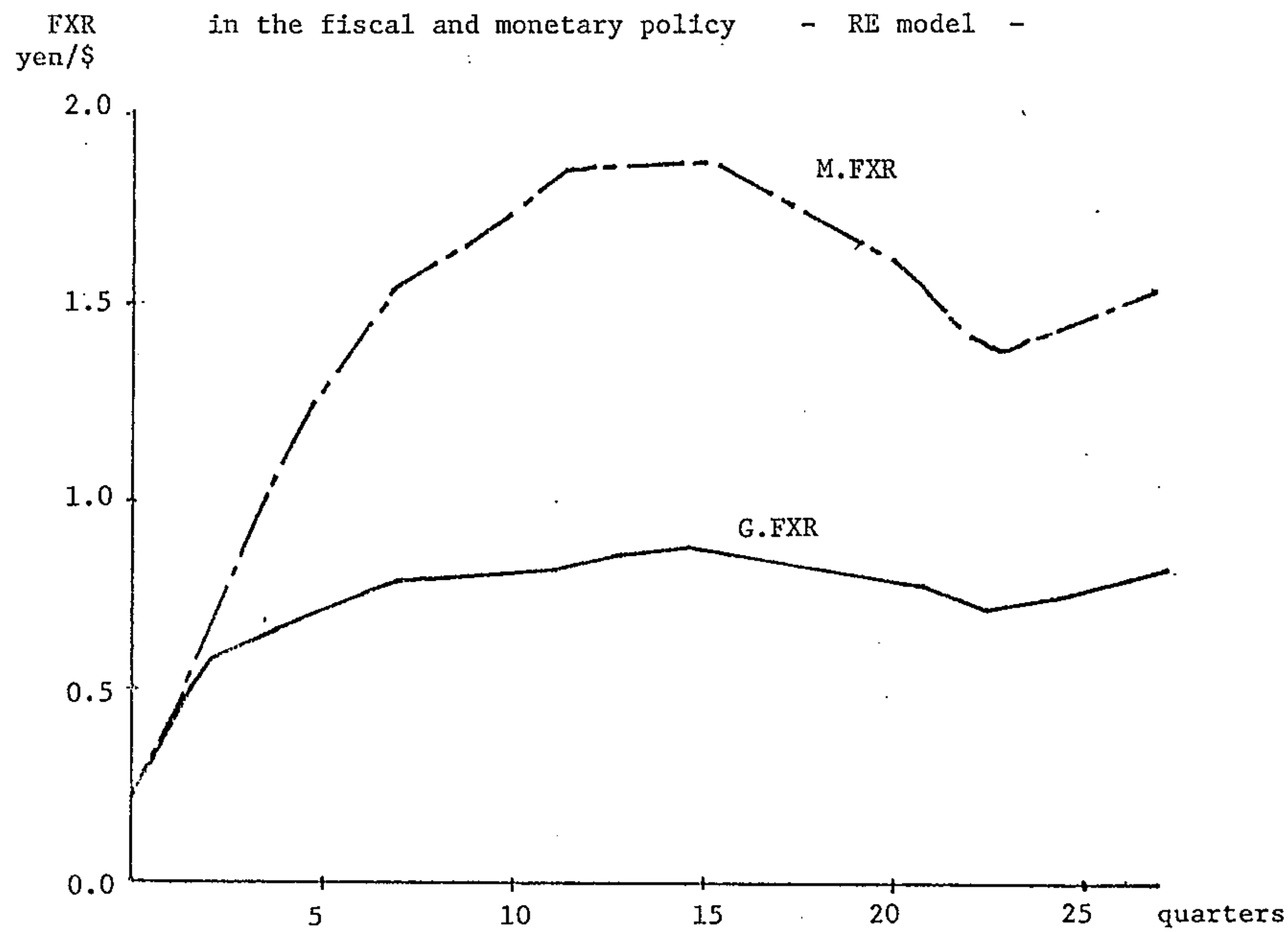


Figure 7. Response of the real GNP to a 1 trillion innovation in the fiscal and monetary policy - non RE model -

