

KOBE  
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32nd  
ANNUAL REPORT



RESEARCH INSTITUTE FOR ECONOMICS  
AND BUSINESS ADMINISTRATION  
KOBE UNIVERSITY

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# IMPORT DEMAND STRUCTURAL CHANGE IN THE PACIFIC BASIN COUNTRIES\*

by

Seiichi KATAYAMA\*\* and Kenichi ISHIGAKI

## 1. Introduction

The purpose of the present paper is to investigate the structural change in the import demand of Pacific basin countries.

Needless to say, international trade is important not only in the world economy but for macro-economic policy issues in a country. As is well summarized by Goldstin and Khan (1985), the estimation of trade equations that means equations for the time-series behavior of the quantities and prices of merchandised imports and exports, has still its importance. And one of the econometric issues in trade modelling is the stability of trade relationships. Whether a regression relationship varies or stable overtime is obviously important from a predictive and analytical point of view.

There are many literatures on the structural change in trade equations. [For example, Heien (1968), Joy and Stolen (1975), Stern, Baum and Green (1979) and Volker (1982)]. Recently Katayama, Ohtani and Toyoda (1985) examined the stability issues by applying the Bayesian method. In their paper, the main issue is to investigate the structural change in the 1970's that includes the breaking out of the first oil crisis.<sup>1)</sup> Although the exogeneous shock such as oil crisis is important, there seems another factor which gives an impact to structure, for example, taking off to rapid economic growth in Japan in the 1960's. Therefore, we will extend the observation periods to two decades, from the 1960's to the 1970's.

The method of the test for structural change is the Bayesian test. To detect a change point in a linear regression, Quandt (1958) proposed

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\*We thank to Professors T. Toyoda and K. Ohtani. Professor Ohtani gave us many suggestions which improved much the present paper. The earlier draft of the present paper was read at the workshop of Kobe University. We were benefited from the discussion there and the comments from Professor M. Saito. However, the whole responsibilities are ours.

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1) In their paper, Katayama, Ohtani and Toyoda (1985) examined the export demand structure also.

the switching regression model and Brown, Durbin and Evans (1975) proposed the Cusum test. But, it is assumed in their models that the change in parameters occurs abruptly. The switching regression model that can deal with the gradual change in parameters has been proposed by Bacon and Watts (1971) and Tsurumi (1980). However the end-point of the gradual change can not be estimated explicitly in their model. Therefore, we will apply the alternative gradual switching regression model by Ohtani and Katayama (1985), in which the end-point can be explicitly estimated.

These results are compared with those which are obtained by the maximum likelihood (ML) method with autocorrelated error terms recently developed by Ohtani and Katayama (1986). Economic variables overtime have often autocorrelation. Hence the comparison with the estimates by the method has its meaning. This is the second purpose of this paper.

In the next section we will briefly explain their methods.

## 2. The Models

At first we will use the fundamental aggregate import equation employed in Houthakker and Magee (1969). And by applying the alternative method to this equation, we will explain how to detect the structural change. For details, see Ohtani and Katayama (1985).

Import equation :

$$\log M_t = \beta_1 \log Y_t + \beta_2 \log PM_t + \beta_3 + \varepsilon_t \quad (1)$$

where the subscript,  $t$ , represents a time and

- $M_t$  = quantity of imports demanded in the importing country,
- $Y_t$  = real gross domestic product of the importing country,
- $PM_t$  = ratio of the price of imports to the domestic price level,
- $\varepsilon_t$  = error term. We assume that this term distributes as the normal distribution with mean zero and constant variance  $\sigma^2$ .

Note that  $\beta_1$  is interpreted as the income elasticity and  $\beta_2$  is interpreted as the price elasticity of imports. The gradual switching regression models for this equation employed in this paper are written as

$$\log M_t = (\beta_1 + \delta_1 \lambda_t) \log Y_t + (\beta_2 + \delta_2 \lambda_t) \log PM_t + (\beta_3 + \delta_3 \lambda_t) + \varepsilon_t. \quad (2)$$

In the above model, it is assumed that the regression coefficients shift from  $\beta$  to  $\beta + \delta$  along the transition path,  $\lambda_t$ , defined as

$$\begin{aligned} \lambda_t &= 0 && \text{for } t = 1, 2, \dots, t_1^*, \\ \lambda_t &= (t - t_1^*) / (t_2^* - t_1^*) && \text{for } t = t_1^* + 1, \dots, t_2^* - 1, \\ \lambda_t &= 1 && \text{for } t = t_2^*, t_2^* + 1, \dots, T. \end{aligned} \quad (3)$$

The parameters  $t_1^*$ , represents an end-point of the first regime (in other words, a start point of the gradual change), and the parameter,  $t_2^*$ , represents a start-point of the second regime (in other words, an end-point of the gradual change). Note that if the null hypotheses,  $H_0: \delta_i = 0 (i = 1, 2, 3)$ , are accepted in the test, we judge that there is no structural change. Since the sampling properties of the estimators of parameters in this gradual switching regression model are not known, we use the Bayesian method in estimation of parameters. Assuming the appropriate non-informative priors on parameters, we can obtain the posterior distributions of parameters to be estimated. And we can get the Bayesian point estimates of parameters (i.e. posterior means), and we can make the tests the hypotheses,  $H_0: \beta_i = 0$  and  $H_0: \delta_i = 0 (i = 1, 2, 3)$ .

Next we will briefly explain the method to detect the structural change when the error terms are autocorrelated. For detail, see Ohtani and Katayama (1986).

$$\begin{aligned} \log M_t &= (\beta_1 + \delta_1 \lambda_t) \log Y_t + (\beta_2 + \delta_2 \lambda_t) \log PM_t + (\beta_3 + \delta_3 \lambda_t) + u_t \\ u_t &= \rho u_{t-1} + \varepsilon_t; \varepsilon_t \sim \text{NID}(0, \sigma^2) \end{aligned} \quad (4)$$

Where  $u_t$  is an error term which consists of the first order autoregressive scheme with a parameter  $\rho$ . The transition path,  $\lambda_t$  is defined the same as (3). The ML estimates  $t_1^*$ ,  $t_2^*$  and  $\rho$ , say  $\hat{t}_1^*$ ,  $\hat{t}_2^*$  and  $\hat{\rho}$ , can be obtained as through the ordinary procedure. Conditional on the estimated parameters  $\hat{t}_1^*$ ,  $\hat{t}_2^*$  and  $\hat{\rho}$ , we can make the test for the hypotheses  $H_0: \beta_i = 0$  and  $H_0: \delta_i = 0 (i = 1, 2, 3)$ , and  $H_0: \rho = 0$ .<sup>2)</sup>

### 3. Empirical Results

Using the quarterly data whose source and the definition are shown in the Appendix, we examined the structural change of import equation of

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2) The critical region of the large sample likelihood ratio (LR) test with  $\alpha$  percent level for the null hypothesis,  $H: \rho = 0$ , can be written as

$$L_{max}(\hat{t}_1^*, \hat{t}_2^*, \hat{\rho}) - L_{max}(\hat{t}_1^*, \hat{t}_2^*, \rho = 0) > X_1^2(\alpha) / 2$$

where  $X_1^2(\alpha)$  is the upper  $\alpha$  percent critical value of the chi-square distribution with degree of freedom 1. See Ohtani and Katayama (1986).

the five countries: U.S.A.(US), Canada(CA), Japan(JA), Korea (KR) and Australia (AL).

The results of applying the Bayesian inference to the gradual switching model are shown in Table 1 and 2. In the tables, the posterior means for parameters are shown and the values in parentheses below the estimates of coefficients are posterior standard deviations. (\*\*) means that the hypothesis  $H_0: \beta_i = 0$  and  $H_0: \delta_i = 0 (i = 1, 2, 3)$  are rejected at the 5% level by the Bayesian one-sided test, and (\*) means that they are rejected at the 10% level. Note that, although the estimates of the end-point of the first regime and the start-point of the second regime (i.e.,  $t_1^*$  and  $t_2^*$ ) are shown in the table, these estimates are meaningless if all the tests for  $H_0: \delta_1 = 0$ ,  $H_0: \delta_2 = 0$  and  $H_0: \delta_3 = 0$  are accepted. We also note that, although the posterior distribution of  $t_1^*$  and  $t_2^*$  for the equation are not flat, there is the case that we can not judge that the structural change occurred in the equation since the hypotheses  $H_0: \delta_i = 0 (i = 1, 2, 3)$  are accepted.

From the results in the Table 1 and 2, we see the following facts. First, all five countries have experienced the structural change in the import equation in the 1960's and/or the 1970's, US in the 1960's, CA and KR in the 1970's, JA and AL in the 1960's and 1970's. The relation between the breaking out of the first oil crisis and the structural shift can not be observed clearly. Japanese structural shift started earlier than the time of breaking out of the crisis.

Second, the spans of adjustment to the structural change are different. For JA and AL, the time period of adjustment is short. KR had shown no structural shift from 1965 to 1969.<sup>3)</sup> Therefore, as was pointed out by Katayama, *et al.* (1985), KR started her change early in the 1970's and it is judged to be continuing in the decade.

Third, Stern, Bauml and Green (1979) found weak evidence of structural change for US imports in the mid to late 1960's and much stronger evidence in the first quarter of 1972 and thereafter. Volker (1982) re-examined it and showed that there has been no significant change. In our test for the hypothesis  $H_0: \delta_i = 0 (i = 1, 2, 3)$  were accepted in two decades and we judge no structural change for US import equation. This supports the Volker's result.

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3) Note that as for Korea, the observation period is restricted to from 1965 to 1980 by the date availability.

#### 4 . Comparison of the two different estimates

In this section we will compare the estimates by Bayesian method with those by ML method. The comparison is limited to the estimated results based on the date from the first quarter of 1970 to the fourth quarter of 1980.

As an example, by using US data, we have computed the values of the concentrated log-likelihood,  $L_{max}(t_1^*, t_2^*, \rho)$ , and found that the ML estimates of  $t_1^*$ ,  $t_2^*$ , and  $\rho$  are  $\hat{t}_1^*=10$ ,  $\hat{t}_2^*=23$  and  $\hat{\rho}=0.5$ .

(See Table 3). The large sample likelihood ratio (LR) test with 5% level for the null hypothesis,  $H_0: \rho=0$  is rejected. The estimates of other parameters conditional on  $t_1^*$ ,  $t_2^*$  and  $\rho$  are shown in Table 4. From the table, we see that the hypothesis,  $H_0: \rho=0$ , can not be accepted by the Durbin-Watson test. By incorporating possible autocorrelated error terms, the fact that  $H_0: \delta_i=0 (i=1, 2, 3)$  can not be accepted does not change. This means that the structural shift occurred both in price and income elasticities in US. The conditional t-values for the estimates  $\delta_i (i=1, 2, 3)$  that are the values in the parentheses under the estimates are decreased, although they are still significant at 5% level. The results by applying the ML method are shown in Table 5. Note that LR test for the hypothesis  $H_0: \rho=0$  was accepted for JA and KR. From Table 5, we see that the hypothesis,  $H_0: \rho=0$ , can not be accepted by the Durbin-Watson test for four countries and, as for KR, the possible autocorrelation is indeterminate. Note that CA shows the negative autocorrelation.

By examining the results on Table 1 and 5, we see the following facts. First, US shows the strong evidence of structural shift in the second quarter of 1972 and thereafter by ML method. On the contrary, the Bayesian method does not show it. ML estimates support the Stern, Baum and Green (1979) argument. CA shows the structural change both in price and income elasticities by ML estimate method. Bayesian estimates show the weak evidence in the structural change in price elasticity nearly the same time. KR shows the weak evidence in structural shift in income elasticity by ML estimate, but not by Bayesian estimate. On the whole ML method seems to capture sharply structural shift than Bayesian method.

Second, when the structural change is found, the time of the changes i.e.,  $t_1^*$ , and  $t_2^*$ , and the spans of adjustment time are not exactly the same but do not differ very much by the both methods. As is pointed out by Katayama *et. al.* (1985), the structural shift in KR might be on



the way in the sample period from the posterior distribution of  $t_1^*$  and  $t_2^*$ . This point is the same by ML estimates of KR data. The change points  $t_1^*$  and  $t_2^*$  stay at near two extremes.

Finally, we need a few comments on the estimated coefficients. First, the signs of  $\beta_1$  and  $\beta_1 + \delta_1$  expected from the theory are positive as long as the imports is not an inferior good and the signs of  $\beta_2$  and  $\beta_2 + \delta_2$  are negative. Both ML and Bayesian estimates show a theoretically correct sign after the structural shift. However, as for pre-change period, several countries have a positive sign of the price elasticities although some of them are at insignificant level, for example, CA and AL in Bayesian estimates and US and AL in ML estimates. The possible adjustment process of both the price and income effect in trade has been neglected in both methods. This might have caused biases of estimates of parameters.

Second, two different methods of the estimation give the different results. The problem is which result reflects better the real fact. At this stage, we can not say anything about it. However, the more studies on the same problem by different methods, the better answer will be obtained. From the point of view of the econometric method, the point is to study an exact estimation method.<sup>4)</sup>

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4) In this respect, the recent research by John Geweke gives an answer to this problem. John Geweke "Exact Inference in Dynamic Econometric Method", presented at 1986 Australian Meetings the Econometric Society, August 28, 1986.

### Appendix Data Source and Definition of Variables

All the data used in the paper are quarterly and seasonally unadjusted from the first quarter of 1960 to the fourth quarter of 1980.

The definition of variables is as follows:

$M_t$  = volume of import at the 1980 prices,

$PM_t$  = ratio of the price of import to the domestic price of importing country. The GNP deflator is used as the domestic price,

$Y_t$  = gross national product at 1980 prices.

The data for  $M_t$ ,  $PM_t$  and  $Y_t$  were drawn from IMF, *International Financial Statistics*. 1983.

Table 1. Bayesian Estimates of the Import Equations. (1970 : 1 - 1980 : 4)

	$t_1^*$	$t_2^*$	const.	PM	Y	Change in const.	Change in PM	Change in Y	Price Elasticity	Income Elasticity
US	74 : 2	76 : 2	-15.118 (6.59)*	- 1.426 (1.53)*	2.148 (0.80)**	4.811 (8.95)	1.040 (1.53)	- 0.523 (1.106)	No Change	No Change
CA	74 : 1	77 : 3	- 8.176 (1.80)**	0.637 (0.75)	2.314 (0.35)**	-10.667 (8.00)	- 1.903 (1.23)*	1.805 (1.39)	Change	No Change
JA	73 : 1	75 : 2	- 0.002 (2.22)**	1.101 (0.18)**	2.301 (0.19)**	11.970 (2.27)**	- 1.184 (0.19)**	- 1.057 (0.89)**	Change	Change
AL	72 : 1	73 : 4	8.889 (3.23)**	2.117 (1.49)	- 0.860 (0.76)	- 9.032 (3.90)**	- 2.242 (1.53)	1.826 (0.89)**	No Change	Change
KR	71 : 2	79 : 2	2.674 (0.83)**	0.438 (0.29)*	0.103 (0.10)	- 0.151 (1.40)	- 1.353 (0.49)**	- 0.121 (0.16)	Change	No Change

Notes :  $t_1^* = 74 : 2$ , for example, means that the posterior mean of  $t_1^*$  is the second quarter of 1974.

The values in parentheses are posterior standard deviations.

(\*\* ) means that the variable is significant at the 5% level and (\*) means that the variable is significant at the 10% level.

The source : Table 2 of Katayama, Ohtani and Toyoda (1985).

Table 2. Bayesian Estimates of the Import Equations. (1960 : 1 - 1969 : 4)

	$t_1^*$	$t_2^*$	const.	PM	Y	Change in const.	Change in PM	Change in Y	Price Elasticity	Income Elasticity
US	62 : 2	65 : 1	- 0.971 (8.58)	- 0.089 (1.63)	0.594 (1.29)	- 9.620 (9.47)	- 1.597 (2.03)	1.195 (1.43)	No Change	No Change
CA	62 : 4	65 : 2	1.300 (4.59)	0.389 (1.48)	0.414 (0.94)	- 7.351 (5.64)	- 0.719 (2.19)	1.490 (1.15)	No Change	No Change
JA	63 : 1	65 : 1	16.728 (17.63)	- 6.359 (2.54)**	- 1.315 (1.64)	-28.138 (20.57)*	6.367 (3.77)*	2.619 (1.92)	Change	No Change
AL	62 : 2	63 : 2	-18.932 (9.26)**	5.152 (4.33)	5.922 (2.50)**	16.808 (9.36)*	- 4.974 (4.47)	- 4.490 (2.53)**	No Change	Change
KR	67 : 1	68 : 1	- 2.911 (0.84)**	- 2.170 (0.42)**	0.750 (0.12)**	1.131 (1.32)	0.610 (0.62)	- 0.140 (0.17)	No Change	No Change

Notes : Korea 1965 : 1 - 1969 : 4 .

See Footnotes in Table 1.

Table 3. US values of  $t_1^*$  and  $t_2^*$  which maximize  $L_{\max}(t_1^*, t_2^*, \rho)$  for various values of  $\rho$ . (1970 : 1 - 1980 : 4)

$\rho$	-0.1	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
$t_1^*$	10	10	10	10	10	10	10	10	10	11	11
$t_2^*$	23	23	23	23	23	23	23	23	23	23	23
$L_{\max}$	251.07	255.77	260.07	263.78	266.71	268.70	269.65	269.55	268.51	266.96	265.37

Notes :  $t_1^* = 10$  is corresponding to the second quarter of 1972,  $t_1 = 11$  the third quarter of 1972 and  $t_2^* = 23$  the third quarter of 1975.

The values of  $L_{\max}$  do not include the constant.

Table 4. US estimates of parameters conditional on  $t_1^*$ ,  $t_2^*$  and  $\rho$ . (1970 : 1 - 1980 : 4)

conditional on	$\beta_1$	$\beta_2$	$\beta_3$	$\delta_1$	$\delta_2$	$\delta_3$	$R^2$	DW
$\rho = 0.5$	0.001 (2.05)	0.435 (1.27)	4.567 (19.96)	2.216 (7.48)	- 1.000 (-2.72)	-17.40 (-7.32)	0.762	1.98
$t_1^* = 10, t_2^* = 23$								
$\rho = 0.0$	0.001 (2.10)	0.493 (2.11)	4.585 (2.93)	2.374 (12.12)	- 1.210 (-4.83)	-18.68 (-11.08)	0.905	1.03
$t_1^* = 10, t_2^* = 23$								

Notes : The values in parentheses are t-values,  $R^2$  is a coefficient of determination, and DW is a Durbin-Watson ratio.

Table 5. ML Estimates of the Import Equations. (1970 : 1 - 1980 : 4)

	$t_1^*$	$t_2^*$	const.	PM	Y	Change in const.	Change in PM	Change in Y	$\rho$	$R^2$	DW	Price Elasticity	Income Elasticity
US	72:2	75:3	4.567 (19.96)**	0.435 (1.27)**	0.001 (2.05)**	-17.40 (-7.32)**	-1.000 (-2.72)**	2.216 (7.48)**	0.5	0.762	1.98	Change	Change
CA	74:3	78:1	2.267 (25.98)**	0.880 (3.44)**	2.267 (25.98)**	-12.14 (-3.29)**	-2.265 (-3.97)**	2.058 (3.22)**	-0.6	0.979	1.78	Change	Change
JA	74:1	75:2	-19.05 (-11.44)**	0.733 (6.05)**	(14.25)**	8.797 (4.37)**	-0.823 (-6.17)**	-0.775 (4.67)**	0.0	0.987	1.76	Change	Change
AL	72:3	74:1	12.68 (2.47)*	1.196 (0.99)	-1.756 (-1.52)	-12.16 (-2.17)**	-1.323 (-1.08)	2.593 (2.07)**	0.5	0.638	1.54	No Change	Change
KR	70:3	79:4	3.472 (3.63)**	0.612 (1.82)**	-0.002 (-0.21)	-1.337 (-0.88)	-1.555 (-2.88)**	0.271 (1.58)*	0.0	0.962	1.86	Change	No Change

Notes : The values in parentheses are conditional t-values.

(\*\*\*) means that the variable is significant at the 5% level and (\*) means that the variable is significant at the 10% level for the one-sided test.

See notes on table 4.

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# A SYNTHETIC ANALYSIS OF STRUCTURALIST AND MONETARIST THEORY OF LATIN AMERICAN INFLATION

Shoji NISHIJIMA

## I Introduction

This paper attempts to synthesize the structuralist and the monetarist theory of Latin American inflation, using the standard macroeconomic analysis. The synthesis is based on the idea that structuralists mainly focus on supply factors and monetarists focus on demand factors. Such a simplification makes it possible to analyze both approaches in a common framework, that is, the aggregate supply and aggregate demand analysis. However, to include agricultural bottlenecks, the aggregate supply is divided into two parts; agricultural supply and industrial supply. We assume that the price of agricultural sector is determined by market clearing, but the price of industrial sector is determined by mark-up principles.

As the recent experiences of Latin American inflation suggest us, analysis of causes and initiating root factors are not sufficient to explain inflations of more than 200 per cent per year. To analyze accelerated and continued inflation, we introduce some mechanisms into the model such as propagation processes and inertial adjustment. We postulate that the propagation processes are generated by the accommodative money supply and exchange rate devaluations. The inflation inertia is assumed to be caused by the wage indexation with one period lagged adjustment. In the model, we treat these institutional factors as policy rules.

Before introducing our model, section II gives a brief survey of the dispute between the monetarists and the structuralists with a critical comment on the two approaches. Our model is presented along with the solutions and the effects of the policy rules in section III. Section IV contains concluding remarks.

## II A Brief Survey: Monetarism vs. Structuralism

In this section, we summarize briefly the salient points of the structuralist-monetarist dispute. Although the dispute covers inflation control policies and even the development problems, we are concerned

only in the dispute about causes and initiating factors of inflation.<sup>1)</sup>

## II - 1 The Monetarist Approach

The term "Monetarist" in Latin America originated with the stabilization program of 1956 recommended by the International Monetary Fund to ease the Chilean inflation and balance of payments problem. However, the term "Monetarist" is used broadly in Latin America beyond the U.S. Monetarist position that stresses "only money matters". In this respect, the Latin American monetarists include those who see excess aggregate demand as the cause of inflation. Campos [1961] argues that the Latin American monetarists should be called "fiscalists" in the sense that the monetarist approach not only depends on the standard money supply policies but also on the use of fiscal policies.

According to Watcher [1976], however, the fact that increases in money supply generally follow excess aggregate demand may explain the origin of the use of the term "Monetarist" to refer to the positions that emphasize excess aggregate demand as the cause of inflation. In Latin America, excess aggregate demand is typically generated by large-scale government deficits financed through increases in money supply. The deficits are blamed on such factors as expansionary fiscal policies, inefficient public corporations and inappropriate subsidy policies, while financing through the money supply results from the weakness of government bond markets and taxation systems.

The monetarist position will be very clear and simple in the analysis of aggregate supply and aggregate demand, since expansionary fiscal and monetary policies which monetarists stress as the cause of inflation can be expressed as a shift of the aggregate demand curve to the right. Needless to say, there will be need to modify this simple interpretation depending on the assumptions as to the degree of bond financing to the budget deficit, the exchange rate system, and the international capital movility, etc. However, at least in a simple closed economy, it is reasonable to assume that the monetarist viewpoints could be interpreted as a shift in the aggregate demand curve upward and to the right, causing a rise in price or rate of inflation in the short run.

While the monetarist position can be understood as a simple one, this simplicity results in it being too general to apply directly to the

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1) The survey in this section is based on following papers: Baer [1967], Baer and Kerstenetzky [1974], Barvosa [1983], Campos [1961], Felix [1961], Grunwald [1961], Lopes [1979], Oliveira [1964], Seers [1962], Sunkel [1958], Watcher [1976].

Latin American case. In this context, the structuralism appeared as a criticism to such a general approach. Structuralism started from the criticism of the ECLA's members to the failure of the stabilization programs in Chile supported by the IMF. Although the 1956 implementation of a monetarist restrictive policy reduced the inflation rate drastically, it brought an abrupt slowdown in Chilean output and employment. Such an adverse effect on the economic activity forced the abandonment of the stabilization program within a few years. Thus, confronting with such a problem, the ECLA's economists tried to seek a new policy framework to reduce inflation without costs on the real side. It can be said that the structuralist theory emerged as the theoretical background for this policy framework.

## II - 2 The Structuralist Approach

The fundamental structuralist position<sup>2)</sup> argues that the primary causes of inflation are structural factors such as supply bottlenecks in the agricultural and external sectors and price rigidities in the industrial sector. In our aggregate supply and demand analysis, structural supply bottlenecks can be interpreted as an insufficient (sometimes stagnant) rightward shift of the aggregate supply curve relative to the rapid shift of the aggregate demand curve due to industrialization. Structural price rigidities in the industrial sector will make sure the positive relationship between the relative price of agricultural goods and the general price level. This leads, as we see in the model, an aggregate supply curve which reflects the structuralist supply bottlenecks. Now, it is useful to contrast the structuralist anti-inflation policy with that of the monetarist to understand the basic difference of the two approaches. To reduce inflation, the monetarist stresses a left and downward shift of the aggregate demand curve by restrictive monetary policies. Be aware that this policy accompanies a reduction of real output. On the contrary, the structuralist recommends a right and downward shift of the aggregate supply curve by improving structural factors. It is clear that the structuralist policy attempts a concomitant reduction in inflation with an increase in real output.

We now turn to the principal hypotheses of the structuralist position. The first hypothesis refers to the existence of structural bottlenecks in the agricultural and external sectors as the source of changes

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2) As to the similarity with the Scandinavian structural model, see Canavese [1982].

in relative price of agricultural goods. The rapid industrialization and urbanization increase demand for primary materials and foodstuffs which is not satisfied by the domestic agricultural supply due to structural conditions. The Latin American land tenure system is generally characterized by *latifundia* and *minifundia*. It is said that both types of properties are still in a traditional and inefficient condition. Because large estates (*latifundia*) are held for the owners' status and for political reason, they are not managed by profit maximization motivations. Their responses to price signals and demand pressures are weak and, therefore, their supply is inelastic. Few resources are spent on improving the productivity of their land and tenant farmers. On the other hand, small holdings (*minifundia*) are too small and too traditional to cultivate efficiently and they only produce for their own consumption. Thus, they cannot respond to the demand pressure at all. As to bottlenecks of external sector, structuralists point out the chronic balance of payment deficits due to the trade structure which depends on primary goods exports and the failure of import substitution. The unfavorable condition in the balance of payment means that the authorities have to reduce imports which are necessary for domestic agricultural production and also have to reduce food imports which could satisfy the excess demand for food. To sum up, the structuralist position hypothesizes the existence of supply bottlenecks due to structural conditions and demand expansion due to rapid industrialization. These work to generate excess demand for agricultural goods, causing a rise in relative price of agricultural goods.

The second structuralist hypothesis is based on the assumption of price rigidities in the industrial sector. Prices of industrial goods are assumed to have downward rigidities ascribed to noncompetitive market structure and price setting through the mark-up principle. Industrial wages are also assumed to be downward rigid because of the existence of institutional wage setting and pressures from labor unions. Therefore, increasing prices of foodstuff lead to a higher cost of living in urban sector which leads to higher wages. A rise in wages finally leads to an industrial price rise through mark-up pricing. Thus, it is the rise in the relative price of agricultural goods that results in an increase in general price level through the rigidity and institutional setting of industrial prices. One additional factor to this hypothesis is the chronic exchange rate devaluations which are ascribed to the structural balance of payments deficits. An increase in the exchange rate implies a rise in prices of imported materials which is finally transmitted to industrial prices through mark-up pricing.

The third hypothesis refers to "passive money" which means the money supply being dependent on price or inflation. Whenever inflation rate increases due to structural factors that accompany an abrupt slow-down in the economic activities, the authorities are disposed to increase the rate of growth of money supply to recover the economic activities to the desired level. One reason is clearly the lack of money supply control due to insufficient statistical data and poorly controlled financial system, while the most fundamental is that the social and political costs of economic contraction are too high as compared to the costs of inflation. Thus, the governments have to expand the money supply to maintain popular support. In addition to these reasons, there is another sources to explain passive money. Once the inflation rate increases, a fall in real balance leads a rise in the real interest rate which provokes expansion of institutional credits which used to be financed by the money supply.

Now we interpret the passive or endogenous money hypothesis in the analysis of aggregate supply and demand. The passive money means that a recession and a inflation due to structural reasons leads authorities to accommodate the money supply to inflation in order to avoid disruptions to the economy. This can be expressed as: facing with a leftward shift of the aggregate supply curve due to structural factors, the authority tries to shift the aggregate demand curve to the right through the expansional money supply to recover the recession. But, we have to notice, that such a passive or accommodative money supply induces an additional inflation. In short, the structuralist argues that the money supply is not a cause of inflation but is passive to inflation. So, the money supply works to confirm or assure the inflational processes.

### II - 3 A Critical Comment on the Two Approaches

So far, we have summarized briefly the monetarist and structuralist debate. We now turn to the criticisms of the two approach to give some bases for the construction of our model.

Criticisms to the monetarist position is well-known. As already mentioned, the monetarist position neglects differences in the economic structure among countries and differences over time within the same countries. Since monetarists mainly focus on the demand side, they offer a demand contraction policy without taking into account supply side conditions such as agricultural supply bottlenecks and other supply shocks. As a consequence, there is a possibility that a monetary con-

traction aimed to reduce inflation which originated from structural factor, may aggravate unemployment that will not be tolerated by the public and the government.

As to the structuralist positions, they fail to specify the role of aggregate demand factors. In the real world, inflation should be regarded as a result of interactions of demand and supply factors. Particularly, since the first oil crisis, many Latin American countries have created strong demand pressures through numerous big national projects to avoid the recession caused by the oil shock. It is natural to think that the inflation rates, during the period of the late 1970s and the early 1980s, were strongly affected by demand factors. In this context, a general framework is necessary to analyze interactions of demand and supply factors.

Finally, to investigate accelerated and continued inflations in recent Argentina and Brazil, it will be insufficient to consider only the causes of inflation that we have discussed above. If structuralist factors and/or monetarist factors alone are to account for an accelerated and ongoing rise in the inflation rate, it will be necessary for the respective aggregate curves to shift continuously and at an rising rate only by these factors. Thus, in this respect, we introduce a propagation and an inertia of inflation into the model, in addition to causes of inflation.

### III The Model Analysis

#### III - 1 Assumptions of the Model

The general structure of the model developed in this section is described very simply with following assumptions.

- (1) The economy has two sectors: agricultural sector and industrial sector.
- (2) The price of agricultural goods is determined by market clearing.
- (3) The price of industrial goods is formed through mark-up pricing on wage and imported material price.
- (4) The aggregate demand depends on real money stock alone, and foreign demand is assumed to be negligible.
- (5) The nominal wage and exchange rate adjustment and the nominal money supply are managed by policy rules which are accommodative to the general price level.
- (6) The general price level is a weighted average of prices in

agricultural goods and industrial goods.

- (7) The aggregate price and output are determined at the intersection point of an aggregate demand and an aggregate supply schedule.
- (8) Price expectations are formed rationally.

### III - 2 The Model

The complete model contains following equations.

$$y_t^{as} = \lambda + \varphi (p_t^a - w_t) + u_t^{as}, \quad \varphi > 0 \quad (1)$$

$$y_t^{ad} + p_t^a - p_t = \mu y_t, \quad \mu > 0 \quad (2)$$

$$y_t^{as} = y_t^{ad}, \quad (3)$$

$$p_t^i = \theta e_t + (1 - \theta) w_t + u_t^i \quad (4)$$

$$p_t = \tau p_t^a + (1 - \tau) p_t^i, \quad 0 < \tau < 1 \quad (5)$$

$$p_t + y_t = m_t + u_t^d, \quad (6)$$

$$w_t = \alpha p_{t-1} + (1 - \alpha) E_{t-1} p_t + \bar{w}, \quad 0 \leq \alpha \leq 1 \quad (7)$$

$$e_t = \beta p_t + \bar{e}, \quad 0 \leq \beta \leq 1 \quad (8)$$

$$m_t = \tau p_t + \bar{m}, \quad 0 \leq \tau \leq 1 \quad (9)$$

where all variables are expressed in logarithm and denote;  $y_t^{as}$ : real agricultural supply;  $\lambda$ : trend component of real agricultural supply;  $p_t^a$ : price of agricultural goods;  $w_t$ : nominal wage rate;  $y_t^{ad}$ : real demand for agricultural goods;  $p_t$ : general price level;  $y_t$ : real aggregate demand (or real aggregate output);  $p_t^i$ : price of industrial goods;  $e_t$ : nominal exchange rate;  $m_t$ : nominal money stock;  $E_{t-1} p_t$ : expected general price level for period  $t$  formulated at the end of last period  $t-1$ ;  $\bar{w}$ ,  $\bar{e}$ ,  $\bar{m}$ : long run desired level of each variables which the authority tries to establish;  $u_t^{as}$ ,  $u_t^i$ ,  $u_t^d$ : stochastic disturbance to the agricultural supply, industrial goods price and aggregate demand, respectively, which are assumed as white noise and not correlated each other.

Equation (1) demonstrates the supply function of agricultural goods which is composed of a secular component, a cyclical component and a random term. The secular component reflects a trend of productivity change and capital accumulation which are expected by structuralists to be stagnant in case of *latifundia* and *minifundia* type land tenure system. The cyclical component varies with change of real wage in terms of its own price, while the nominal wage is assumed to be common to both sectors. Since the nominal wage changes depend on expected general price levels as we see below, unpredicted changes of real wage cause the cyclical movement in the supply of agricultural sector. The random term reflects stochastic disturbances such as climate conditions, which

affect the agricultural supply independently with the unpredicted change of real wage.

Equation (2) shows the real demand in terms of general price for agricultural goods which depends on only real aggregate demand. This means that the price elasticity of demand is nearly zero, since we suppose that the agricultural goods imply essential foodstuff which is insensitive to price change.

Equation (3) is the equilibrium condition for agricultural goods market.

Equation (4) means that industrial goods price is formed through mark-up on wage cost and imported goods cost. For a simplification, the mark-up ratio and the dollar price of imported goods are normalized to unity, allowing the industrial goods price to be expressed as a weighted average of nominal wage and exchange rate. Under this formulation, the supply of industrial goods is implied to be fully elastic to price, and the actual level of industrial supply is determined by the portion of the aggregate demand which is not distributed to agricultural demand. A random term is also included in the equation to reflect stochastic disturbances to the wage rate and exchange rate.

Equation (5) is a definition of the general price level.

From the equation (1) to (5), we get

$$p_t = [\tau \mu y_t + (1 + \varphi)(1 - \tau)\theta e_t + \{(1 + \varphi)(1 - \tau)(1 - \theta) + \tau \varphi\} w_t - \tau \lambda - \tau u_t^{as}] / (1 - \tau + \varphi). \quad (10)$$

This equation may be called a structuralist aggregate supply function. The positive relation between  $p_t$  and  $y_t$  is derived from that a rise in agricultural goods price increases its supply (then an increase in  $y_t$ ) by a decline in real wage rate in terms of its price, while a rise in relative price of agricultural goods brings a general price increase. Other variables that represent structural factors work to shift the supply schedule. The less a change of  $\lambda$  and the more a change of  $w_t$  and  $e_t$ , the more the supply schedule shifts to the left. Thus, we see that structural factors mentioned in the preceding section could be expressed on the supply schedule in a simple way.

In equation (6), the aggregate demand is specified as a function of real money balance alone. Foreign demand is assumed to have no influences on the aggregate demand.<sup>3)</sup> A random variable is also included

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3) The case in which foreign demand is included in aggregate demand was analyzed in Nishijima [1984] in a similar model. The main conclusion does not change as to price behavior.



in the equation representing stochastic disturbances in money supply that are not controlled by the monetary authority.

The model is reduced to two schedules, equation (10) and (6), and the intersection of the two gives a short run equilibrium price and output. The equilibrium solution for  $p_t$  is,

$$p_t = [\tau \mu m_t + (1 + \varphi)(1 - \tau)\theta e_t + \{(1 + \varphi)(1 - \tau)(1 - \theta) + \tau \varphi\} w_t - \tau \lambda - \tau u_t^{as} + \tau \mu u_t^d] / (1 - \tau + \varphi + \tau \mu) \quad (11)$$

As we expected, the demand factors that represent the monetarist viewpoints also have positive relations with  $p_t$ .

So far, we constructed a very simple aggregate supply and demand model which reasonably reflects structuralist and monetarist factors. It is clear, however, that this simple model only explains the causes of inflation or the initiation of inflation. To analyze the recent evidence of high and continued inflations in Latin American countries, we have to introduce the mechanisms of propagation and inertia of inflation. Now, we turn to the policy rules.

Basic idea for wage adjustments follows the standard formulation of wage indexation developed by Fischer [1983],

$$w_t = \alpha p_t + (1 - \alpha) E_{t-1} p_t + \bar{w} \quad (12)$$

This formulation postulates one period wage contact which is based on expected price for period  $t$  formed at the end of period  $t-1$ . However indexation rule corrects this predetermined wage rate according to the realized price level.  $\alpha$  measures the degree of indexation. Since the real wage is equal to  $\bar{w}$  in case of  $\alpha = 1$ , full indexation rule can keep the real wage at a certain level. We suppose that the authority considers the real wage  $\bar{w}$  to be desirable and can change its level in the long run depending on the economic conditions. Here it is also assumed that the wage adjustments by labor market conditions dose not exist.

In our model, we specify a lagged indexation according to Simonsen [1983]. Nominal wages are adjusted at fixed time intervals based on the price of prior period. We assume here the one period lagged indexation as the equation (7). Lagged indexations introduce the inertial adjustment processes for the long run equilibrium into the model. The higher the parameter  $\alpha$ , the more the adjustment process becomes backward-looking, and thus inertial.

Equation (8) shows an adjustment rule for exchange rates.  $\bar{e}$  denotes the desired real exchange rate and its level could be changed in the long

run by authorities (the *maxidesvalorisaçã*o in Brazil may be the case).  $\beta$  measures the degree of which exchange rate are adjusted according to general price levels. The case of  $\beta = 1$  assures the actual real rate to be  $\bar{w}$ .

Money supply rule is given by equation (9).  $\bar{m}$  denotes the desired real money balance which the authority tries to establish, but its level can be changed in the long run reflecting, for example, changes of financial institutions, budget deficits and the level of foreign reserves.  $\tau$  measures the extent to which nominal money supply is accommodating to the general price level. Full accommodation ( $\tau = 1$ ) implies the real money stock are held at the level of  $\bar{m}$ . This accommodative rule for money supply will play an essential role to introduce the inflation propagation into the model. We interpret "the passive money" pointed out by structuralists as highly accommodative money supply rule. As to the empirical studies for the accommodative money supply in Latin American countries, many studies such as Cardoso [1977] and Contador [1978] examined the structuralist view.

### III - 3 Solutions of the Model

The model is reduced into the aggregate supply and the aggregate demand. We now begin with the supply function. Substituting the wage and the exchange rate rule into the equation (10), we get

$$(1 - a_2\beta)p_t - a_1y_t = a_3\alpha p_{t-1} + a_3(1 - \alpha)E_{t-1}p_t + a_2\bar{e} + a_3\bar{w} - a_4\lambda - a_4u_t^{as} + a_5u_t^i$$

where,

$$a_1 = \tau\mu(1 - \tau + \varphi)$$

$$a_2 = (1 + \varphi)(1 - \tau)\theta / (1 - \tau + \varphi)$$

$$a_3 = [(1 + \varphi)(1 - \tau)(1 - \theta) + \tau\varphi] / (1 - \tau + \varphi)$$

$$a_4 = \tau / (1 - \tau + \varphi)$$

$$a_5 = (1 + \varphi)(1 - \tau) / (1 - \tau + \varphi) \quad (13)$$

This supply function can be interpreted as a variation of the Lucas type supply function. If we derive a special case of this function assuming that  $\theta = 0$  and a wage indexation without time lag, the Lucas type supply function will appear:

$$y_t = y_n + [(1 - \alpha) / a_1](p_t - E_{t-1}p_t) + u_t$$

where,

$$y_n = (a_4 / a_1)\lambda - (1 / a_1)\bar{w}$$

$$u_t = (a_4 / a_1)u_t^{as} - (a_5 / a_1)u_t^i \quad (13')$$

It is clear that the difference between the two equations comes from the existence of the exchange rate and the stickness in wage adjustment.