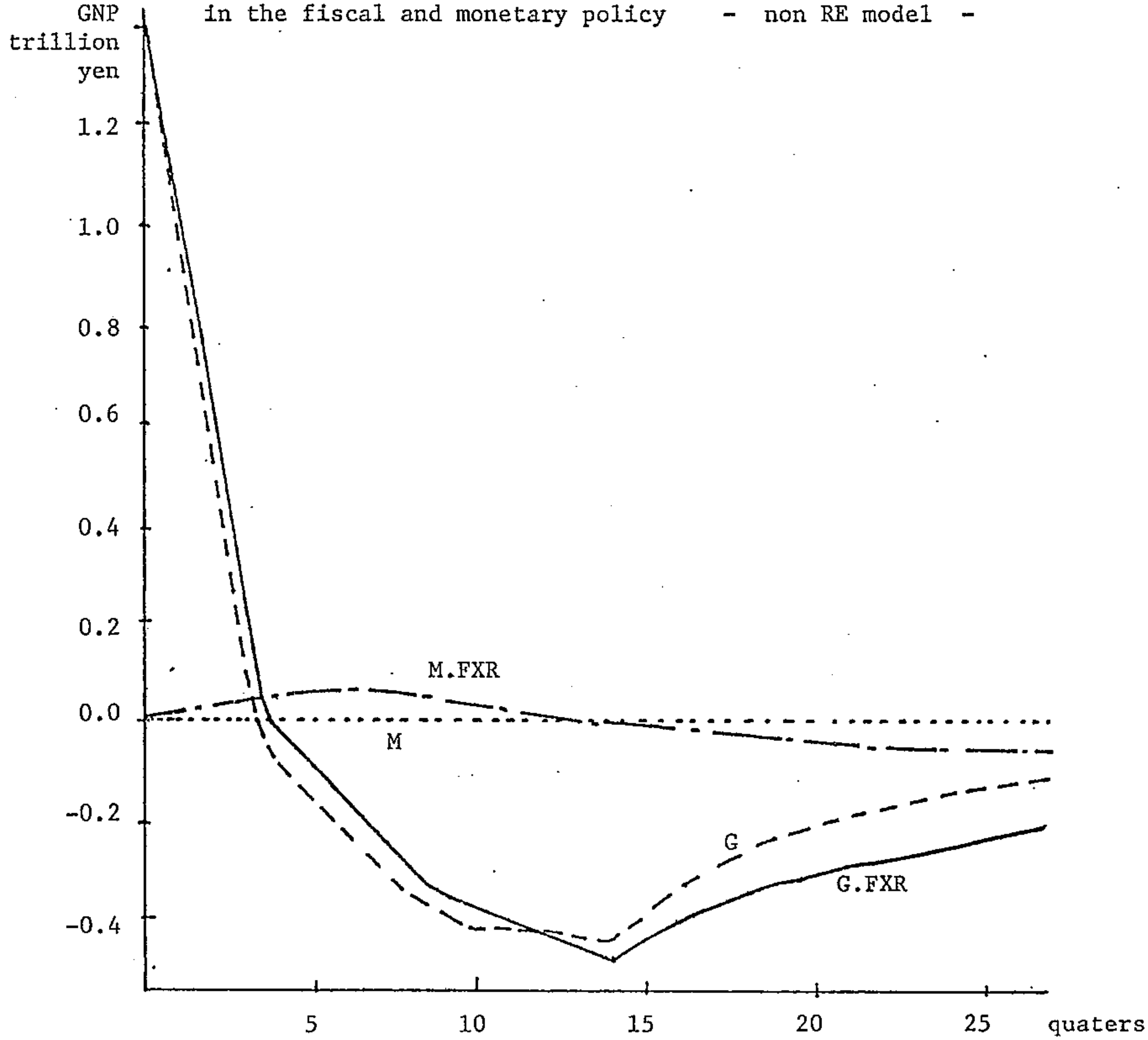


Figure 8. Response of the GNP deflator to a 1 trillion innovation in the fiscal monetray policy - non RE model -

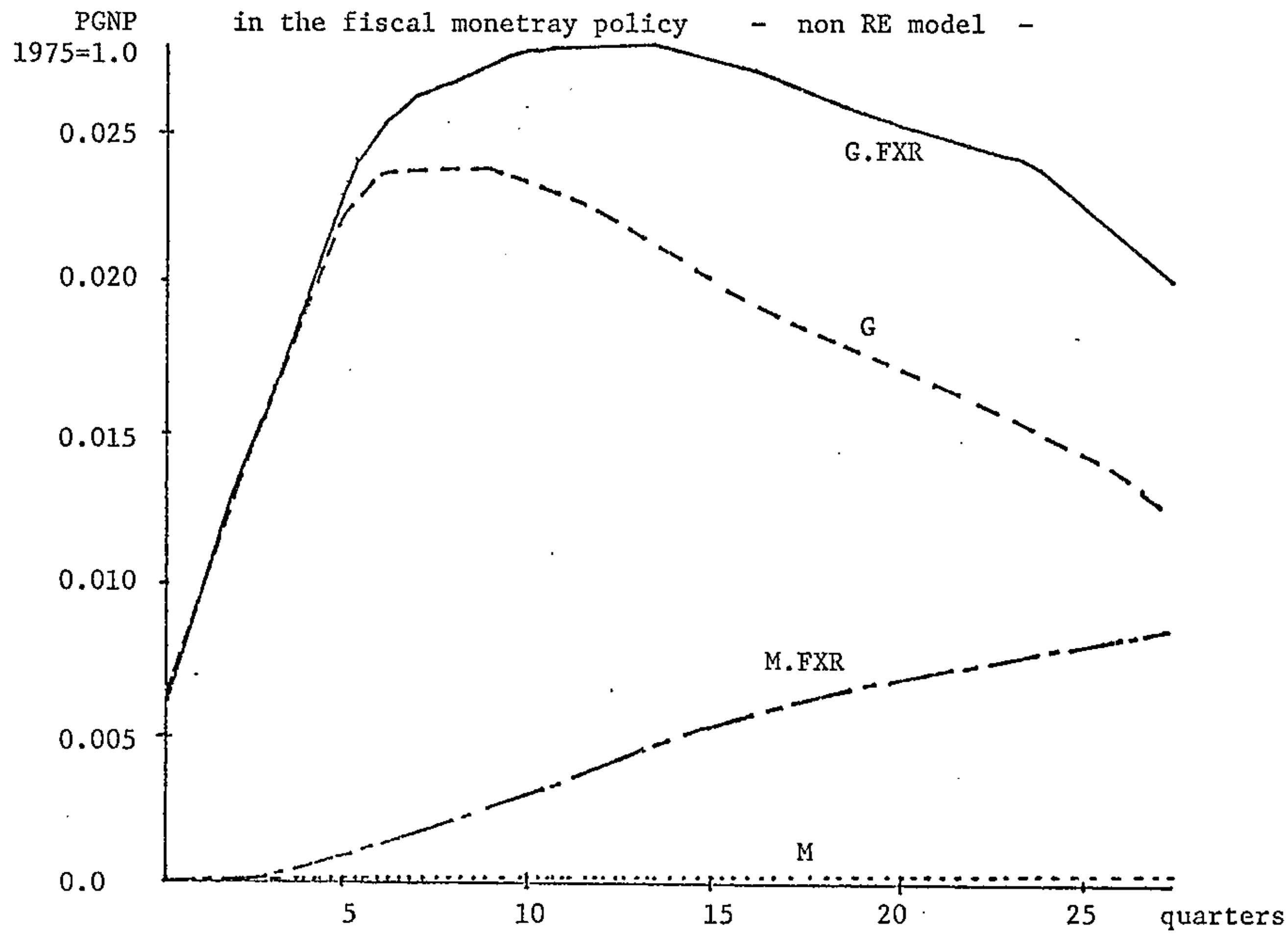


Figure 9. Response of the RCL to a 1 trillion innovation in the fiscal and monetary policy - non RE model -