By equation (6) and (9), the aggregate demand function with the

money supply rule will be given as:

$$(1 - r)p_t + y_t = \bar{m} + u_t^d \quad (14)$$

Notice that the aggregate demand curve will be vertical when the money supply accommodation is complete ( $r = 1$ ).

Under the assumption of rational expectation, the short-run equilibrium will be obtained as follows. From equation (13) and (14), we derive the pseudo reduced form of  $p_t$ ,

$$p_t = [a_3\alpha p_{t-1} + a_3(1-\alpha)E_{t-1}p_t + a_2\bar{e} + a_3\bar{w} + a_1\bar{m} - a_4\lambda - a_4u_t^{as} + a_5u_t^i + a_1u_t^d] / [1 - a_2\beta + a_1(1-r)] \quad (15)$$

Getting the conditional means of equation (15), given the total informations available of period  $t-1$ , we obtain the rationally expected price of period  $t$ :

$$Ep_t = [a_3\alpha p_{t-1} + a_2\bar{e} + a_3\bar{w} + a_1\bar{m} - a_4\lambda] / [1 - a_2\beta + a_1(1-r) - a_3(1-\alpha)]$$

Then, the actual price of period  $t$  is given by substituting  $Ep_t$  into the reduced form equation:

$$p_t = [a_3\alpha p_{t-1} + a_2\bar{e} + a_3\bar{w} + a_1\bar{m} - a_4\lambda] / [1 - a_2\beta + a_1(1-r) - a_3(1-\alpha)] + [-a_4u_t^{as} + a_5u_t^i + a_1u_t^d] / [1 - a_2\beta + a_1(1-r)] \quad (16)$$

Applying the same process, the aggregate real output is obtained:

$$y_t = [a_3\alpha y_{t-1} - (1-r)a_2\bar{e} - (1-r)a_3\bar{w} + (1-a_2\beta - a_3)\bar{m} + (1-r)a_4\lambda - a_3\alpha u_{t-1}^d] / [1 - a_2\beta + a_1(1-r) - a_3(1-\alpha)] + [(1-a_2\beta)u_t^d + (1-r)a_4u_t^{as} - (1-r)a_5u_t^i] / [1 - a_2\beta + a_1(1-r)] \quad (17)$$

### III - 4 Effects of Policy Rules

(1) Effects on the short-run equilibrium price.

The effects of changes in policy parameters on the short-run equilibrium price are derived by partial differential of each parameters on the coefficients of variables. The results are listed in Table 1.

Table 1

	$p_{t-1}$	$\bar{e}$	$\bar{w}$	$\bar{m}$	$-\lambda$	$-u_t^{as}$	$u_t^i$	$u_t^d$
$\alpha$	+	-	-	-	-	0	0	0
$\beta$	+	+	+	+	+	+	+	+
$r$	+	+	+	+	+	+	+	+

note: To get the effects of adverse supply shock,  $\lambda$  and  $u_t^{as}$ , are treated with negative sign.

From equation (7), a rise in the wage indexation parameter ( $\alpha$ ) increases the weight for  $p_{t-1}$  and decreases the weight for  $E_{t-1} p_t$ . Since the politically desired variable ( $\bar{e}, \bar{w}, \bar{m}$ ) and the trend variable of agricultural supply ( $\lambda$ ) are the components of  $E_{t-1} p_t$ , a decrease in its weight implies that a rise in  $\alpha$  will reduce the effects of these variables on price. With regards to random variables, the wage indexation parameter has no effects, because  $\alpha$  is only linked with  $p_{t-1}$  and  $E_{t-1} p_t$  which are independent on stochastic disturbances of the period  $t$ . Thus, as long as the wage indexation rule is formulated like equation (7), wage indexations will reduce the inflationary impacts of the long-run politically designed variables ( $\bar{w}, \bar{e}, \bar{m}$ ) and the effects of the agricultural supply bottleneck ( $\lambda$ ). In addition to this, the wage indexation rule has no relations with unpredicted disturbances and, in other words, the wage rule does not amplify the impacts of stochastic disturbances of inflation. On the contrary, the exchange rate rule ( $\beta$ ) and the money supply rule ( $\tau$ ) have positive effects on the coefficients of all the variables. This is because the nominal exchange rate and the nominal money supply are adjusted according to the present price and transmit the inflationary impacts to industrial price through the mark-up principle. Therefore, we have to notice that the policy rules have different effects on inflation in the short-run.

## (2) Effects on inertia

Taylor [1979] developed a macro model of the sticky wage adjustment of overlapping wage contracts. Here we introduced another form of sticky wage adjustment where an inertia of price adjustment appears because of the one period lagged wage indexation. If the characteristic root of the homogeneous part of equation (16) is smaller than unity in absolute term, a steady solution exists. The characteristic root is given as:

$$\rho \equiv a_3 \alpha / [1 - a_2 \beta + a_1 (1 - \tau) - a_3 (1 - \alpha)]$$

As long as  $0 < \alpha, \beta, \tau < 1, 0 < \rho < 1$  is satisfied. Since the characteristic root  $\rho$  implies a convergence speed from some deviated point to the long-run equilibrium,  $\rho$  indicates the extent of the inertia in price adjustments. Because a higher value of  $\rho$  means a slower convergence speed, a higher  $\rho$  means more inertial adjustment process. That is, the influence of past prices on current price becomes more persistent. The question now arises whether the policy rules make the adjustment process more inertial or not. We get, therefore, the partial differentials of the three rules on  $\rho$ :

$$\partial \rho / \partial \alpha > 0, \quad \partial \rho / \partial \beta > 0, \quad \partial \rho / \partial \tau > 0$$

All the rules have positive effects on  $\rho$ . Thus, when the current price is deviated to higher level than that of the long-run equilibrium due to some disturbances, the higher value of policy rules results in the higher prices level being more persistent.

(3) The long-run equilibrium price

As far as  $|\rho| < 1$ , there exists a long-run equilibrium. Getting the unconditional means of equation (16), we derive the long-run equilibrium of price,

$$\bar{p} = [a_2 \bar{e} + a_3 \bar{w} + a_1 \bar{m} - a_4 \lambda] / [1 - a_2 \beta + a_1 (1 - \tau) - a_3] \quad (18)$$

As is expected, the long-run price is determined by  $\bar{e}$ ,  $\bar{w}$ ,  $\bar{m}$ , and  $\lambda$ . However, the extent to which these variables influence the long-run price is dependent on the value of the policy parameters  $\beta$  and  $\lambda$ , but not dependent on that of  $\alpha$ . Because the wage indexation rule is weighted term for  $p_{t-1}$  and  $E_{t-1} p_t$  which will have same value in the long run, the weights of  $\alpha$  will be cancelled out. Thus,  $\alpha$  does not have any effect on the long-run wage rate and does not appear in equation (18). It can be said, therefore, as long as we assume the wage adjustment rule formulated by Fischer, its effect on the long-run price is neutral.

On the other hand, the exchange rate rule and the monetary rule play a role for the inflation propagation. If these rules are more accommodative (have higher values), the coefficients of equation (18) become larger and the effect on the long-run price will be amplified. More accommodative rules imply steeper aggregate supply and demand curves. If the authority sets  $\beta$  and  $\tau$  at the value very near to 1,  $\bar{p}$  will have an almost unlimited value because the denominator of equation (16) will be very near zero.

Thus, if we recognize that the exchange rate and the monetary policies in some Latin American countries tend to be highly accommodative, our results will be very suggestive to explain the high and continued inflation in Latin America. Now consider the following probabilities in these countries. Confronting with social instabilities caused by the hyper-inflation itself and/or the restrictive IMF policy, the authorities may raise the planned real wage ( $\bar{w}$ ) which they consider desirable in the long-run. Also, the authorities may have to raise its planned real exchange rate ( $\bar{e}$ ) in order to recover external balances which are indispensable for the external debt strategy. Furthermore, it is worth mentioning the possibility that the reductions of subsidies for agriculture sector would have a negative impact on

the secular trend of its production ( $\lambda$ ). Finally it is important that the huge budget deficits have emerged from numerous gigantic national projects and inefficient government enterprises. These have been a primary cause of the increase of real money supply ( $\bar{m}$ ) which the monetary authorities have to accept. Under such circumstances, widely established policy rules which are highly accommodative to current price tend to propagate the inflationary impacts to a higher inflation, and tend to perpetuate inflation by the inertial adjustment process.

(4) Effect on the asymptotic variances

To know the effects of policy rules on the impacts of stochastic disturbances, we get the asymptotic variances of random terms. Expressing the deviations from the long-run equilibrium as

$$\tilde{x}_t = x_t - E(x),$$

We obtain the following equation from equation (16) :

$$\tilde{p}_t = \rho \tilde{p}_{t-1} + [-a_4 \tilde{u}_t^{as} + a_5 \tilde{u}_t^i + a_1 \tilde{u}_t^d] / [1 - a_2 \beta + a_1 (1 - r)]$$

As the characteristic root of the homogeneous part of this equation is smaller than unity as long as  $0 < \alpha, \beta, r < 1$ , a steady state solution exists and  $\tilde{p}$  has stochastic movements around  $E(\tilde{p}_t) = 0$  with a certain variance. The asymptotic variance of  $\tilde{p}_t$  following AR (1) is:

$$E(\tilde{p}^2) = [b_0^2 / (1 - \rho^2)] \sigma_{as}^2 + [b_1^2 / (1 - \rho^2)] \sigma_i^2 + [b_2^2 / (1 - \rho^2)] \sigma_d^2$$

$$\text{where, } b_0 = a_4 / [1 - a_2 \beta + a_1 (1 - r)]$$

$$b_1 = a_5 / [1 - a_2 \beta + a_1 (1 - r)]$$

$$b_2 = a_1 / [1 - a_2 \beta + a_1 (1 - r)]$$

$\sigma_{as}^2$ ,  $\sigma_i^2$  and  $\sigma_d^2$  represent the variance of  $u_t^{as}$ ,  $u_t^i$  and  $u_t^d$  respectively. Since the partial differentials of the three rules on the coefficients of variances are all positive, the more accommodative policy rules work to increase the variances of stochastic disturbances. Notice that, while the wage indexation rule has no impact on stochastic disturbances in the short-run equilibrium, the wage rule in this case has a positive effect on the variances of stochastic disturbances through the effect on inertia.

It is obvious from the definition of  $\rho$  that, when all the policy rules are fully accommodated at the same time ( $\alpha, \beta, r = 1$ ), a steady solution does not exist and  $\tilde{p}_t$  follow a "random walk" as:

$$\tilde{p}_t = \tilde{p}_{t-1} + u_t$$

$$\text{where, } u_t = [-a_4 \tilde{u}_t^{as} + a_5 \tilde{u}_t^i + a_1 \tilde{u}_t^d] / [1 - a_2]$$

In such a case, price movements will become very irregular depending exclusively on stochastic disturbances.

(5) Effects on the real aggregate output

Finally we mention the relation between the aggregate output and the policy rules. While the policy rules tend to propagate inflations and have effects of inertia on inflation, they tend to isolate the impacts of shocks in  $\bar{w}$ ,  $\bar{e}$ ,  $\bar{m}$  and  $\lambda$  and disturbances on the real aggregate output. From equation (17), the full accommodation in money supply rule ( $\tau = 1$ ) works to isolate completely the shocks and disturbances on supply side ( $\bar{e}$ ,  $\bar{w}$ ,  $\lambda$ ,  $u_i^{as}$ ,  $u_i^s$ ), because  $\tau = 1$  makes the aggregate demand curve vertical. On the contrary, the rules in supply side have an incomplete isolation effect. The exchange rate rule  $\beta$  can isolate the shock of  $\bar{m}$  which comes from demand side, but isolates incompletely the stochastic disturbances of  $u_i^d$  and  $u_{i-1}^d$ . Similarly, the wage rule dose not have a complete isolation effect on  $\bar{m}$ ,  $u_i^d$  and  $u_{i-1}^d$ . Such a difference between the rules is easily understood from the fact that the aggregate supply curve becomes vertical only in the special case as already discussed in equation (13').

From the implications of the results in this section, we may have the following interpretations for the Latin American inflation. If the authorities face with the social instabilities caused by recessions and unemployments, they tend to adapt highly accommodative policies to stabilize output and employment. The reason is that in Latin America, the social and political costs of recessions and unemployments are generally considered to be more serious than the inflation costs. In this sense, the highly accommodative policy may be reasonable from the viewpoint of the Latin American reality.

#### IV Concluding Remarks

This paper is an attempt to synthesize the monetarist and the structuralist theory of Latin American inflation, based on the simplification that the former emphasizes on the demand side factors and the latter dose on the supply side. Furthermore, we introduced the accommodative policy rules to explain the propagation process. The lagged wage indexation rule played important role in generating the inertial adjustments.

Instead of summarize the results, we now briefly mention the future tasks implied by the study.

(1) In our model, the adjustment process through the disequilibrium in

labor market is neglected. To investigate the adjustment process from the short-run equilibrium to the long-run equilibrium, this adjustment is indispensable.

(2) In addition to wage indexation, other indexations to financial assets and taxes should be considered.

(3) From the recent Brazilian evidence, the endogenous indexation, which means the reduction of the indexation interval is of interest to explain the acceleration of inflation (see Simonsen [1983]).

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# STAGFLATION

## —CAUSES AND POLICIES—

Nobuo OKISHIO

### I Stagflation and Modern Capitalism

The word of stagflation, which is composed of stagnation and inflation, means the situation where economic stagnation and inflation proceed simultaneously. Following five factors have been accused as the causes of stagflation.

- (1) Monopolistic capital: Stagflation is caused by monopolistic capital's behaviour to administrate prices and accumulation.
- (2) State: Stagflation is closely related with the state's fiscal and monetary policies which are carried out for monopolistic capital.
- (3) Working class: Stagflation is due to working class's increasing militancy to resist the reduction of the real wage rate below their required level.
- (4) International monetary system: Stagflation is owing to over supply of U.S.A. dollars and the floating exchange system which appeared after the collapse of IMF international monetary system. This system had been one of the fundamental institutions of post war capitalism.
- (5) Energy resources: Stagflation is the result of remarkable increase in the oil price which is the result of the collapse of imperialistic hegemony over energy resource countries.

In my opinion, all of these five factors deeply relate to the fundamental characteristics of modern capitalism and are closely related to the occurrence of stagflation.

- (1) Stagflation would not have occurred, if monopolistic capital had not administrated prices to get a higher level of profit and had not decided capital accumulation anarchically.
- (2) Stagflation would not have occurred, if the government expenditure and the monetary supply had not been so great, though depression might have been more serious.
- (3) Stagflation would not have occurred, if working class had been so weak that they could not resist a reduction of the real wage rate and so weak as to passively accept cutting money wage rates in the case of unemployment.

- (4) If there were not over supply of dollars by the U.S.A. and the floating of exchange rate and instead the rate of increase of money supply in capitalistic countries had been restricted, inflation would not have spread all over the world.
- (5) Stagflation would have been mitigated, if imperialistic countries could depress the real price of oil by dominating oil producing countries.

The above five factors can be restated as the following three conflicts or struggles in modern capitalism. (a) conflict between monopolistic capital and working class. (b) conflict between monopolistic capital and energy resource producing countries. (c) conflict and dependency among imperialistic countries

(a) If monopolistic capitalists want to realize a high desired rate of profit, they must force the working class to accept a low real wage rate or to increase labour productivity. In short, they must raise the rate of exploitation. So if the working class is strong enough to refuse this and succeed in raising the money wage rate and resist an increase of labour productivity in order to force down the rate of exploitation, monopolistic capital can not realize their own desired rate of profit. Then, monopolistic capital will try to raise the prices of its commodities to cut down the real wage rate again. In this way, a "wage-price spiral" occurs. This is an expression of a conflict between monopolistic capital and working class.

(b) If monopolistic capital wants to realize their own high desired rate of profit, they must depress the real price of energy resources measured by their commodities as low as possible. However energy resource countries which become free from imperialistic ascendancy refuse the decrease of real price of resources and demand higher prices. If the real price of the resources rises, the rate of profit of monopolistic capital decreases. In order to restore the rate of profit up to the desired level, monopolistic capital raises their prices, then the real price of resources decreases again. The spiral thus caused is an expression of conflict and struggle between monopolistic capital and resources exporting countries.

(c) Given technologies, the real wage rate and the real price of resources, the higher the prices of commodities purchased from the other capitalists becomes, the lower the rate of profit of monopolistic capital becomes. In other word, if production technologies, real wage rate and real price of resources are given, the profit rates of monopolistic capitalists have antagonistic relationships. Therefore if monopolistic

capital in a country raises its price in order to realize its high desired rate of profit, it would cut down the rate of profit of monopolistic capital in the other countries unless the sacrifices are shifted to working class and resources supply countries. These capitalists upon which a decrease in the rate of profit is forced raise the price as a counter-attack. The spiral thus caused is an expression of conflict among monopolistic capitalists.

As sketched above, stagflation must be analyzed by the main factors characterizing modern capitalism and by the main antagonistic relationships in modern capitalism.

## II Causes of Economic Stagnation

As stagflation has two faces: stagnation and inflation, we first consider the causes of stagnation. Here, stagnation means the situation where the rate of profit and the rate of utilization of equipment lingers at a low level and the rate of unemployment is rather high. In order to know the causes of such a stagnation, we must know the factors which determine the level of the rate of profit, utilization and unemployment. There shall be dealt with in turn.

### (A) Factors determining a Rate of Profit

It is needless to say, the realized value of the commodities produced in a country depends on the amount of demand for them. To illustrate, let  $C + V + M$  be the value of the commodities which is realized in a country as a whole. Here  $C$  represents constant capital,  $V$  variable capital and  $M$  surplus value. Then

$$C + V + M = D \quad (1),$$

where  $D$  is the quantity demanded for commodities of the country. The demand for commodities of the country  $D$  consists of following six parts.  $C_h$ : Replacement demand for domestic capital goods. That is, demand to replace capital goods worn out by the production of domestic goods in this period.  $A_h$ : Consumption demand of the working class for domestic goods.  $B_h$ : Consumption demand of capitalists for domestic goods.  $I_h$ : Accumulation demand (new investment demand) of capitalists for domestic goods.  $G_h$ : Demand of the government for domestic goods.  $E$ : Demand from abroad for domestic goods, i.e. exports. Therefore we get

$$D = C_h + A_h + B_h + I_h + G_h + E \quad (2).$$

Let  $C_f$ ,  $A_f$ ,  $B_f$ ,  $I_f$  and  $G_f$  denote replacement demand, consumption demand of working class, consumption demand of capitalist, accumulation demand of capitalist, demand of the government for import goods from abroad, respectively. Then the aggregate amount of imports  $F$  becomes

$$F = C_f + A_f + B_f + I_f + G_f \quad (3).$$

As replacement demand is equal to constant capital part of realized goods,

$$C = C_h + C_f \quad (4).$$

As consumption demand of working class is assumed to be equal to variable capital part of realized goods net of tax on working class  $T_v$ ,<sup>1)</sup>

$$V = A_h + A_f + T_v \quad (5).$$

As consumption demand of capitalists is a part of a surplus value net of tax on capitalists  $T_M$ ,

$$\alpha (M - T_M) = B_h + B_f \quad 0 < \alpha < 1 \quad (6),$$

where  $\alpha$  denotes the ratio of capitalists' private consumption demand to disposable surplus value. Let  $I$ ,  $G$ ,  $T$  be the aggregate amount of accumulation demand, government's demand and tax respectively, then we obtain

$$I = I_h + I_f \quad (7)$$

$$G = G_h + G_f \quad (8)$$

$$T = T_v + T_M \quad (9).$$

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1) If labourers save a portion of their wages, the equation (5) is written as

$$A_h + A_f = \beta (V - T_v) \quad (5').$$

Here  $\beta$  denotes a ratio of labourers' consumption to their wage after tax and

$$0 < \alpha < \beta < 1$$

Replacing (5) with (5'), from the equation (11) which determines a profit rate after tax  $r$  we obtain

$$(1 - \alpha) r = g + d + e - (1 - \beta) \frac{V - T_v}{K} \quad (11').$$

From this we know that, even if  $g$ ,  $d$  and  $e$  are the same, the realized rate of profit becomes lower than that in the case that labourers expend the total amount of their wages for consumption.