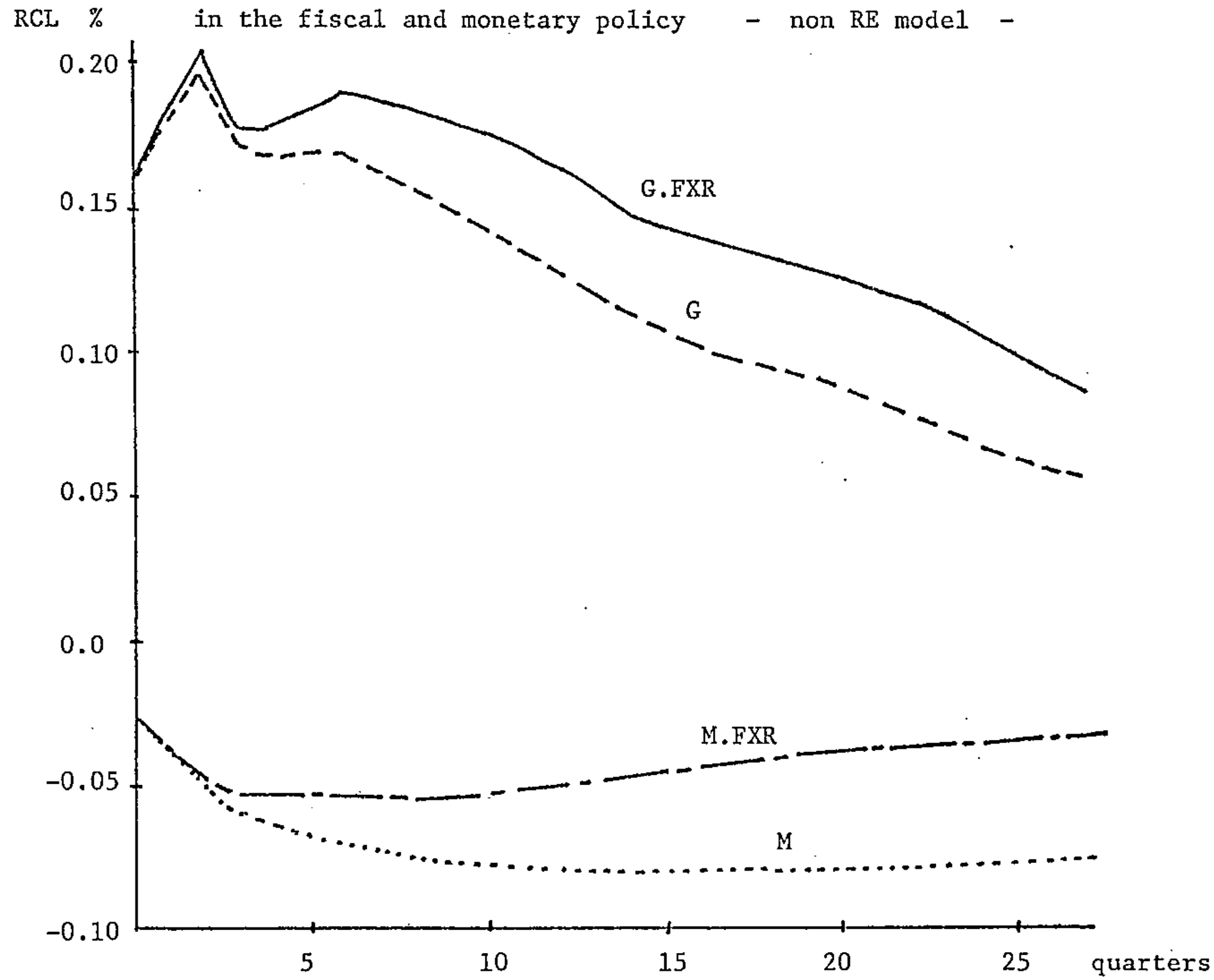
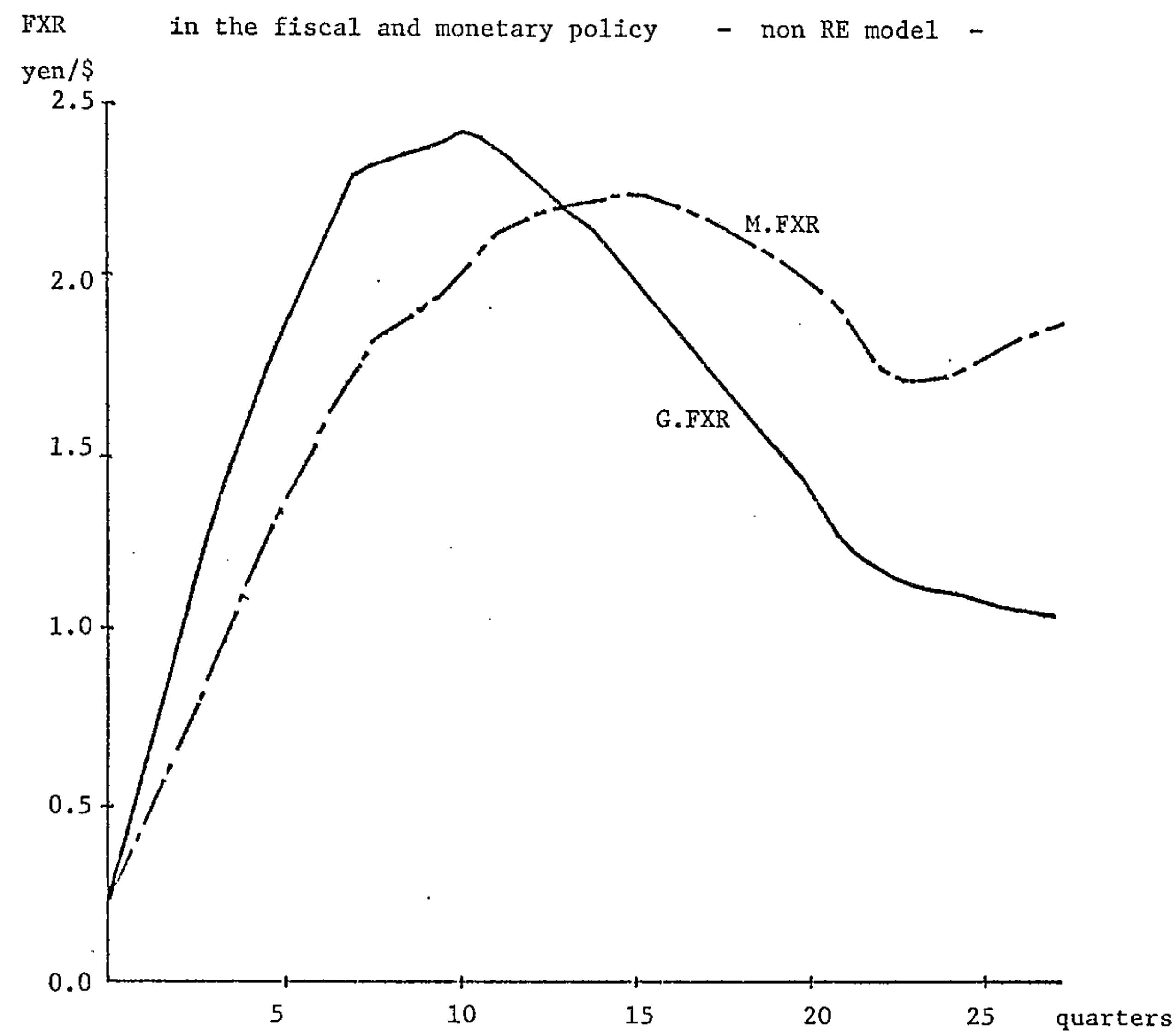


Figure 10. Response of the FXR to a 1 trillion innovation in the fiscal and monetary policy - non RE model -



Appendix The data and sources

C	Households consumption expenditures, 1975 prices, billion yen, NIA
EW	World exports (f.o.b.), 1975 prices, 10 million dollar, MBS
EX	Exports of goods and survices, 1975 prices, billion yen, NIA
FXR	Foreign exchange rate (inter-bank spot rate middle), yen/dollar, ESM
G	Government final consumption and fixed expenditures, 1975 prices, billion yen, NIA
H	Total hours worked of all industry excluding services, 100 hours, MLS
I	Gross fixed investment by private enterprises, 1975 prices, billion yen, NIA
IM	Imports of goods and services, 1975 prices, billion yen, NIA
K	Capital stck by private enterprises, 1975 prices, billion yen, NIA
L	Total employment, 10000 persons, LFS
LH	Total manhours (= L * H)
M	Money supply (currency + quasi money), 100 million yen, EMS
NW	Net worth, current prices, billion yen, NIA
P	Deflator for Y, 1975 = 1, NIA
PC	Defaltor for C, 1975 = 1, NIA
PEW	Unit value of world exports, 1975 = 100, MBS
PIM	Deflator for IM, 1975 = 1, NIA
POP	Working age population, 10000 persons, LFS
RCL	Call rate (unconditional), percent, ESM