Substituting (2) ~ (9) into (1), we get

$$(1 - \alpha) (M - T_M) = I + (G - T) + (E - F) \quad (10).$$

Divide both side of (10) by the aggregate capital invested  $K$ , then we have

$$(1 - \alpha) r = g + d + e \quad (11),$$

where

$$\begin{aligned} r &= (M - T_M) / K \\ g &= I / K \\ d &= (G - T) / K \\ e &= (E - F) / K \end{aligned} \quad (12)$$

In words,  $r$ : rate of profit after tax of this country as a whole,  $g$ : accumulation rate of capital,<sup>2)</sup>  $d$ : ratio of government financial deficit to the invested capital and  $e$ : ratio of trade surplus to the invested capital.

By equation (11), we know the factors determining the realized rate of profit. The rate of profit (to be exact it is a profit rate after tax, but we shall simply call it profit rate hereinafter) depends on next four factors. (1) The rate of capital accumulation (2) The rate of financial deficit (3) The rate of trade balance (4) The rate of consumption of capitalists. If these four factors are given, then the

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2) Most Marxian economists call  $1 - \alpha$  the rate of capital accumulation, where  $\alpha$  denotes the ratio of capitalists' private consumption to surplus value. In this paper by the rate of capital accumulation we mean the rate of capitalists' accumulation demand to the total amount of capital, which is equal to the growth rate of capital.

In my opinion, it is not appropriate to call a ratio of a portion of surplus value not consumed the rate of capital accumulation. For this definition is apt to imply that capitalists necessarily invest all surplus value which remains after their consumption. Though it is certain that they privately accumulate this part of surplus value in some form, it does not necessarily meet the accumulation demand for commodities. Some part may be accumulated as money or financial assets. It is "Say's law" to claim that it always meets the accumulation demand. Furthermore this definition is apt to imply that capitalists can accelerate their accumulation demand only by reducing a ratio of their consumption to surplus value  $\alpha$ . But they can do it without reducing this ratio. For example, capitalists can expand their accumulation demand by borrowing. Increases of production and exploitation rate in response to the accumulation demand enable capitalists to accelerate accumulation even if the ratio of their consumption to surplus value remains unchanged.

realized rate of profit is determined.<sup>3)</sup> The greater are the rate of capital accumulation, financial deficit, trade balance and capitalists' consumption, the greater the realized rate of profit becomes. The main cause of high rate of profit in the upward phase of the trade cycle is that capitalists increase accumulation demand  $I$  which arises the rate of capital accumulation  $I/K$ . Conversely, the main reason why the

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3) Mr. Turuta (Chu-o University, Japan) offered the following two questions on the equation (11). (a) Is equation (11) satisfied only in the equilibrium? (b) What relationship is there between the realized profit rate thus determined and the exploitation rate? As these questions seem to be interesting for readers, we try to answer these as compactly as possible.

(a) The equation (11) is derived from equation (1). Equation (1) shows the equality of production and demand for the total commodities produced in the country; so, it is the equilibrium condition. Therefore, equation (11) derived from the equation (1) is also satisfied just in the equilibrium state. When aggregate production is greater than demand, we have

$$(1 - \alpha) r > g + d + e \quad (*)$$

But even in this case realized profit rate,  $r_a$  is determined by

$$(1 - \alpha) r_a = g + d + e$$

We easily know that realized profit rate  $r_a$  is lower than the profit rate in the equation (\*), because some portion of product is not realized. Conversely when aggregate production is less than demand, we have

$$(1 - \alpha) r < g + d + e \quad (**)$$

In this case, by price appreciation and production expansion, the realized profit rate rises, reaching the level determined by the equation (11).

(b) Given the rate of capital accumulation  $g$ , financial deficit  $d$  and trade balance  $e$  and capitalist's consumption rate  $\alpha$ , we have

$$(1 - \alpha) r = g + d + e$$

Thus, realized profit rate after tax is determined. The profit rate after tax is by definition

$$r = \frac{M - T_m}{K}$$

which we can rewrite as

$$\begin{aligned} r &= (1 - t_m) \frac{M}{N} \cdot \frac{N}{K} \\ &= (1 - t_m) \frac{\mu}{1 + \mu} \cdot \frac{N}{K} \end{aligned}$$

where  $t_m$ ,  $N$  and  $M$  denote tax rate on surplus value, the amount of living labour which is equal to  $V + M$  and the rate of exploitation respectively. Therefore, given realized profit rate after tax,  $r$ , tax rate on surplus values,  $t_m$ , and the organic composition of capital  $N/K$ , the rate of exploitation  $\mu$  is determined. For example, a rise of capital accumulation rate,  $g$ , increases the realized profit rate after tax,  $r$ , and increases the exploitation rate,  $\mu$ , when the tax rate,  $t_m$ , and organic composition of capital,  $N/K$ , remain unchanged.

rate of profit falls in downward phase of trade cycle is that accumulation demand of capitalists decreases and the rate of capital accumulation falls. To explain, if the rate of accumulation falls for certain reasons, the rate of profit decreases. Responding to this, capitalists restrain their accumulation demand, causing a further decline of the capital accumulation rate. Thus, the downward cumulative spiral of the profit rate occurs. In order to mitigate this cumulative process, the increases of the government financial deficit or of the trade balance become necessary to offset the decline of the capital accumulation rate.

(B) Factors Determining the Utilization Rate  
and Unemployment Rate

In capitalism, the means of production are possessed by the capitalist class and decisions on production with them are possessed by capitalists. Capitalists make these decisions aiming at a higher rate of profit. In modern capitalism, monopolistic capitalists govern most of main means of production and make decision on them. They have a certain desired rate of profit. Unless this profit rate is achieved usually, the capitalists do not keep the utilization rate. Instead, they try to raise the monopolistic price by lowering the utilization rate to restore the rate of profit. Therefore, the utilization rate is considered to depend on the realized profit rate (see Fig. 1).

As seen in the above section, the rate of profit is determined by the rate of capital accumulation, financial deficit and trade balance. So the rate of utilization also depends on these factors. A decline of a rate of capital accumulation results in a decrease of rate of profit and a further decline in utilization. This, consequently, increases the unemployment rate. In the same way, a decline of the rate of the government financial deficit or trade balance result in the decrease of the rate of profit and utilization. Consequently, the rate of unemployment increases.

Here we must note that there is another important determinant of the rate of utilization and unemployment. The Fig. 1 shows the functional relationship between the rate of utilization and profit. What determines such functional relationship between the rate of profit and the utilization as shown in the Fig. 1 ?



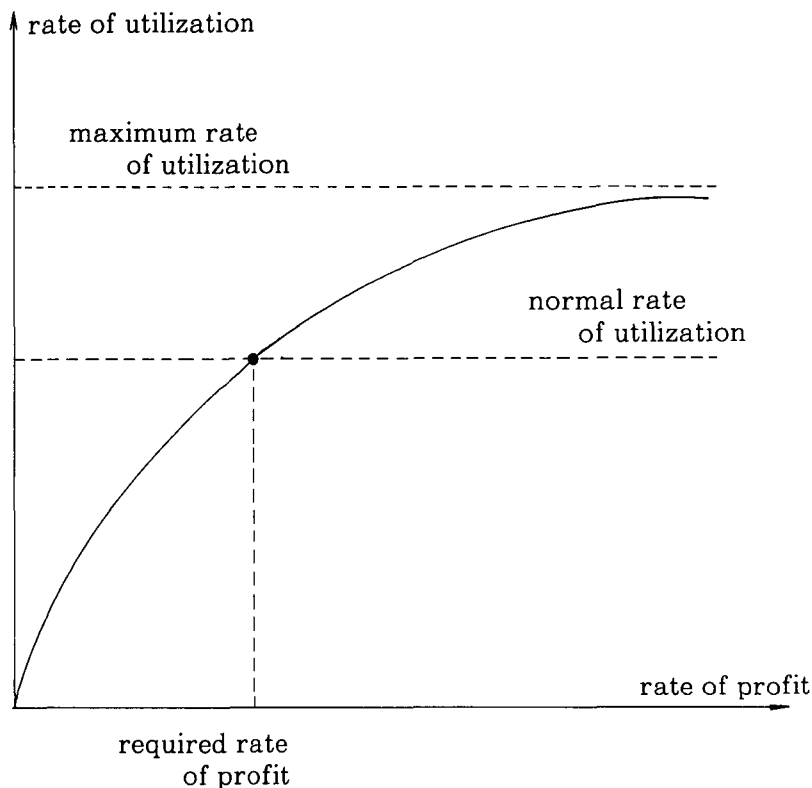


Fig. 1

The relationship is not a technical and natural conditions, but represents the attitude of monopolistic capitalists who make the production decision. For example, when the degree of monopoly rises and the desired rate of profit rises, the curve in the Fig. 1 shifts downward. So the rate of utilization corresponding to a certain rate of profit declines. Conversely if the democratic regulation succeeds in depressing the desired rate of profit of monopolistic capital, the curve shifts upwards and the utilization rate corresponding to a certain rate of profit rises. In this case, in spite of a decline of rate of profit, it is possible to raise the utilization rate. Thus, we can see that the factors determining the profit rate and monopolistic capital's attitude in decision making are the factors determining the rate of utilization and unemployment.

### (C) Causes of Stagnation

To study the causes of stagnation we need to investigate what

actually happened to the following four factors determining the rate of profit, utilization and unemployment after 1970: the rate of capital accumulation; the governmental financial deficit; the trade balance; and the decision making attitude of monopolistic capital. These are taken up in turn.

(1) The rate of capital accumulation: Capitalist's desire for capital accumulation depends on their expectation with respect to profit rate, utilization rate and financial conditions. But there are factors which restricts the capital accumulation. If production technologies are given, the rate of capital accumulation cannot exceed the growth rate of labour supplies and resources supplies in the long run. In order for capital to grow faster than the supply of labour and resources, new technologies must be introduced which enable them to save labour and resources. However after 70's, the rate of technical progress became low and limitation of resources supply became apparent because of resources supply countries' independent supply policies. In addition, in the 70's most people began to recognize that the natural environment has been destroyed in the process of capital accumulation by monopolistic capital and further destruction of the environment will endanger the survival of human beings. Thus, strong warning and opposition occurred against monopolistic capital accumulation. As these limitations became noticeable, the rate of capital accumulation declined in the 70's.

(2) The rate of financial deficit of the government: A fall of a capital accumulation rate results in a decrease in the profit rate, and in utilization, and an increase in the unemployment rate. To stop or mitigate these, monopolistic capital asked the government to raise the rate of financial deficit. The government increased financial expenditure more than tax revenue. However, this induced several troubles. If the deficit is financed by an additional issue of national bonds which are sold in open market, the price of national bonds falls. A rise of the rate of return on government bonds induces a rise of the general interest rate. This is the so-called "crowding out effect", and negatively influences the demand for capital accumulation. Thus, the increase of financial deficit rate may be offset by a decrease in the rate of capital accumulation and the rate of profit and utilization. The unemployment rate, of course increases. To avoid such a negative effect, the central bank must buy government bonds by increasing the money supply. Such an increase in the money supply causes inflation. Inflation may cause political crises and an unfavorable trade balance owing to the higher price of exported goods compared with prices in

other countries. This makes the government unable to continue to increase financial deficit rate by expanding the money supply.

(3) The trade balance: When the rate of capital accumulation falls and it becomes impossible to raise the governmental financial deficit enough to offset the fall for the above reasons, the rate of profit and utilization declines and unemployment rate rises. To cope with it, there remains nothing but to raise a rate of trade balance. Every countries pursued favorable balance of trade through driving exports. However, this also caused troubles. The sum of trade balance of all countries in the world is always zero. Therefore, if some country has a favorable balance of trade, there must be another country which has a trade deficit. As in a country which has a trade deficit, the realized rate of profit falls in response to the deficit. The increase of the trade surplus raises the rate of profit of the country sacrificing the other country's profit rate; so severe international conflicts take place. To confine these conflicts within a tolerable range, some constraints to export become necessary. Though the aggregate sum of trade balance of all countries being zero as already mentioned, still it is possible for the sum of so-called advanced capitalist countries to be positive on the conditions that developing countries and socialist countries are compelled to have trade deficits. So, advanced capitalist countries can raise their own rate of profit in this way. However, a deficit in the trade balance in developing countries causes their enormous cumulative debts. The increasing possibility of the developing countries defaulting on their deficits makes exports to these countries extremely unstable. The exports to socialist countries will remain unstable, unless the politically, militarily and economically antagonistic relationships between capitalist countries and socialist countries are terminated.

(4) Monopolistic capitalist's attitude in decision making: Even if by the reasons stated above, the rate of profit falls, the rate of utilization would not decrease and the unemployment rate would not increase, if capitalists had kept the rate of utilization high under a low rate of profit. However, in the 70's the monopolistic capitalists tried to restore the rate of profit by raising monopoly prices through restricting production. So the rate of utilization declined sharply and the unemployment rate increases greatly in response to a decrease of profit rate.

### III Mechanism of Stagflation

The stagnation is caused by monopolistic capitalists' restrictive decision-making on production and the decline of the sum of the rate of capital accumulation, financial deficit and trade balance. Why is inflation accelerated under the condition of stagnation? In order to answer this question, we first must study the antagonistic relationship among the rate of profit, real wage rate and real price of natural resources.

(A) The Antagonistic Relationship among the Rate of Profit, Real Wage Rate and Real Price of Natural Resources

When production technologies are constant, the rate of profit, the real wage rate and the real price of resources have the antagonistic relationship one another. Here, the real wage rate and real price of resources are measured in terms of the produced commodity.

When the production technologies are unchanged, a rise of the profit rate is sure to lower either the real wage rate of labour or the real price of resources. Likewise, a rise in the real price of resources necessarily decreases either the profit rate or the real wage rate of labour. Finally a rise of real wage rate of labour will certainly cut down either the profit rate or the real price of resources. Thus, there exists the antagonistic relationship among profit rate, the real wage rate and the real price of resources under constant production technologies.

(B) The Incompatibility among Requirements of Monopolistic Capital, Working Class and Resources-Supply Countries.

As stated above, the profit rate, the real wage rate and the real price of resources have an antagonistic relationship. On the other hand, monopolistic capital, the working class and resources-supply countries require a certain level of the profit rate, real wage rate and real price of resources, respectively.

(1) The required rate of profit. Monopoly capitalists, as mentioned before, are not indifferent to the level of profit rate when they make decisions on utilization of their own production equipment. They never normally utilize their equipment without expecting their required rate

of profit depends on the degree of monopoly, on the capital accumulation rate intended by monopolistic capital and on the rate of interest, etc.

(2) The required real wage rate. As working class make a living only by selling their own labour power, it is natural that they are seriously interested in the kinds and quantities of consumption goods purchasable with their wage. The real wage rate is directly related to the rate of exploitation of labour under constant technologies. Suppose labourers work by the amount  $N$  and earn their wages  $V$  in terms of values (i.e. bestowed labour), surplus value  $M$  is given by

$$M = N - V \quad (13).$$

As  $V$  is the value of consumption goods purchasable with wages,

$$V = B \quad (14),$$

where  $B$  denotes the amount of consumption goods received by labourers, and  $t$  denotes the value per unit of consumption goods. Then the rate of exploitation  $M/V$  is expressed, using (13), (14), as

$$\frac{M}{V} = \frac{N - Bt}{Bt} \quad (15).$$

By the definition of real wage rate  $R$ ,

$$R = \frac{B}{N} \quad (16),$$

then substituting (16) into (15), we have

$$\frac{M}{V} = \frac{1 - Rt}{Rt} \quad (17).$$

When production technologies remain constant, the amount of bestowed labours necessary to produce consumption goods  $t$  also remain constant. Then from (17), the higher (lower) is real wage rate  $R$ , the lower (higher) rate of exploitation becomes. Therefore the requirement of working class for a level of real wage rate implies that they refuse higher rate of exploitation than a certain level.

(3) The required real price of resources. Since World War II until the middle of 1960's, as energy resources-supply countries have been ruled by the imperialistic countries which are represented by U. S. A., real price of raw oil has been depressed. But the supply countries succeeded in getting out of the ascendancy of imperialistic

countries, and became able to have their own oil-supply policy. Thus, they became able to require a certain real price in order to use oil proceeds for their independent development.

(4) The incompatibility of requirements. When monopolistic capital, working class and resources-supply countries have the required profit rate, real wage rate and real price of resources respectively, can all three requirements be satisfied at the same time? If these required levels are high, the three requirements become incompatible because, as described above, there exists the antagonistic relationship among the profit rate, real wage rate and real price of resources under constant technologies. As a result, when monopolistic capital gains its required rate of profit, either required levels of working class or resources-supply countries, or both of them, cannot be achieved. When resources-supply countries realize their required real prices of resources, either the requirements of monopolistic capital, or the working class cannot be realized. In this sense, the three requirements are incompatible.

(C) The Rate of Profit Required  
by Monopolistic Capital and Stagflation

To reiterate, there exists the antagonistic relationship among the rate of profit, the real wage rate and the real price of resources. Then it is difficult for the profit rate required by monopolistic capital, real wage rate by labourers and price of resources by supply countries to be compatible, if the required levels of these three are high. For both of the required real wage rate of labourers and the desired real price of resources to be realized, the rate of profit must be  $\alpha$  in Fig. 2. Whereas monopolistic capital's required profit rate is much greater than  $\alpha$ , as shown  $\beta$  in Fig. 2. The inequality  $\beta > \alpha$  shows the incompatibility of requirements of monopolistic capital, of labourers and of resources supply countries. Thus, we have three domains of profit rate, as (a), (b), (c) in Fig. 2.

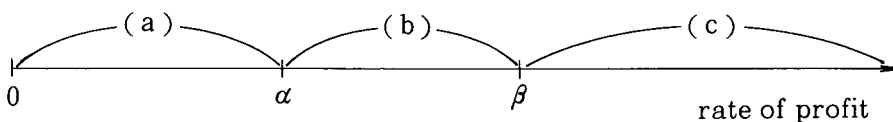


Fig. 2

When the rate of profit is in the domain (a), it is remarkably low, much lower than the desired level  $\beta$ . Therefore, the level of utilization, employment and demand for natural resources are also very low. However, as the rate of profit is below  $\alpha$ , both the real wage rate and real price of resources exceed their requirements.<sup>4)</sup> The economy is in the stagnation, but it is not probable that inflation is accelerated in this case because of the following. First, because there exists high rate of unemployment in the labour market and great excess supply in the resources-market, labourers and resources supply countries hesitate to raise the money wage and prices of resources. Second, large scale idle capacity in the commodity market prevents monopolistic capital from raising their prices.

When the rate of profit is in the domain (b), it is lower than the desired level  $\beta$ , similarly to the case (a). Therefore, there exists under-employment of equipment and labours. So we have the stagnation,

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4) Profit rate and real wage rate have the antagonistic relationship as shown in Fig. A, when production technologies and the rate of utilization are given. Even if production technologies embodied in the existing production equipment are given, labour productivity differs according to the level of utilization of this equipment. It may be natural to suppose that labour productivity increases up to the maximum as the rate of utilization increases. After the utilization rate exceeds the normal level, labour productivity begins to decrease sharply. As monopoly capitalists decide the utilization rate in response to the profit rate, we may have the relationship between the profit rate and the real wage rate as shown in Fig. B. This results from labour productivity changing in response to utilization rate. It is notable that when the profit rate (and at the same time the utilization rate) is very low, the real wage rate becomes a increasing function of the profit rate. Therefore, in this situation, we cannot observe the antagonistic relationships between them.

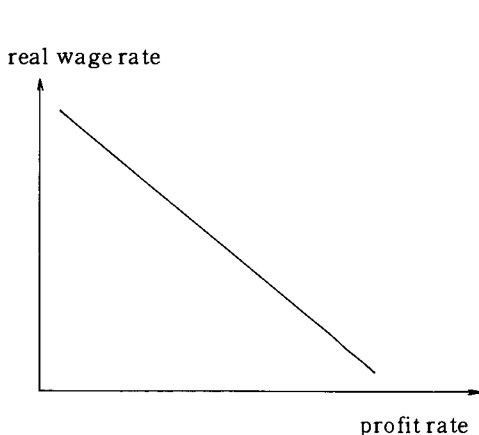


Fig. A

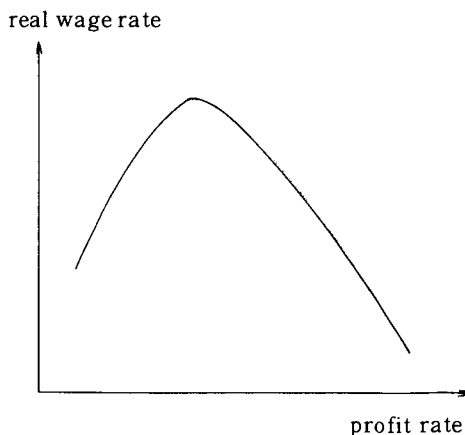


Fig. B

though its severeness is weaker than the domain (a). But in the domain (b) the rate of profit exceeds  $\alpha$ . So real wage rate and price of resources do not meet requirements. In this domain, all three requirements are not satisfied. It is possible here that inflation is accelerating in spite of the stagnation of production and employment. Working class and resources-supply countries try to raise the nominal wage rate and resources price, respectively, to attain their requirements while monopolistic capitalists raise prices to hold their profit rate. In this domain, the excess supply of labour and resources and idle capacity are not severe enough to negate the militance of labourers and resources supply countries and the greed of monopolistic capital. Then a "Price-wage-resources price spiral" occurs if monetary conditions are accomodating. Accordingly, stagnation and inflation can co-exist when the profit rate is in the domain (b).

When the rate of profit is in the domain (c), it is at an outstandingly high level and exceeds the desired level  $\beta$ . Therefore, production equipment and labourers are highly employed. In this case, as the profit rate exceeds  $\alpha$ , real wage rate and real price of resources is much below their required levels. Labourers and resources-supply countries raise the nominal wage rate and the price of resources while capitalists raise their prices to maintain high rate of profit. This inflation is not accompanied with the stagnation, therefore, is not stagflation.

As known from above, the following four conditions are necessary for stagflation to occur.

- (1) The profit rate required by monopolistic capital, the real wage required by working class and the real price of resources required by supply-countries are incompatible.
- (2) Monopoly capitalists have the ability to administrate their own price so as to maintain or restore the rate of profit when the rate of utilization of their equipment is not extremely low.
- (3) Labourers and resources-supply countries do not passively accept the reduction in the real wage rate and the real price of resources below their requirements and they can raise nominal wage rates or the price of resources even if there exists excess supply in the labour and resources market.
- (4) The realized rate of profit, which is determined by the sum of the rate of capital accumulation, financial deficit and trade balance, is lower than that desired by monopolists, and is higher than the level which is compatible with desired real wage and real



price of resources (in Fig. 2, between  $\alpha$  and  $\beta$ ).

#### IV The Intervention of the State and Stagflation

Next problem is to consider the reason why a realized rate of profit is confined into the domain (b), where stagflation occurs, for a long time. For this purpose it is necessary to make clear that the accumulation process is unstable in the capitalistic economy. Further, the modern capitalism is very vulnerable to this instability.

##### (A) The Instability of Accumulation Process in the Capitalism

When the high rate of capital accumulation increases the realized rate of profit and the utilization rate, especially when the utilization rate exceeds its at the normal level, capitalists accelerate the demands for their accumulation and increase the rate of accumulation. This raises a realized rate of profit and utilization rate further, inducing capitalists to increase the rate of capital accumulation further. Thus, occurs the upward cumulative disequilibrium process.

Conversely, when the low capital accumulation rate decreases the realized rate of profit and the utilization rate, especially when it falls below its normal level, capitalists curtail the rate of accumulation. This decreases the realized rate of profit and utilization further. In response, capitalists decrease the rate of capital accumulation further. This is the downward cumulative disequilibrium process.

Thus, once the disequilibrium occurs, it is not smoothly adjusted by the price mechanism but cumulates in the capitalistic economy. This phenomenon is due to the fundamental contradiction in capitalism. It arises, in particular, from the fact that the private capitalists, especially monopolistic capitalists, make their private capital accumulations decision without consideration of the effects on the society as a whole.

If the cumulative disequilibrium process goes on ceaselessly; it becomes impossible for capitalism to reproduce itself. In order for capitalism to reproduce itself, the cumulative process must be switched to the opposite direction. The switching of the upward cumulative process of disequilibrium into the downward cumulative process is carried out by "Crisis". Crisis is "Forced Equilibrating Process" as K. Marx said. Conversely the downward cumulative process is switched

through the recovery of the rate of capital accumulation. Thus, capitalism inevitably takes the form of a trade cycle.

(B) The Intervention of State in Trade Cycle

By the instability of the accumulation process in the capitalistic economy, when the rate of profit is larger than  $\beta$ , namely in the domain (c), there must be upward cumulative process of disequilibrium. Because responding to high rate of profit, the rate of utilization exceeds its normal level and it accelerates the rate of capital accumulation, which arises the rate of profit further. Conversely, when the rate of profit is smaller than  $\beta$ , namely in the domain (a) and (b), there must be downward cumulative process. In response to the low rate of profit, there appears idle equipment. This discourages capital accumulation, which decreases the rate of profit further.

As seen above, it is the situation where the rate of profit lies between  $\alpha$  and  $\beta$ , i.e. in the domain (b) that stagflation occurs. However, when the rate of profit is below  $\beta$ , that is, left of  $\beta$  in Fig. 2, it continues to decline owing to the instability. Even if the rate of profit is in the domain (b) initially, in due time, the rate of profit falls into the domain (a) where it is below  $\alpha$ . In this case, we can observe the stagflation only in the earlier stage of downward phase of the trade cycle.

Now we must consider why the rate of profit stays in the domain (b) and the stagflation lasts for a long time. It is due to the intervention of state in the trade cycle. When the profit rate is initially in the domain (b), the downward cumulative movement comes out. The unemployment of equipment and labour cumulatively increase and the working class and the minor capitalists face the great difficulties if the movement is left as it is. Today, however, people are no longer passive and accept these difficulties as their inevitable "fate" and wait the "fortune" calmly. They try to struggle against the governing class's inability to control the production capacity. A political crisis is caused and the state cannot help but intervene in order to avoid these political crises and to check depression for the sake of the monopolistic capitalists who want to restore their rate of profit. The government takes various measures to prevent profit rate from falling further (These measures may include a increase in government expenditure financed with deficit, a reduction of interest rate, introducing favorable tax system for investment and others to stimulate capital accumula-

tion, or the promotion of export.). These policies prevent the profit rate from falling into domain (a) in Fig. 2.

On the other hand, the state must also intervene to keep down the rate of profit into the domain (b) from the domain (c). For, as mentioned above, in the domain (c) the profit rate shows the upward cumulative movement and accelerates capital accumulation. At that time, the profit rate much exceeds  $\alpha$ , depressing the real wage rate and the real price of resources below both required levels. Further, the real wage rate and resource price continue to decline. Against the reduction of the real wage rate and the real price of resources, the working class and resources-supply countries, assisted by the excess demand of labour and resources, easily raise the nominal wage rate and the resources price. Capital pushes up the commodity price not only to offset these nominal rises but to raise their rate of profit taking advantage of excess demand of commodities caused by the increased rate of capital accumulation. Such process is repeated, so inflation is rapidly accelerated.

The accelerated inflation, on the one hand, is a process of the increasing rate of the profit and the decreasing real wage rate and real price of resources. So, it is certainly advantageous for monopolistic capital. On the other, it produces the crisis which may endanger the capitalistic system when it is allowed to go on. The inflation accelerated depreciates real income of the people who earn a fixed income and involves all people into the struggle for greater share of nominal income. This appears as an "economic civil war". Moreover, when inflation is accelerated at different speeds among the nations, it diminishes the exports of the country with the most rapid inflation and brings about an excess of imports over exports. That is, the balance of payment deteriorates. Furthermore, the accelerative hyper-inflation deprives money of the function to measure values and results in difficulties in the economic calculation. This provokes a serious political and economic crisis. Facing these menaces the state intervenes in order to cope with the crisis. The government exercises the aggregate demand contraction policy. Financial expenditure is postponed or contracted and the demands for accumulation are restrained. Through these policies the rate of profit is brought back from the domain (c) into (b) where stagflation occurs.

Thus, the generation and persistence of stagflation are closely related with the intervention of the state which is one of characteristics of modern capitalism.

## V Two Policies

The policies against stagflation are opposite according to the interest of which class they are based on.

### (A) The Policy on the Standpoint of Monopolistic Capital

The policies against stagflation on the side of the monopoly aim at getting rid of both stagnation and inflation, keeping the profit rate high and depressing money wages and the money price of resources. These policies try to suppress the working class and the resources-supply countries from raising the nominal wage rate and the price of resources in response to the reduction of their real incomes.

For these purposes it becomes necessary to intervene in labour organizations, in order to make them less militant and to force them to accept the reduction of the real wage rate by various kinds of maneuvers. Then, if this fails to persuade the working class to acquiesce, compulsory measures are introduced. To weaken militancy of working class, the policy to increase the rate of unemployment intentionally by decreasing effective demand greatly are sometimes introduced.

Similarly, against resources-supply countries, the political policies including even military power is mobilized to force them to accept a decline of real price of the resources and to revive the favorable conditions of resources-supply for the monopoly. The main economic policy is to decrease demand for the resources by diminishing aggregate demand.

However, it is impossible to keep permanently labourers and resources-supply countries from raising the nominal wage rate and resources price when their requirements remain unsatisfied.

In order for monopolistic capital to keep the profit rate high without depressing the real wage rate and real prices of resources which provoke severe struggles, they must introduce new techniques which increase productivity of labour and decrease the resources input per a unit of product. Given the requirements of monopolistic capital, working class and resources-supply countries, the incompatible relationship among three is lightened by technical innovation. In other words, these technical innovations make the domain (b) narrower. Thus the possibility of stagflation becomes less.

However, for such technical innovations to be introduced, there must be drastic changes on the system of labour including reshuffling,

degradations and discharge of labourers. In some cases, industries as a whole are scrapped. In such industries, not only labourers but also capitalists are obliged to resist. To remove these resistances, the government also tries to conservatize the labourers' organizations and to force them compulsorily.

Even if labour productivity increases and energy input per unit decreases sufficiently, still it is highly probable that there remains a wide stagflation domain, (b) in Fig. 2. The real wage rate required by labourers does not always remain as before when labour productivity increases. It means the acceptance of higher rate of exploitation when labour keeps the required real wage rate as before in spite of an increase of labour productivity. Labourers aim not only at the absolute level of the real wage rate but a relative one to labour productivity. That is to say, they require a reduction of the exploitation rate.<sup>5)</sup> The required real wage rate may rise relative to the labour productivity. Then when labour raise the money wage rate to realize their requirements, the monopolistic capital raise prices to counter-attack and keep the high rate of profit. Then price-wage spiral reappears. Even sufficiently high technical innovations cannot exclude this. As to the price of resources, the same reasoning is valid.

#### (B) The Policy on the Standpoint of Working Class

The policies on the side of working class have diametrically opposite purposes. They try to get rid of both stagnation and inflation, keeping the high wage and real price of resources by depressing the realized profit rate of monopoly. They also try to compel capitalists to keep a high rate of utilization and employment, depressing a rise of commodity prices which restore the realized rate of profit.

For the majority of the society, it is not desirable to keep the rate of capital accumulation exceedingly high for a long period. It depresses people's consumption and causes inflation, resources shortage

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5) The rate of exploitation,  $\mu$ , is, as is already seen in third section, expressed by

$$\mu = \frac{1 - Rt}{Rt} = \frac{1/t}{R} - 1,$$

where  $R$  denotes real wage rate, and  $t$  denotes an amount of bestowed labour necessary to produce one unit of consumption goods. Therefore  $1/t$  shows labour productivity. Thus, we know that exploitation rate depends on a relative ratio of real wage rate  $R$  to labour productivity  $1/t$ .

and pollution of the environment. Furthermore, the upward cumulative process of disequilibrium caused by the exceedingly high rate of accumulation is inevitably followed by the downward cumulative process where people's welfare is seriously injured. Therefore, policies for the majority must aim at reducing the excessively high rate of capital accumulation, financial deficit and trade surplus.

To curtail excessive capital accumulation, the tax system favorable to investment must be removed and the monetary and the financial system which promotes investment must also be reformed. To decrease the financial deficit, the tax system favorable to monopolistic capital must be removed and government expenditures for monopolistic capital and for military purposes must be decreased. To reduce trade surplus, people's consumption must be increased, for which the increase of real wage and the shortening of working day are necessary.

If these three rates are reduced by the policies, the rate of profit will surely decline. However, it is naive to suppose that monopolistic capitalists will accept this without any counteraction. If the decision on current production remains intact and in their hands, they try to lower the rate of utilization and to decrease employment of labour, corresponding to the low level of profit rate. They also will try to increase prices to restore their required profit rate. The other counteraction is to shift the adverse effect of the policies to non-monopolistic capital. The decrease of the three rates reduces the rate of profit, which is the weighted average of profit rates.<sup>6)</sup> So, it is possible for monopolistic capital to keep their profit rate intact by sacrificing non-monopolistic capital even though the weighted average of profit rates falls. The final counteraction is to move their capi-

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6) Let  $\pi_i$  be the amount of profit after tax and  $K_i$  be the amount of invested capital in the  $i$  th sector. The rate of profit after tax in the society as a whole is given by

$$r = \frac{\pi_1 + \pi_2 + \dots + \pi_n}{K_1 + K_2 + \dots + K_n}.$$

Rewriting it, we have

$$r = \frac{r_1 K_1 + r_2 K_2 + \dots + r_n K_n}{K_1 + K_2 + \dots + K_n},$$

where

$$r_i = \pi_i / K_i$$

Here  $r_i$  denotes profit rate in the  $i$  th sector. Thus we know that  $r$  is a average of  $r_i$  with weights  $K_i$ .

tal abroad.

The policies cannot achieve their aims unless they succeed in checking these counteractions. Against monopolistic capital's strike, not only the inducing or compulsory regulation by the government but also the civil regulation by labourers employed by monopolistic capital and others are needed. Against their shifting the adverse effects to other capital, the policies must not only reduce the aggregate sum of the three rates but also pay attention to the directions of changes in demand. Against their escaping abroad, the systematic regulations of international transactions are indispensable.

In short the democratic policies on stagflation is the intervention for the interest of people in monopolistic capital's decision on capital accumulation, production, employment and pricing. To exercise these policies effectively, the establishment of the government which is supported by people and has the intention and ability to do it is absolutely necessary. Monopoly capital will desperately take every political and economic measures to hinder this. As stated above, even after the democratic government is established, they will try to counteract against these regulations. Stagflation stands on the class struggle both in its causes and in policies against it.

# A COMPUTABLE GENERAL EQUILIBRIUM MODEL OF THE JAPANESE ECONOMY\*

Mitsuo EZAKI\*\*

## Summary

The purpose of this paper is to present a computable general equilibrium (CGE) model of the Japanese economy which integrates real and financial sectors, and to apply it to a quantitative evaluation of the oil price changes and the fiscal and monetary policies from the point of view of the short run comparative statics.

The model attempts to explicitly introduce financial aspects into a multi-sector general equilibrium model and to capture interactions between real and monetary phenomena in a rigorous way under the general equilibrium setting. The absolute price level is determined endogenously in the model, and the fields of application of the model are extended from the industry-related problems to the macroscopic ones such as inflation, stabilization policies and so on.

The model covers markets for products, labor, foreign exchanges and financial assets. Correspondingly, the model determines product prices, wage, exchange rate and interest rates in such a way as to clear those markets basically. The model consists of 13 industries and 5 institutional sectors. The data and methodological framework of *1980 Input-Output Tables* and *National Accounts Statistics* in Japan are fully utilized in the construction and application of the model.

The performance of the model is checked for the benchmark year (1980) only. For the same year, the model is applied to the analysis of comparative statics, giving a quantitative evaluation on the impacts of oil price changes, the fiscal and monetary policies, and the direct policy measures to reduce trade surpluses. Sensitivity test is also made to check the stability of comparative statics. Dynamic simulations and comparative dynamics based on the model are left to be done in future.

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## 1. Introduction

The purpose of this paper is to construct a computable general equilibrium (CGE) model of the Japanese economy which integrates real and financial sectors, and to apply it to a quantitative evaluation of the oil price changes and the fiscal and monetary policies from the point of view of the short run comparative statics.

In his previous paper (Ezaki [1985]), the author has presented a CGE model of the Japanese economy focusing mainly on the real industrial sectors. The model covers markets for products, labor and foreign exchanges but not for financial assets (under an implicit assumption that financial markets are all cleared a priori in some way or others). As a result, only quantities, real values and relative prices are determined in the model, leaving absolute levels of values and prices underdetermined. The model in this paper, on the other hand, attempts to explicitly introduce financial aspects into the multi-sector general equilibrium model and to capture interactions between real and monetary phenomena in a more rigorous way. The absolute price level is now determined endogenously in the model and the field of application of the model can be extended from the industry-related problems to the macroscopic ones such as inflation, stabilization policies and so on.<sup>1)</sup>

CGE models are now widely used, mainly by World Bank, for the analysis of development planning and policies in the developing countries. The CGE model of Japan in this paper owes its theoretical framework at the starting point to one of the World Bank studies: Dervis, De Melo and Robinson [1982, Ch. 7].<sup>2)</sup> The Japanese model here, however, includes a different approach to the labor market, an elaboration in the distribution and expenditure sides of GDP, and an extension

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1) See Dervis, De Melo and Robinson [1982, pp. 150 – 152] for the importance of model's extension in this direction. Major changes in framework of the present model from the previous one are: (1) addition of behavioral equations, identities and equilibrium conditions for the financial sector, (2) separation of banking and insurance from the industrial sectors, (3) separation of financial institutions from the institutional sectors, (4) revision in the specification of net property income, and (5) revision in the exchange rate determination.

2) See Sanderson and Williamson [1984] for a survey and evaluation of the World Bank studies on CGE models. See Drud, Grais and Vujovic [1982], Amranand and Grais [1984], ESCAP [1983] and A. Gelb [1983] for models of Southeast Asia, which is the region of the author's main interest. General equilibrium models are widely used also in the developed countries by the name of applied general equilibrium (AGE) model for the analysis of taxation and trade policies. See Shoven and Whalley [1984] for a detailed survey of such AGE models (which includes CGE models also but partly).

in the determination of exchange rate and price level, the last of which is closely related to the endogenous treatment of the financial sector. It should be emphasized that the Japanese model here fully utilizes the data and methodological framework of the new SNA (System of National Accounts), which is a synthesis of the five major accounts or statistics for the national economy: input-output tables, national income accounts, balance of payment accounts, flow of funds tables and national balance sheets.<sup>3)</sup>

There exist at least three *econometric* models of the multi-sector general equilibrium type for the Japanese economy: Saito [1973], Tsujimura and Kuroda [1973], and Saito [1983]. The first two are the pioneering studies in this field made in the early seventies, while the third is an attempt to extend the 1973-version by allowing for monetary behaviors and the financial sector. They are all carefully made empirical studies. The model in this paper may be said to be a quick version of these studies in the sense that empirical rigorousness is sacrificed for theoretical preciseness and operational simplicity (as is the case in most CGE studies).<sup>4)</sup>

The CGE model of Japan here depends exclusively on *Showa 55 Nen Sangyo Renkan Hyo (1980 Input-Output Tables)* (which will be referred to as *IO80* hereafter) for the data of industrial productions and expenditure allocations, so that 1980 is the bench mark year in the model for which the economy is assumed to be in equilibrium. Almost all of the other data required in the model such as distributed income, expenditures, physical and financial assets, etc. are derived from *Kokumin Keizai Keisan Nenpo (Annual Report on National Accounts)* (which will be referred to as *NAS* hereafter). As shown in Table 1, the model disaggregates the economy into thirteen industrial sectors according to the 72×72 table of *IO80* with a special treatment for energy-

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3) See United Nations [1968] for the new SNA, and Economic Planning Agency [1978] for its Japanese version. Social Accounting Matrix (SAM) is usually used for the models of developing countries. SAM may be considered as a matrix unification of input-output tables, national income accounts and balance of payments accounts. See Pyatt and Round [1977, 1979] for SAM and its relations with SNA.