RDT Interest rate of time deposit 1 year, percent, ESM

RL Industrial bond rate, percent, ESM

RTAX Average tax rate of personal income, percent, NIA

RTB Treasury bill rate in U.S., percent, IFS

RU Unemployment rate, percent, LFS

USM Money supply in U.S. (currency + quasi money), billion dollar, IFS

USY Gross national product in U.S., 1972 prices, billion dollar, SCB

W Nominal wage per manhour (= (compensation of employees + total income of self-employed) / LH), 100 yen, NIA

Y Gross national products, 1975 prices, billion yen, NIA

YD Disposable income, current prices, billion yen, NIA

YDR Real disposable income (= YD / PC), billion yen, NIA

YP Personal income, current prices, billion yen, NIA

Z Miscellaneous expenditures, 1975 prices, billion yen, NIA

Notes

ESM : Economic statistics monthly, Bank of Japan

IFS : International financial statistics, International Monetary Fund

LFS : Labor force survey, Ministry of Labor

MBS : Monthly bulletin of statistics, United Nations

MLS : Monthly labor survey, Ministry of Labor

NIA : National income accounts, Economic Planning Agency

SCB : Survey of current business, Department of Commerce

Footnotes

1. Sargent and Wallace (1976), Barro (1976) and many other papers.
2. Bilson (1978)
3. At first we estimated all the equations using the method (ii). However the asymptotic t-values of first-order serial correlation coefficients of these six equations were small and insignificant. So we estimated them using ordinary two stage least squares.
4. ρ is the maximum likelihood estimate of first-order serial correlation coefficient in Fair (1970).
5. Predicted values are static prediction from regression described in (iii) of section 3.
6. Miskin (1979)
7. Figure of government expenditures, G_t, is adjusted at annual rate, while that of money supply, M_t, is at quarterly rate. So the amount of shocked innovation in the money supply is 0.25 trillion yen.
8. The simulation experiments are based on the sample period for 1973:II - 1980:I and hence cover a period of 28 quarters.
9. We only removed the foreign exchange rate equation (31) in the estimated model and did not reestimate the model on the assumption that economic agents expect FXR_t rationally from the information about its stochastic time series process.
10. Anderson and Carlson (1974), and Shimpo, Konishi and Ohira (1978)

References

Anderson, L. C. and K. Carlson, 1974, St. Louis model revisted, International Economic Review 15, 305-327.

Ban, K., 1981, Estimation of consumption function with a stochastic income stream, Discussion Paper no. 104, Institute of Socio-Economic Planning, University of Tsukuba, Ibaraki, Japan.

Barro, R. J., 1976, Rational expectations and the role of monetary policy, Journal of Monetary Economics 2, 1-32.

Bilson, J. F. O., 1978, The monetary approach to the exchange rate: Some empirical evidence, International Monetary Fund Staff Papers 25, 48-75.

Bilson, J. F. O., 1980, The rational expectations approach to the consumption function: A multi-country study, European Economic Review 13, 273-299.

Fair, R. C., 1970, The estimation of simultaneous equation models with lagged endogenous variables and first order serially correlated errors, Econometrica 38, 507-516.

Fair, R. C., 1979, An analysis of the accuracy of four macroeconometric models, Journal of Political Economy 87, 701-718.

Lucas, R. E., 1976, Econometric policy evaluation: A critique, in: K. Brunner and A. H. Metzler eds., The Phillips curve and labor markets, (North-Holland, Amsterdam), 19-46.

Miskin, F. S., 1979, Simulation methodology in macroeconomics: An innovation technique, Journal of Political Economy 87, 816-836.

Sargent, T. J. and N. Wallace, 1975, "Rational" expectations, the optimal monetary instruments, and the optimal money supply rule, Journal of Political Economy 83, 241-254.

Shimpo, S., K. Konishi and S. Ohira, 1978, An analysis of stagflation with a monetarist model, Economic Analysis no. 72, Institute of Economic Research, Economic Planning Agency, Tokyo, Japan.

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"A Macroeconometric Model of Japan with Rational Expectations," (September, 1981).