4) In the three econometric models, the aggregate budget constraint which leads to the Walras' Law is not explicitly shown, so that it is not clear which of the (possible) equilibrium conditions is redundant and therefore dropped from the system. Money is considered as the determinant of absolute price level in the second model above, but its supply is assumed to be *identically* equal to its demand. The wage rate based on the Philipps relations is the determinant of absolute price level in the first and third models above.

related industries and banking and insurance,<sup>5)</sup> on the one hand, and five institutional sectors which correspond exactly to the *NAS* classification, on the other.

The CGE model of Japan assumes Cobb-Douglas production functions for the 13 industries mentioned above. The model employs also Cobb-Douglas functions in aggregating imports and domestic products into composite goods for each of the 13 industries. The model assumes further a Cobb-Douglas utility function (in addition to a constant saving rate) for the households sector in deriving consumption demand disaggregated for each industry. In other words, elasticities of substitution are all set equal to one between production factors, between imported and domestically produced goods, and between consumption goods, resulting in the functional parameters to be estimated by appropriate shares in 1980. The model in this paper, therefore, describes the economy of Japan as the one with unitary elasticity of substitution, assuming it to be in equilibrium for the benchmark year 1980.<sup>6)</sup>

The structure and characteristics of the Japanese CGE model will be discussed in detail in Section 2. The performance of the model will be checked for the benchmark year in Section 3. In the same section, the model will be applied to the analysis of comparative statics in 1980, giving a quantitative evaluation on the impacts of oil price changes, the fiscal and monetary policies, and the direct policy measures to reduce trade surpluses. Sensitivity test will also be made there to check the stability of comparative statics. In Section 4, concluding remarks will be given, stressing the necessity of further elaborations of the model especially toward comparative dynamics.

## 2. Structure of the Model

Notation and system of equations for the Japanese CGE model are listed in Table 2 and Table 3, while financial assets and liabilities accounts used in the model are illustrated in Table 4. Most of the parameters in the model, especially shares, ratios and constant terms, are estimated directly from *IO80*, *NAS* and other proper sources, but var-

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5) Energy-related industries are separated out in some detail here for the model to be able to deal with energy problems at a minimum level. The disaggregation in energy-related industries here follows Saito and Ohno [1984] with the exception of coal industry. The separate treatment of banking and insurance is necessary to integrate the financial sector with the real parts of the model. This industry corresponds exactly to the sector of financial institutions.

6) The present model adopts a number of other simplifying assumptions and procedures, which are listed at the end of Section 2.

ious elasticities in relation to demand and supply functions are derived from a very crude guess work as the first approach. The latter are summarized in Table 5.

The model is formulated precisely as a general equilibrium system, so that its essential part may best be summarized by the Law of Walras. Combining budget constraints and related equations in Table 3, we can express the aggregate identity which leads to the Walras' Law in the following way (See Table 2 for notation):<sup>7)</sup>

$$\begin{aligned} & \sum_{i=3} PD_i (X_i^D - X_i^S) + W [\sum (L_{si} + L_{li}) - L^S] \\ & + ER [\sum \overline{PWM}_i M_i + (\overline{RL}_w + \overline{RA}_w + \overline{RT}_w) - \sum PWE_i E_i - F_w] \\ & + (AC_H + AC_C - AC_B^*) + (AS_H + AS_B - AS_C^* - AS_G^*) \\ & + (AL_B - AL_H^* - AL_C^* - AL_G^*) = 0, \end{aligned}$$

where the second term must be dropped when the minimum wage constraint holds (i.e.,  $W = \bar{W}$  which will be explained in more detail later). As may be seen from this aggregate identity, it is supposed in the model that the domestic prices ( $PD_i$ ,  $i \neq 3$ ) are determined by the equilibrium conditions in the product markets (eq. (44) in Table 3 and the first term above), the nominal wage ( $W$ ) by the equilibrium condition for the labor market (eq. (9) and the second term) unless the minimum wage constraint is effective, the exchange rate ( $ER$ ) by the equilibrium condition for the foreign exchanges market (eq. (45) and the third term), and the interest rates of securities and loans ( $r_s$  and  $r_l$ ) by the two equilibrium conditions in the financial markets (eqs. (33.2) and (33.3) and the last two terms). There still remains one equilibrium condition in the model, i.e., eq. (33.1) (the fourth term above), which is redundant or not independent of the other equilibrium conditions due to the aggregate identity above. It is for the cash currency with unitary price or zero interest rate, so that the independent equilibrium conditions, when solved, give the absolute levels of prices and interest rates in equilibrium. Eq. (33.1) is explicitly introduced into the model but not actually used in solving the system. The demand for and the supply of cash currency match automatically when the markets for products, labor, foreign exchanges, securities and loans are all cleared through adjustments in the corresponding prices and interest rates. In other words, the prices and interest rates determined endogenously for their absolute

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7) The aggregate identity below is a combination of flow and stock variables so that the initial stock relations (at the end of the previous year), whether they are definitional identities or equilibrium conditions, are fully utilized in deriving it.

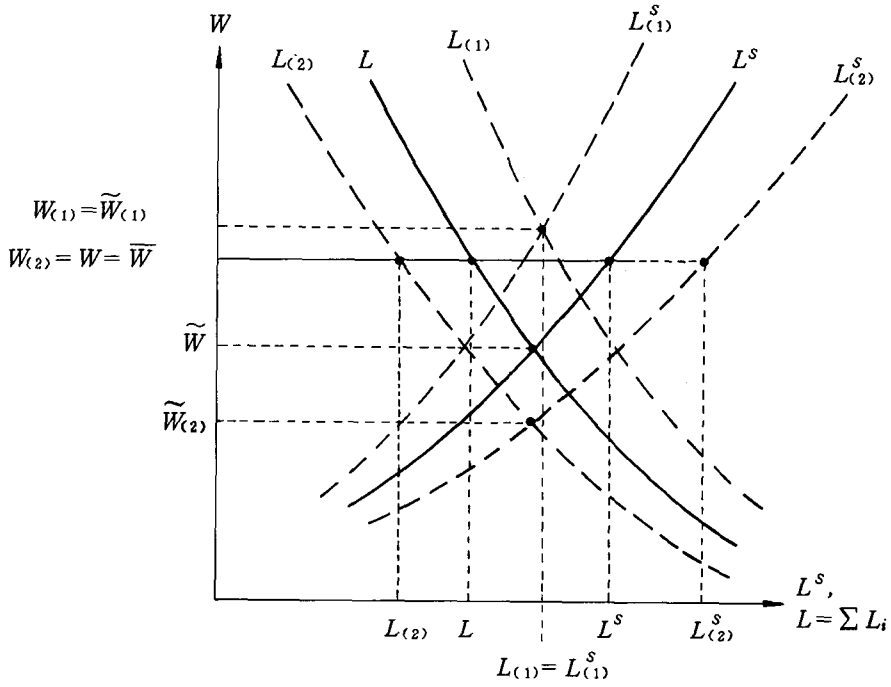
levels in the model are the ones that guarantee also the equilibrium in the money market.<sup>8)</sup>

The labor market in the present model is a deviation from the pure general equilibrium system. As seen from eq. (9), the model assumes the nominal wage ( $W$ ) to be downward rigid, making it impossible for the wage to decline below a certain minimum level ( $\bar{W}$ ). This minimum wage level is set equal to the *actual* wage level in solving the system for 1980 and applying it to the analysis of comparative statics in the next section. In other words, the model adopts a labor supply function of the Keynesian type, assuming the economy to be basically in underemployment equilibrium. The situation is illustrated in Figure 1 (Case A), from which we can see that the model permits also a possibility of full employment where the wage rate is determined in such a way as to clear the labor market (i.e.,  $L_{(1)} = L_{(1)}^S$  in Case A). It is possible, by a small modification of the model, to deal with the case of completely flexible nominal wage, as is illustrated also in Figure 1 (Case B). In this case, totally unemployed labor force (in 1980) is regarded as 'natural' or 'desired' and excluded from the labor supply function, on the one hand, and the labor market is assumed to be always cleared through adjustments in the flexible nominal wage, on the other. Case A is considered as a standard case in the model, but the results of comparative statics based on Case B will also be presented for reference purposes in the next section.<sup>9)</sup>

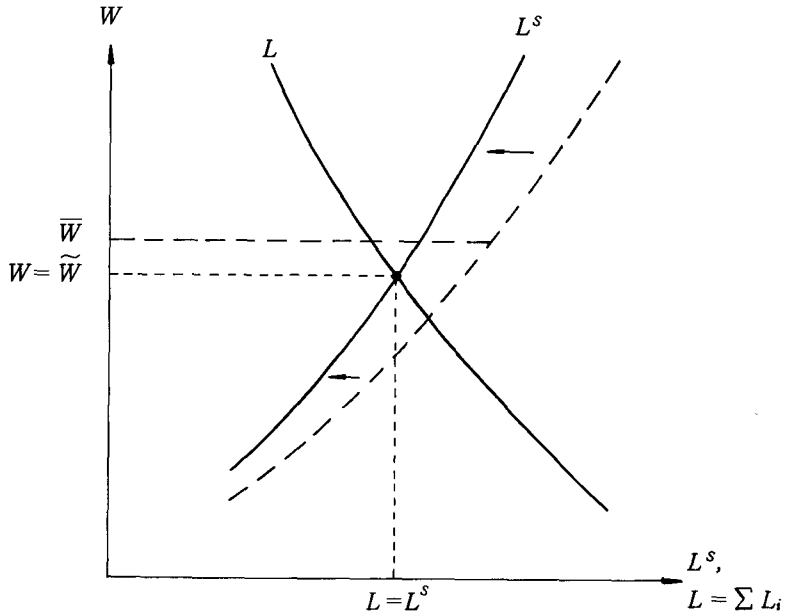
8) Money here means 'cash currency in circulation' ( $\overline{AC}_B^*$ ) but it may be regarded as 'narrow money' ( $AC_B^* + AD_B^*$ ) or 'broad money' ( $AC_B^* + AD_B^* + AT_B^*$ ). Note that the supply of cash currency ( $AC_B^*$ ) is treated as exogenous in the model. The independent supply behavior of this kind is crucial in determining the absolute levels of prices and interest rates. If, for example, the supply of cash currency is endogenized in such a way as to automatically match to the demand for it, then eq. (33.1) is no longer the equilibrium condition and the system cannot determine the absolute levels of prices and interest rates by the Law of Walras, resulting in the necessity of choosing one of the prices and interest rates as numeraire. In the Korean CGE model by Adelman and Robinson [1979], the supply of money is explained as exogenous (p.25) but only the demand for money appears in the system (pp. 206-225), assuming implicitly in the solution process that the supply of money is *identically* equal to the demand for money (pp. 239-243).

9) Average wage never declined in nominal terms throughout the postwar period (except for 1958) in the Japanese economy, but it did decline in real terms recently in 1980. Whether money (i.e., nominal) wage was rigid or real wage was rigid or both were flexible in the postwar period are discussed in detail in Kurosaka and Hamada [1984, Chapters 3 and 9]. In the present model, the money wage is assumed to be downward rigid and its actual level (in 1980) is equated with the exogenous minimum wage ( $\bar{W}$ ), regarding it as an initial condition to the system to have been determined already at the beginning of the year (by such an occasion as the spring wage negotiation) based on the rates of unemployment and inflation, etc. of the previous year.

Fig.1. Equilibrium in the Labor Market



Case A. Downward rigid nominal wage



Case B. Flexible nominal wage under labor supply  
excluding totally unemployed labor force

The present model is not a *pure* general equilibrium system in which prices (including exchange rate and interest rates) are *all* flexible and markets are *all* cleared by price adjustments. For several markets in the model, prices are given exogenously (or nearly exogenously) and supply-demand equalities (not equilibria) are assumed to be attained by quantity adjustments mainly from the supply side. The labor market was an example (though only for the case where the minimum wage constraint is effective), and the demand for labor is assumed to be realized by the supply adjustment, permitting the existence of unemployed labor (eqs. (9) and (10)). The second example is the market for crude oil (industry 3), in which the domestic supply ratio is very small (less than 1%). For this industry, domestic price is given by import price which is nearly exogenous (eqs. (44) and (1)), while domestic production can be expanded to any level without allowing for demand limitations (eq. (39)), and the gap between total demand and domestic supply is filled by imports (eq. (41)). The third example is the markets for financial assets: demand deposits ( $AD$ ), time deposits ( $AT$ ), trade credits ( $AU$ ), and other domestic financial assets ( $AO$ ) (See Table 4). It is assumed in each of these markets that demand is always matched by supply under the exogenously given level of interest rate (eqs. (32.3), (32.4), (32.5) and (30.4)). In other words, infinitely elastic behaviors are supposed for the supply side. The final example is the markets for foreign products (i.e., imports) and foreign financial assets (i.e., net capital inflow or outflow). Based on the small country assumption, it is supposed in the model that Japan can import any amount of foreign products without affecting their prices under the infinitely elastic foreign supply (eq. (41) and the exogenous import price  $\overline{P_{WM}_i}$ ). Similarly, Japan is supposed to be able to import (or export) any amount of capital without affecting its interest rate under the infinitely elastic foreign supply (or demand) (eq. (34.2) and the exogenous interest rate  $\overline{r}_F$  though the latter is not explicitly used in the model).

So far have been comments and explanations on the general structure of the model. We will next discuss about more specific aspects of the model, especially on the composite goods, the financial sector, and the exchange rate determination.

In the present model, domestically produced and imported goods are not considered as homogeneous but as substitutes (except for industries 3, 9 and 10 with negligible domestic production or zero imports). Based on the so-called 'Armington' procedure, they are aggregated into a composite commodity in each industry ( $Q_i$ ), for which the domestic demand

is supposed to arise and from which the demand for domestic goods ( $D_i$ ) and the demand for imported goods ( $M_i$ ) are derived. In other words, assuming an aggregation function of constant returns to scale ( $Q_i = g_i(M_i, D_i)$ ) and using the identity in value ( $P_i Q_i = PD_i D_i + PM_i M_i$ ), we get the price definition for composite goods (eq. (3)). Assuming further the cost minimization behavior of the users or buyers under a given level of the demand for composite goods (i.e.,  $Q_i = Z_i + C_i + Co_i + V_i$  in the model), we get the domestic demand for domestic goods ( $D_i$ ) as well as the import demand ( $M_i$ ) in each industry (eqs. (39)–(41)). This approach and the related framework for the real industrial sectors in the model are closely in line with Dervis, De Melo and Robinson [1982, Ch. 7].<sup>10)</sup>

The financial sector in the model (eqs. (27)–(34) and Tables 4 and 5) plays a crucial role in the determination of absolute price levels as explained already. It affects also the real part of the system through net property income (eq. (13)) and private investments (eq. (22)), on the one hand, and the price structure of the system through exchange rate (eqs. (1), (2) and (45)), on the other. The specification of the sector basically follows Brainard and Tobin [1968] though the equity price and dynamics of adjustment are not allowed for here. All of the financial assets are measured in nominal terms (neglecting the possibility of price speculations), so that only interest rates are relevant prices in the sector. There are several points to be especially noted for the specification here. First, government deficits are assumed to be domestically financed by both bond issues and borrowings under a constant allocation share between the two (eqs. (31.4) and (31.5)).<sup>11)</sup> Second, all of the foreign assets and liabilities are aggregated into a single concept (i.e., net foreign assets) due to the lack of data on detailed asset categories, and the net demand for foreign assets in each sector (except government) is derived as residuals since its sign alternates between years especially in the sector of corporate enterprises (eqs. (29.8),

10) Note that this composite goods approach is concerned about *total* domestic demand for each industry. The approach can be replaced by the introduction of import matrix, which makes it possible to determine total demand for imports from its disaggregate sources: intermediate demands, consumption demands, investment demand, etc. The model, however, becomes far more complex in this case especially when the substitutability between domestic and imported goods is assumed individually for each of the disaggregate demand sources.

11) This specification is adopted for the purpose of doing comparative statics in a proper manner in the next section, where exogenous shocks are given to government expenditures and tax rates.



(30.8) and (32.6)).<sup>12)</sup> Finally, the central bank, banking institutions, and non-bank financial institutions are not separated but treated as a single sector, for which an average behavior is specified in their asset choices (eqs. (32.1) and (32.2)).<sup>13)</sup>

The determination of exchange rate in the present model (eq. (45)) follows the traditional approach: the exchange rate is determined in such a way as to attain the supply-demand equilibrium in the foreign exchanges market. In other words, the exchange rate in the model is the rate at which the sum of current and capital accounts in the balance of payments becomes equal to zero (where the capital account incorporates changes in official reserves). This is the approach adopted by Mundell [1968 (Chs. 17 and 18)] and Amano [1980 (Chs. 9 and 10)] in their theoretical analyses of employment and stabilization policies under the flexible exchange rate system, and also by Amano [1978, 1982 (Chs. 10–12)] in his FLEX (flexible exchange rate) model for the Japanese economy.<sup>14)</sup> Note that the capital account in the present model (for the sign reversed) is derived as changes in the desired stocks of net foreign financial assets (eq. (34)), but those desired stock levels are determined as residuals in the domestic sectors without allowing for any speculative elements in relation to the exchange rate expectations.

Most of the remaining equations in Table 3 seem to be self-explanatory, so that detailed explanations are skipped on individual equations, and only a brief summary is given on the simplifying assumptions and procedures adopted in the model.

(1) Production, aggregation and utility functions are of Cobb-Douglas type with constant returns to scale. (2) Saving rate in households is constant. (3) Coefficients of intermediate inputs are con-

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12) This may cause a relatively large error in solving the system for the variable of net foreign financial assets, especially when its level is not large as in the case of households sector.

13) It is not possible to treat the three financial institutions separately for the consistency between industrial and institutional sectors to be maintained. It may be desirable, however, to separate the central bank from other institutions at least in the institutional sectors for the purpose of analyzing monetary policies in a more precise way. A theoretical analysis of Horiuchi [1980, Ch. 1] seems to be useful in considering such an extended framework.

14) The FLEX model is an econometric model which focuses strategically on the endogenization of exchange rate, allowing for a variety of flexible rate systems. It gives a comprehensive explanation on the balance of payments and the exchange rate (though the specifications for other part of the economy is suppressed to a necessary minimum). The method of exchange rate determination in the FLEX model is called 'demand-supply balance approach.'

stant. (4) Industrial labors (employed, self-employed and unpaid family workers) are measured in terms of efficiency units based on relative wages to overall average. (5) A discounting factor ( $1/4$ ) is multiplied to the number of self-employed and unpaid family workers in industry 1 allowing for job overlappings and working hours. (6) A constant share and the same wage are assumed between employed and other workers for each industry. (7) A constant share is assumed between households and corporate enterprises for operating surplus. (8) Adjustment factors are introduced into net property income due to the data inconsistency between income, financial stocks and interest rates. (9) Imputed interest is attributed solely to corporate enterprises. (10) Net transfer receipts are assumed to be proportional to appropriate income. (11) A constant share in depreciation is assumed between institutional sectors other than financial institutions. (12) Government consumption and investment are regarded as exogenous in nominal terms. (13) Allocation coefficients of consumption demand between industries are constant in value terms for private consumption (due to the utility function of Cobb-Douglas type) and in quantity terms for government consumption. (14) Investments are assumed to be homogeneous irrespective of their origins and types, resulting in a single investment deflator. (15) Shares of investment between types and between industries of destination are constant in quantity terms. (16) Allocation coefficients of investment demand between industries are constant in quantity terms. (17) Various demand and supply functions are specified in their simplest forms with elasticities estimated by a very crude guess work as shown in Table 5.

### 3. Solution of the Model and Comparative Statics

The CGE model of the Japanese economy presented above is a system of non-linear equations consisting of 385 endogenous variables, 43 exogenous variables and more than 700 parameters. The model can be solved not only for any single year statically but also for any successive years dynamically, provided that the data for exogenous variables and parameters are available. Here the model is solved only for the benchmark year (1980) from which most of the parameter values are derived, leaving dynamic simulations and comparative dynamics to be done in future. We will check, first, traceability of the model in the benchmark year. Then, the model will be applied to comparative statics to quantitatively evaluate (1) the impacts of oil price changes, (2) the effects

of fiscal and monetary policies, and (3) the direct policy measures in reducing current account surpluses. Finally, a sensitivity test will be made to check the stability in comparative statics under parameter values different from those in Table 5.

*Traceability of the Model (Base Solution)*

A variety of computational algorithms are now available to solve general equilibrium systems of non-linear type.<sup>15)</sup> The Gauss-Seidel method, which seems to be the simplest among others, is used to solve the Japanese CGE model here. This method requires each of the equations to be expressed by an explicit function with only the dependent variable on the left-hand side. In Table 3, the equilibrium conditions are expressed in the form of implicit functions, so that they are rewritten as follows with the corresponding prices on the left-hand side:

$$(9)' \quad W = \max \{ \Sigma \alpha_i P N_i X_i^S / L^S, \bar{W} \}$$

$$(44)' \quad PD_i = \frac{\alpha_i^{-1} \bar{A}_i^{-\nu \alpha_i} W (X_i^D / K_{i,0})^{(1-\alpha_i)/\alpha_i} + \Sigma P_j \bar{a}_{ji}}{1 - \bar{b}_{oi} - (\bar{t}d_i - \bar{t}s_i)} \quad (i \neq 3)$$

$$(33.2)' \quad r_s = r_s[-1] \times \left[ 1 + 0.1 \times \frac{(AS_c^* + AS_G^*) - (AS_H + AS_B)}{(AS_H + AS_B)} \right]$$

$$(33.3)' \quad r_L = r_L[-1] \times \left[ 1 + 0.1 \times \frac{(AL_H^* + AL_C^* + AL_G^*) - AL_B}{AL_B} \right]$$

$$(45)' \quad ER = ER[-1] \times \left[ 1 + 0.1 \times \frac{\Sigma P \bar{W} M_i + (\bar{R}L_w + \bar{R}A_w + \bar{R}T_w) - (\Sigma P W E_i E_i + F_w)}{\Sigma P \bar{W} M_i + (\bar{R}L_w + \bar{R}A_w + \bar{R}T_w)} \right]$$

where  $[-1]$  means the previous iteration. The first two equations above are solutions of the equilibrium conditions obtained by treating other relevant endogenous variables as given. The remaining three, on the other hand, are formulated as adjustment functions, assuming that the equilibrium conditions are attained by adjusting prices ( $1/r_s$ ,  $1/r_L$  and  $ER$ ) positively when excess demands exist (or negatively when excess supplies exist) in each stage of the iteration process.<sup>16)</sup> The adjustment speed

15) See Dervis, De Melo and Robinson [1982, Appendix B] and Shoven and Whalley [1984, p. 1021].

16) A similar approach is used in the FLEX model for the determination of exchange rate (Amano [1982, Ch. 10]), and also in ESCAP [1983] for the determination of product prices (Annex II).

here is set equal to one-tenth (0.1) of the discrepancy rate between demand and supply.

The solution of the model for 1980 is shown in Table 6 for key endogenous variables. It is called 'base solution' since it serves as base in evaluating solutions under various shocks (i.e., 'shock solutions'). The solution is derived for the case of downward rigid nominal wage where the minimum wage ( $\bar{W}$ ) is set equal to the actual wage level in 1980 (i.e., 3.054 million yen). It is needless to say that the solution, which is obtained by solving the whole system without using the equilibrium condition for cash currency (eq. (33.1)), guarantees that equality though up to the third effective number.<sup>17)</sup> As seen in the table, the base solution traces the actual figures quite well especially for the price variables. However, the base solution indicates a slight but steady underestimation for the quantity variables. This is due to an ad hoc procedure adopted here to mitigate the data inconsistency between *IO80* and *NAS* represented by the fact that GDP in *IO80* is bigger by 2.3% than GDP in *NAS* (241253.3 versus 235911.5 billion yens). That is to say, the industrial productions and the labor supply are artificially made smaller to some extent by setting  $\bar{A}_i$ 's and  $\bar{l}^s$  at the levels smaller by one percent than their original ones. Otherwise, the base solution will result in a steady underestimation for the price variables. The base solution indicates a relatively good traceability of the model also for the value variables except net financial assets of foreigners ( $AF_w$ ) and net capital inflow from abroad ( $F_w$ ). Gaps from the actual figures are not small for the two variables. However, the gaps do not seem to be very large considering the fact that the two variables are derived as residuals which may possibly accumulate errors in other parts of the system.<sup>18)</sup>

The solution of the model for the case of flexible nominal wage is shown in Table 7. The base solution in this case is more or less the same as in Table 6 with one important exception: the labor market is perfectly cleared ( $r_{UL} = 0.0$ ) under the equilibrium wage level (3.0364 million yen) which is a little smaller than the actual wage in 1980.

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17) The convergence criterion is  $1/10000$  on the average for 385 endogenous variables. Under this criterion, about 100 iterations are needed to get base solutions, while 100-1000 iterations to get shock solutions (for Tables 6 to 11).

18) Errors may occur especially in the linkage part between flow and stock variables. In *NAS*, reconcillation accounts are provided between capital finance accounts (flows) and balance sheet accounts (stocks) for the institutional sectors. The model here does not allow for those reconcillation accounts.

### *Comparative Statics : Oil Price Changes*

Impacts of oil price changes on selected key endogenous variables are also presented in Table 6 (for the case of downward rigid nominal wage). We will investigate the results mainly from the point of view of the oil shocks (i.e., the last two columns in Table 6).

A comment is necessary on the exchange rate ( $ER$ ) in the first place. The oil shocks result in the yen depreciation in the new equilibrium through the following process. The yen is depreciated, first, by increased trade deficits caused by the oil price increases. This yen depreciation is however, counteracted by increases in exports ( $E$ ) and decreases in imports ( $M$ ) due to the depreciated yen itself, on the one hand, and by increases in foreign capital inflow ( $F_w$ ) due to a tendency toward deficits in the domestic institutions ( $Y_H$ ,  $Y_C$ ,  $Y_B$ ,  $Y_G$  and  $S$ ) and a corresponding tightening in the domestic financial markets ( $r_S$  and  $r_L$ ), on the other. In the new equilibrium, the yen depreciates by 1.77% for the 10% increase in oil price and by 9.64% for the 50% increase in oil price. In other words, the exchange rate elasticity with respect to oil price changes (*ceteris paribus*) is about 0.2 according to the model here.

The oil shocks give stagflationary impacts to the economy, causing inflation ( $PC_H$ ,  $PC_C$ ,  $PI$  and  $PD_i$ 's), reducing outputs and employment ( $GDP$ ,  $X_i$ 's and  $L$ ), and increasing unemployment ( $r_{UL}$ ). Note that  $GDP$  deflator ( $PGDP$ ) is not a proper measure of inflation in the case of oil shocks or import price shocks, since its definition (eq. (48)) includes as negative terms the value of imports (price  $\times$  exchange rate  $\times$  quantity) in the numerator while the quantity of imports in the denominator, permitting the possibility of its decrease for the case of import price increases.<sup>19)</sup> Note also that, though stagflation due to the oil shocks must be analyzed from both supply and demand sides (Shinkai [1980]), the supply side is often regarded as more important than the demand side as is stressed in Bruno and Sacks [1981]:

"Accelerating goods prices and increasing unemployment suggest the co-existence

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19) The rate of increase in GDP deflator (2.6%) was far smaller than those in consumption and investment deflators (6~7%) for 1980, while they were approximately the same (20.6% and 21~26% respectively) for 1974. Note that Tables 6 and 7 indicate pure effects of oil price changes. Actual prices are influenced not only by oil price changes but also by fiscal and monetary policies as seen from Tables 8 and 9. A rapid increase in GDP deflator in 1974 seems to be related with expansionary fiscal and/or monetary policies around that year. See Moriguchi [1983] for the detailed analysis of Japan's macroeconomic policies in the 1970's.

of demand pressure in the commodity market and excess supply in the labor market. . . . An increase in the price of a variable factor of production, such as oil, may reduce profits, output, and the input of other variable factors, such as labor, unless their relative price adjusts downwards. . . . Such a recession can further be exacerbated by restrictive domestic demand management, which may be required to combat inflation and rising current account deficits. . . . It is precisely because of the existence of demand-induced elements that it is all too easy to attribute all of the unemployment to Keynesian factors, although a large part of it is really of a "classical" nature. That part can only be eliminated by a fall in real wages or increased capital accumulation, neither of which is likely to occur in the short run." (p. 16)

What is implied in Table 6 is closely in line with this analysis of real supply shocks.<sup>20)</sup> In Table 6, however, the nominal wage is assumed to be rigid downwards. The real wage, therefore, can fall but only to a small extent, resulting in a significant increase in unemployment.

In the case of flexible nominal wage, on the other hand, the labor market is cleared by a fall in both nominal and real wages under the oil price increases as shown in Table 7. The negative impacts of oil shocks in this case are relatively smaller for most parts of the real economy, especially on real GDP. For the households sector, not only inflationary pressures ( $PC_H$ ) but also declines in real consumption ( $C_H$ ) and real income ( $Y_H/PC_H$ ) are smaller in this case. The flexible wage, therefore, seems to attain a better performance than the rigid wage under the situation of real supply shocks from both growth and welfare points of view at least in the short run.

*Comparative Statics : Fiscal and Monetary Policies*

Effects of various fiscal and monetary policies are summarized in Table 8 for the case of downward rigid nominal wage. In the table, shocks of one trillion yen or their approximate equivalents are given to government fiscal measures ( $\overline{C}_G^n$ ,  $\overline{I}_G^n$ ,  $\overline{ty}_H$ ,  $\overline{ty}_C$ ,  $\overline{ty}_B$  and  $\overline{td}_i$ 's) and to monetary instruments of Bank of Japan ( $\overline{AC}_B^*$  and  $\overline{AS}_{BJ}$ ). For the government fiscal measures, negative effects on government budgets caused by the shocks are assumed to be automatically financed from domestic sources through bond issues and borrowings (See eqs. (31.4) and (31.5)). On the other hand, the open market operation is assumed for the monetary instruments, equating the increase in the supply of cash currency

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20) The effects of oil price increases are different, of course, between industries, depending on the cost and demand structures in each industry. Decreases in output are relatively large in the industries with high oil inputs such as industries 5, 10 and 11, while the effects of oil shocks are relatively small or even positive in the industries with high export demands such as industry 7 due to the yen depreciation. Industry 3, of course, increases its output under the oil bonanza.

( $\overline{AC}_B^*$ ) with the increase in the Bank of Japan's purchases of government bonds ( $\overline{AS}_{BJ}$ ).<sup>21)</sup>

From Table 8, we can derive several observations on the nature and characteristics of various policy measures. First, the government fiscal expansion, whether it is by means of consumption or investment, gives favorable effects to many parts of the economy (as is expected under the existence of unemployed resources such as labor). It causes increases in employment, real private consumption, real GDP, industrial productions (with a few exceptional industries), sectoral income and so on, reducing the rate of unemployment significantly. It causes even the decrease in private consumption deflator partly through yen appreciation but mainly through declines in domestic prices in most industries due to supply pressures. Effects on industrial productions are different depending on the mean of fiscal expansion. The industry which is affected most is services ( $X_{13}^S$ ) in the case of consumption increases, while it is constructions ( $X_9^S$ ) in the case of investment increases. GDP multipliers, however, are almost the same between the two means: about 1.4 in nominal terms and about 1.1 in real terms.<sup>22)</sup>

Second, the monetary expansion is quite similar to the fiscal expansion in its effects on quantities, but quite opposite in its effects on prices. It gives positive impacts to almost every part of the real economy (probably not to a small extent judging from the amount of given shocks). However, it gives inflationary impacts to almost every aspect of the economy, accompanying significant declines in the two interest rates and the value of yen. Its positive impact on real GDP is caused mainly by export expansions due to the yen depreciation (which lead to output expansions in export industries such as machinery ( $X_7^S$ )) but also by increases in private investments ( $I_P = I_H + I_C + I_B$ ) due to the interest rate declines and other positive factors related to profits.

Third, effects of tax reductions are quite similar to those of the expansionary fiscal policies but only for the categories of personal income taxes and indirect taxes. Reductions in the indirect taxes, however, include an important exceptional effect: declines in all of the prices including GDP deflator. For the category of corporate income

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21) Note that the cash currency here is almost equivalent with high powered money (which is often called reserve money, base money or monetary base). The former is smaller than the latter by the following two components: deposits with the Bank of Japan and currency held by banks. See footnote 13.

22) They are 1.7 and 1.0, respectively, according to the *macroeconomic* model of Japan constructed by M. Ezaki and C. Moriguchi (See Ichimura and Ezaki [1985, Ch. 10]).

taxes, on the other hand, effects of tax reductions are almost the same as those of the monetary expansions (but only with a far smaller degree of impacts). This asymmetry between corporate income taxes and other tax categories seems to be closely related with the assumption of downward rigid nominal wage.<sup>23)</sup>

Note that both of the fiscal and monetary expansions result in the increases in real GDP and employment (with GDP multipliers greater than one for the case of fiscal expansions) under the framework of flexible exchange rate here. This result is contradictory to the theoretical conclusion of Mundell [1968, Ch. 18] (which is based on the assumption of perfect capital mobility). It is, however, consistent with the theoretical analyses of Amano [1980, Ch. 10] and Dornbush and Fischer [1981, Ch. 19] (which allow for the imperfect capital mobility) as well as with the empirical results of FLEX model (Amano [1982, Ch. 12]) for the Japanese economy. In the case of fiscal expansion, increases in government consumption ( $C_G$ ) or investment ( $I_G$ ) are almost cancelled by decreases in exports ( $E$ ) and increases in imports ( $M$ ) due to the yen appreciation accompanying foreign capital inflows ( $F_w$ ), but the other domestic final demands, private consumption ( $C_H$ ) in particular, increase significantly at the same time, resulting in the GDP multipliers greater than one. In the case of monetary expansion, on the other hand, all of the final demand components (except government) contribute to the increase in real GDP but the most important contribution comes from foreign trades, i. e., increases in exports and decreases in imports due to the yen depreciation accompanying foreign capital outflows.<sup>24)</sup>

According to the present model, both of the monetary and fiscal policies are effective under the flexible exchange rate system but only for the situation of underemployment with the downward rigid nominal wage. When the wage rate is completely flexible and full employment is attained (allowing for a certain amount of 'natural' or 'desired' unemployment), both of the monetary and fiscal expansions lose their effectiveness on real GDP (in the short run) as shown in Table 9. The

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23) Table 9, which corresponds to the case of flexible nominal wage, indicates symmetric effects for the three tax categories. Relatively small effects for the category of corporate income taxes in Table 8 seem to be closely related with the specification of investment functions (eq. (22.1)), by which tax reductions can directly affect the real economy through profit rates (eqs. (21.1) – (21.3)). A relatively low level (0.1) of elasticities is assumed for the profit rates since the system does not converge when it is greater than 0.5.

24) See Kurosaka and Hamada [1984] for the problems of policy mix under the flexible exchange rate system with particular reference to the Japanese economy (Ch. 12, pp. 264–267).



fiscal expansion causes only the compositional changes in real GDP and industrial productions under an inflationary tendency, while the monetary expansion affects the real economy only slightly even with a less severe inflation. Whether the wage rate is flexible or rigid is, therefore, crucial for the evaluation of various policy measures. This should be so since whether the wage rate is flexible or not corresponds exactly, in the model, to whether the economy is in full employment or in underemployment. In the present paper, the downward rigid wage is considered as the standard normal case for the Japanese economy at least in the benchmark year 1980.<sup>25)</sup>

*Comparative Statics: Measures to Reduce Current Account Surpluses*

Japan is now (at the time of 1985) criticized severely against its huge trade surpluses and various policy measures are proposed to make the surpluses smaller. The model in this paper can provide a rough evaluation of the effects of such policy measures based on the short run comparative statics for 1980. The results are presented in Table 10 for several selected direct measures such as tariff reductions, import subsidies (i.e., negative tariffs), export duties (i.e., negative export subsidies), and increase in ODA grant. Note that the current balance of payments ( $-F_w$ ) is the target variable here and that increase in ODA grant is identified with increase in net transfer payments abroad (See eq. (15.4)).

As seen in Table 10, a considerable decrease in surpluses (actually, an increase in deficits for 1980) is expected by the tariff reductions to zero levels in all industries (the first column). The amount of decrease is estimated as 2.6 billion US dollars ( $=637.6/242.0/1.0118$ ), of which the contribution from manufacturing industries is dominant (the fourth column). The effects of tariff reductions are generally favorable for the aggregate economy with real GDP and real consumption increased while unemployment rate reduced. Reductions in tariffs further to the negative levels (i.e., import subsidies) have similar but stronger effects as expected (the fifth column). Unexpectedly, however, the imposition of export duties does not contribute to the decrease in current account surpluses but does to the increase (the sixth column). This is because imports ( $M$ ) decrease more than exports ( $E$ ) due to the domestic recession according to the model here. The increase in ODA grant just causes almost the same amount of decrease in the current account surpluses with only a small impact to the aggregate economy. Pol-

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25) See footnote 9.

icy measures discussed above are all directly related with the current balance of payments. These direct measures can be used either independently or in combination with such indirect measures as fiscal and monetary expansions and various tax reductions, whose effects on the current account surpluses are already presented in Table 8.

*Sensitivity Test for Comparative Statics*

The results of comparative statics presented in Tables 6 to 10 are all based on the elasticities in Table 5 derived from a very crude guesswork. The results may change depending on the elasticities. The problem is to what extent the results will change under different values of the elasticities, i.e., the degree of stability in comparative statics based on the present model. A sensitivity test is made to check this stability for the case of 10% decrease in oil price, assigning a fairly different parameter value to each of the elasticities. The results are presented in Table 11 only for the aggregate variables. Comparing the first column with the remaining ones in the table, we can see that the model provides quite a stable result on the comparative statics. There exist, however, two minor exceptions. One is the private investment ( $I_P$ ) under bigger investment elasticities (the fifth column), where the sign is reversed. The other is the rate of unemployment ( $r_{UL}$ ) under smaller asset elasticities (the last column), where the rate in shock solution is a little bigger. Though they are only minor exceptions in Table 11, the former indicates a problem in the investment function while the latter in the traceability of the model in relation to the asset choice functions.

Sensitivity tests of other kinds are not attempted yet. However, the results of comparative statics in Tables 6 to 10 seem to remain more or less the same in many parts under different parameter values as well as different specifications, unless the changes in parameters and/or specifications are drastic.<sup>26), 27)</sup>

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26) Fairly drastic changes in specification are incorporated into the present model compared with the previous one (Ezaki [1985]) as explained in footnote 1. Yet, the two models give very close results on comparative statics (under the flexible nominal wage) for most of the price and quantity variables. Compare Table 7 of this paper with Table 3 of the previous paper for the case of 50% decrease in oil price, using 0.0403 as the rate of change for the numeraire ( $PGDP$ ) in the previous paper.

27) The survey of Japanese macroeconometric models by Saito and Moriguchi [1985] is very useful, in this context, from which we can get a rough idea on the reasonable ranges in various parameter values as well as on the possible ranges in impacts under various shocks.

#### 4. Concluding Remarks

The CGE model of the Japanese economy presented here has a wide applicability to various policy problems not only in the industry level but also in the aggregate national level, dealing with each of the problems from both levels in a consistent way. This is possible since the model has a firm basis on the data and methodological framework of the new SNA. The financial sector, in particular, may be emphasized as a key element in the present model (probably as a new element in the CGE studies), without which the model can neither determine the absolute level of prices nor analyze the monetary aspects of the economy such as inflation.

The model has been applied to the analysis of comparative statics under various external shocks, resulting in reasonable implications in each case, but only for the benchmark year. Comparative statics for other years or comparative dynamics for successive years are, of course, possible based on the present model, but not attempted yet due to the data problems in exogenous variables and parameters. It is difficult to get data directly for the exogenous variables of industry level in the years other than the benchmark. Some of the parameters estimated from the benchmark data may change not to a small extent in those years. Among others, technological change in each industry is crucial in the dynamic context. A further elaboration of the model as well as a careful work on the data base are, therefore, necessary toward the dynamic application of the present model, which is the next step in the author's CGE study of the Japanese economy.

Table 1. Sectoral Classification

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*Industrial Sectors:*

	(sectoral code of 72×72 IO table)
1. Agriculture, forestry and fishery, and mining other than coal and petroleum	01-05, 07, 09
2. Coal	06
3. Crude petroleum and natural gas	08
4. Pulp, paper and chemicals	24, 25, 29-34
5. Petroleum refinery and coal products	35, 36
6. Metal	38-43
7. Machinery	44-49
8. Other manufacturing	10-23, 26-28, 37, 50
9. Construction,	51-53
10. Electricity and gas	54, 55
11. Transportation and communication	61-63
12. Banking and insurance	58
13. Commerce, real estate, public and other services, water supply, and others	56, 57, 59, 60, 64-72

*Institutional Sectors:*

- H. Households (including private unincorporated non-financial enterprises and private non-profit institutions serving households)
  - C. Non-financial incorporated enterprises
  - B. Financial institutions
  - G. General government
  - W. Rest of the world
-

Table 2. Notation of Variables

## Endogenous Variables

*Price Variables:*

$PD_i$	= domestic price of industry $i$
$PN_i$	= price of net product (value added) of industry $i$
$P_i$	= price of composite goods for domestic products and imports of industry $i$
$PM_i$	= import price of industry $i$
$PWE_i$	= export price of industry $i$ (in terms of US dollars)
$PI_i$	= deflator of investment (production capital) in industry $i$
$PI$	= deflator of gross domestic fixed capital formation
$PI'$	= deflator of investment on public capital (= $P_g$ )
$PJ$	= deflator of inventory investment
$PC_H$	= deflator of private consumption expenditures
$PC_G$	= deflator of government consumption expenditures
$PC_0$	= deflator of consumption expenditures outside households
$PE$	= deflator of exports of goods and services
$PM$	= deflator of imports of goods and services
$PGDP$	= deflator of gross domestic product (GDP)
$r_{Kk}$	= rate of return to capital in sector $k$ ( $k=H, C, B$ )
$r_S$	= interest rate of securities
$r_L$	= interest rate of loans
$W$	= wage rate (average annual income of employees)
$ER$	= exchange rate ( $\text{¥}/\text{\$}$ )

*Quantity Variables*

$X_i^S$	= domestic production of industry $i$
$X_i^D$	= total demand for domestic production of industry $i$
$M_i$	= imports of industry $i$
$E_i$	= exports of industry $i$
$D_i$	= domestic demand for domestic production of industry $i$
$V_i$	= intermediate demand for composite goods of industry $i$
$C_{0i}$	= consumption demand outside households for composite goods of industry $i$

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$C_i$	=private and government consumption demand for composite goods of industry $i$
$Z_i$	=investment demand for composite goods of industry $i$
$d_i$	=ratio of domestic supply in total domestic demand for composite goods of industry $i$
$L_i$	=total employment of industry $i$ (in terms of efficiency units based on the wage ratios between industries)
$L_{s,i}$	=number of self-employees and unpaid family workers of industry $i$ (efficiency units)
$L_{e,i}$	=number of employees of industry $i$ (efficiency units)
$L^S$	=total labor supply
$UL$	=total unemployment
$r_{UL}$	=rate of unemployment
$I_i$	=gross investment on production capital in real terms of industry $i$
$K_i$	=gross capital stock (production capital) in real terms of industry $i$
$I$	=gross domestic fixed capital formation in real terms
$I'$	=gross investment on public capital in real terms
$J$	=inventory investment in real terms
$I_k$	=gross investment in real terms of sector $k$ ( $k=H, C, B, G$ )
$J_k$	=inventory investment in real terms of sector $k$ ( $k=H, C$ )
$K_k$	=net capital stock in real terms of sector $k$ ( $k=H, C, B, G$ )
$KJ_k$	=inventory stock in real terms of sector $k$ ( $k=H, C$ )
$C_0$	=consumption expenditures outside households in real terms
$C_H$	=private consumption expenditures in real terms
$C_G$	=government consumption expenditures in real terms
$E$	=exports of goods and services in real terms
$M$	=imports of goods and services in real terms
$GDP$	=gross domestic product in real terms (real GDP)

*Value Variables*

$RL$	=compensation of employees
$RK$	=operating surplus
$RK_k$	=operating surplus of sector $k$ ( $k=H, C, B$ )
$DK$	=depreciation of fixed capital
$DK_k$	=depreciation of fixed capital of sector $k$ ( $k=H, C, B, G$ )

$RA_k$	= net property income of sector $k$ ( $k=H, C, B, G, W$ )
$RII_C$	= imputed interest (attributed to sector $C$ )
$RT_k$	= net transfer income of sector $k$ ( $k=H, C, B, G$ )
$Y_k$	= disposable income of sector $k$ ( $k=H, C, B, G$ )
$S_k$	= net saving of sector $k$ ( $k=H, C, B, G$ )
$GDP^n$	= gross domestic product (nominal GDP)
$NW_k$	= net worth of sector $k$ ( $k=H, C, B, G$ )
$AN_k$	= net financial assets of sector $k$ ( $k=H, C, B, G$ )
$AC_k, AC_k^*$	= currency in sector $k$ (assets and liabilities)
$AD_k, AD_k^*$	= demand deposits in sector $k$ ( " )
$AT_k, AT_k^*$	= time and saving deposits in sector $k$ ( " )
$AS_k, AS_k^*$	= securities in sector $k$ ( " )
$AL_k, AL_k^*$	= loans in sector $k$ ( " )
$AU_k, AU_k^*$	= trade credits in sector $k$ ( " )
$AO_k, AO_k^*$	= other domestic assets in sector $k$ ( " in net terms)
$AF_k$	= net foreign financial assets of sector $k$ ( $k=H, C, B, G$ )
$AF_W$	= net financial assets of foreign sector (in Japanese yens)
$F_W$	= increase in net financial assets of foreign sector (in US dollars)

#### Exogenous Variables

##### Price Variables:

$\overline{PWM}_i$	= import price of industry $i$ (in US dollars)
$\overline{PW}_i$	= world price in the export market of industry $i$ (in US dollars)
$\overline{r}_D$	= interest rate of demand deposits
$\overline{r}_T$	= interest rate of time and saving deposits
$\overline{r}_R$	= reserve ratio
$\overline{r}_{BJ}$	= interest rate of Bank of Japan loans
$\overline{W}$	= minimum wage rate in nominal terms

##### Quantity Variables:

$\overline{N}$	= population over 15 years of age
$\overline{J}_k$	= real inventory investment by sector $k$ ( $k=H, C$ )

*Value Variables:*

$\overline{RL}_W$	=net labor income of foreign sector (in US dollars)
$\overline{RT}_W$	=net transfer receipts of foreign sector (in US dollars)
$\overline{AC}_B^*$	=supply of currency by Bank of Japan
$\overline{AL}_{BJ}$	=loans by Bank of Japan
$\overline{AS}_{BJ}$	=government bonds purchased by Bank of Japan
$\overline{C}_G^n$	=nominal government consumption expenditures
$\overline{I}_G^n$	=nominal government investment expenditures
$\overline{AO}_G$	=other domestic assets (in net terms) in sector $G$
$\overline{AU}_G^*$	=trade credits (liabilities) in sector $G$
$\overline{AF}_G$	=net foreign financial assets of sector $G$

Parameters

*Taxes and subsidies:*

$\overline{tm}_i$	=import tariff rate of industry $i$
$\overline{te}_i$	=export subsidy rate of industry $i$
$\overline{td}_i$	=indirect tax rate of industry $i$
$\overline{ts}_i$	=subsidy rate of industry $i$
$\overline{ty}_k$	=income tax rate of sector $k$ ( $k=H, C, B$ )

*Shares and rations:*

$\overline{s}_H$	=saving rate of households sector
$\overline{\omega}_{Hi}$	=value share of industry $i$ 's product in private consumption expenditures
$\overline{q}_{Gi}$	=quantity share of industry $i$ 's product in government consumption expenditures
$\overline{q}_{0i}$	=quantity share of industry $i$ 's product in consumption expenditures outside households
$\overline{h}$	=quantity share of investment on production capital in gross domestic fixed capital formation
$\overline{h}_i$	=quantity share of industry $i$ 's investment in total investment on production capital
$\overline{s}_{Ii}$	=quantity share of industry $i$ 's product in gross domestic fixed capital formation
$\overline{s}_{I'i}$	=quantity share of industry $i$ 's product in total investment on public capital



- $\bar{s}_{ji}$  = quantity share of industry  $i$ 's product in total inventory investment  
 $\bar{s}_{ij}$  = quantity share of industry  $i$ 's product in investment on production capital of industry  $j$   
 $\bar{l}_i$  = share of self-employees and unpaid family workers in total employment of industry  $i$   
 $\lambda_i$  = ratio of industry  $i$ 's wage rate to overall average rate ( $W$ ) to be used to transform original employment ( $L'$ ) to employment in efficiency units ( $L$ )  
 $\bar{v}_{KH}$  = share of operating surplus (excluding imputed wages) of households sector  
 $\bar{v}_{Dk}$  = share of depreciation of sector  $k$  ( $k=H, C, G$ )  
 $\bar{u}_{Tk}$  = ratio of net transfer receipts to income in sector  $k$  ( $k=H, C, B$ )

*Functional Parameters*

- $\bar{a}_{ij}$  = intermediate input coefficient from industry  $i$  to industry  $j$   
 $\bar{b}_{0j}$  = input coefficient of consumption expenditures outside households in industry  $j$   
 $\bar{b}_{Dj}$  = rate of depreciation in industry  $j$   
 $\bar{A}_i, \alpha_i$  = parameters of Cobb-Douglas production function for industry  $i$   
 $\bar{B}_i, \beta_i$  = parameters of Cobb-Douglas aggregation function for composite goods of industry  $i$   
 $\bar{E}_i, \eta_i$  = parameters of export demand function for industry  $i$   
 $\bar{l}^S, \xi$  = parameters of labor supply function  
 $\bar{I}_k, \delta_{kj}$  = parameters of gross investment function in sector  $k$  ( $k=H, C, B$ )  
 $\bar{a}_{ik}^o, \varepsilon_{ijk}$  = parameters of asset choice function in sector  $k$  ( $k=H, C, B, G$ )
-

Table 3. System of Equations

*Price Identities*

$$(1) \quad PM_i = \overline{P} \overline{W} M_i (1 + \overline{tm}_i) ER$$

$$(2) \quad PWE_i = PD_i / (1 + \overline{te}_i) / ER$$

$$(3) \quad P_i = (PD_i + PM_i M_i / D_i) / g_i(M_i / D_i, 1) \quad (i=3, 9, 10)$$

$$\text{where } g_i(M_i, D_i) = \overline{B}_i M_i^{\beta_i} D_i^{1-\beta_i}$$

$$P_3 = PM_3$$

$$P_i = PD_i \quad (i=9, 10)$$

$$(4) \quad PN_i = PD_i - \sum P_j \overline{a_{ji}} - \overline{b_{0i}} PD_i - (\overline{td}_i - \overline{ts}_i) PD_i$$

*Production and Equilibrium in the Labor Market*

$$(5) \quad X_i^S = f_i(L_i, K_{i,0})$$

$$= \overline{A}_i L_i^{\alpha_i} K_{i,0}^{1-\alpha_i} \quad \text{where } L_i = \lambda_i L_i'$$

$$(6) \quad PN_i (\partial X_i^S / \partial L_i) = W \quad \text{or} \quad L_i = \alpha_i PN_i X_i^S / W$$

$$(7) \quad L_{si} = \overline{l}_i L_i, \quad L_{ei} = (1 - \overline{l}_i) L_i$$

$$(8) \quad L^S / \overline{N} = \overline{l}^S (W / PC_W)^\epsilon$$

$$(9) \quad \sum L_i = L^S \quad (\text{and } W = \widetilde{W}) \quad \text{if } \widetilde{W} \geq \overline{W}, \quad \text{or}$$

$$W = \overline{W} \quad (\text{and } \sum L_i \leq L^S) \quad \text{if } \widetilde{W} \leq \overline{W},$$

where  $\widetilde{W}$  is the wage rate which equates  $\sum L_i$  with  $L^S$ .

$$(10) \quad UL = L^S - \sum L_i, \quad r_{UL} = UL / L^S$$

*Distributed Income and Its Components**Aggregation in value added items:*

$$(11.1) \quad RL = W (L^s - \Sigma L_{si}) - \overline{RL}_w ER \quad \text{if} \quad \widetilde{W} \geq \overline{W}, \quad \text{or}$$

$$RL = W (L^s - UL - \Sigma L_{si}) - \overline{RL}_w ER \quad \text{if} \quad \widetilde{W} \leq \overline{W}.$$

$$(11.2) \quad RK = \Sigma (PN_i X_i^s - W L_{ei}) - DK$$

$$(11.3) \quad DK = \Sigma \overline{b}_{Di} PI_i K_{i,o}$$

*Operating surplus by sector:*

$$(12.1) \quad RK_H = \Sigma W L_{si} + \overline{v}_{KH} [(RK - \Sigma W L_{si}) - RK_B]$$

$$(12.2) \quad RK_C = (1 - \overline{v}_{KH}) [(RK - \Sigma W L_{si}) - RK_B]$$

$$(12.3) \quad RK_B = (PN_{12} X_{12}^s - W L_{e,12}) - DK_B - W L_{s,12}$$

*Net property income by sector:*

$$(13.1) \quad RA_H / \overline{z}_H = \overline{r}_D AD_{H,o} + \overline{r}_T AT_{H,o} + r_S AS_{H,o} + \overline{r}_D AO_{H,o} \\ + r_F AF_{H,o} - r_L AL_{H,o}^* \quad (\overline{z}_H = 1.6)$$

$$\text{where } r_F = (\overline{r}_D + \overline{r}_T + r_S + r_L) / 4$$

$$(13.2) \quad RA_C / \overline{z}_C = \overline{r}_D AD_{C,o} + \overline{r}_T AT_{C,o} + \overline{r}_D AO_{C,o} + r_F AF_{C,o} \\ - r_S AS_{C,o}^* - r_L AL_{C,o}^* \quad (\overline{z}_C = 1.3)$$

$$(13.3) \quad RA_B / \overline{z}_B = r_S AS_{B,o} + r_L AL_{B,o} + r_F AF_{B,o} \\ - \overline{r}_D AD_{B,o}^* - \overline{r}_T AT_{B,o}^* - (\overline{r}_D + \overline{r}_T) / 2 \cdot AO_{B,o}^* \quad (\overline{z}_B = .9)$$

$$(13.4) \quad RA_G / \overline{z}_G = \overline{r}_D AD_{G,o} + \overline{r}_T AT_{G,o} + \overline{r}_T AO_{G,o} + r_F AF_{G,o} \\ - r_S AS_{G,o}^* - r_L AL_{G,o}^* \quad (\overline{z}_G = .9)$$

$$(13.5) \quad RA_w ER = - (RA_H + RA_C + RA_B + RA_G)$$

*Imputed interest:*

$$(14) \quad RII_C = RA_B \quad (RII_H = 0)$$

*Net transfer income by sector:*

$$(15.1) \quad RT_H = \bar{u}_{TH} (RL + RK_H)$$

$$(15.2) \quad RT_C = \bar{u}_{TC} RK_C$$

$$(15.3) \quad RT_B = \bar{u}_{TB} RK_B$$

$$(15.4) \quad RT_G = - (RT_H + RT_C + RT_B + \bar{RT}_W ER)$$

*Disposable income by sector:*

$$(16.1) \quad Y_H = (1 - \bar{t}y_H) (RL + RK_H + RA_H + RT_H)$$

$$(16.2) \quad Y_C = (1 - \bar{t}y_C) RK_C + RII_C + RA_C + RT_C$$

$$(16.3) \quad Y_B = (1 - \bar{t}y_B) RK_B - RII_C + RA_B + RT_B$$

$$(16.4) \quad Y_G = \bar{t}y_H (RL + RK_H + RA_H + RT_H) + \bar{t}y_C RK_C + \bar{t}y_B RK_B \\ + \Sigma \bar{t}m_i \bar{P}WM_i ER M_i - \Sigma \bar{t}e_i \bar{P}WE_i ER E_i \\ + \Sigma (\bar{t}d_i - \bar{t}s_i) PD_i X_i^s + RA_G + RT_G$$

*Depreciation by sector:*

$$(17.1) \quad DK_B = \bar{b}_{D,12} PI_{12} K_{12,0}$$

$$(17.2) \quad DK_k = \bar{v}_{Dk} (DK - DK_B) \quad (k = H, C, G)$$

*Saving and Consumption*

*Net saving by sector:*

$$(18.1) \quad S_H = \bar{s}_H Y_H$$

$$(18.2) \quad S_c = Y_c$$

$$(18.3) \quad S_B = Y_B$$

$$(18.4) \quad S_G = Y_G - \bar{C}_G^n \quad (\text{or} \quad Y_G - PC_G \bar{C}_G)$$

*Real consumption expenditures:*

$$(19.1) \quad C_H = \Sigma \omega_{Hi} (1 - \bar{s}_H) Y_H / P_i \quad (\Sigma \omega_{Hi} = 1)$$

$$(19.2) \quad C_G = \bar{C}_G^n / PC_G \quad (\text{or} \quad \bar{C}_G)$$

$$(19.3) \quad C_o = \Sigma \bar{b}_{o,j} PD_j X_j^s / PC_o$$

*Consumption deflators:*

$$(20.1) \quad PC_H = (1 - \bar{s}_H) Y_H / C_H$$

$$(20.2) \quad PC_G = \Sigma \bar{q}_{Gi} P_i \quad (\Sigma \bar{q}_{Gi} = 1)$$

$$(20.3) \quad PC_o = \Sigma \bar{q}_{oi} P_i \quad (\Sigma \bar{q}_{oi} = 1)$$

*Investment and Capital Stock*

*Rate of return to capital (after tax) by sector:*

$$(21.1) \quad r_{KH} = [(1 - \bar{t}y_H) (RK_H - \Sigma W L_{si}) + DK_H + (PI - PI_o) K_{H,o}] / PI_o K_{H,o}$$

$$(21.2) \quad r_{KC} = [(1 - \bar{t}y_C) RK_C + DK_C + (PI - PI_o) K_{C,o}] / PI_o K_{C,o}$$

$$(21.3) \quad r_{KB} = [(1 - \bar{t}y_B) RK_B + DK_B + (PI - PI_o) K_{B,o}] / PI_o K_{B,o}$$

*Gross capital formation by sector:*

$$(22.1) \quad I_k = \bar{I}_k r_{Kk}^{\delta Kk} r_L^{\delta Lk} r_S^{\delta Sk} GDP^{\delta Xk} \quad (k=H, C, B)$$

$$(22.2) \quad I_G = \bar{I}_G^n / PI \quad (\text{or} \quad \bar{I}_G)$$

$$(22.3) \quad J_k = \bar{J}_k \quad (k=H, C)$$

*Net capital stock by sector:*

$$(23.1) \quad K_k = K_{k,o} + I_k - DK_k / PI \quad (k=H, C, B, G)$$

$$(23.2) \quad KJ_k = KJ_{k,o} + J_k \quad (k=H, C)$$

*Total investments and investment deflators:*

$$(24.1) \quad I = I_H + I_C + I_B + I_G$$

$$(24.2) \quad PI = \sum \bar{s}_{i,i} P_i \quad \text{where} \quad \bar{s}_{i,i} = \sum \bar{s}_{i,j} \bar{h}_j \bar{h} + \bar{s}'_{i,i} (1 - \bar{h})$$

$$(24.3) \quad J = J_H + J_C$$

$$(24.4) \quad PJ = \sum \bar{s}_{j,i} P_i$$

*Gross fixed capital formation by industry:*

$$(25.1) \quad I_j = \bar{h}_j \bar{h} I$$

$$(25.2) \quad PI_j = \sum \bar{s}_{i,j} P_i$$

$$(25.3) \quad I' = (1 - \bar{h}) I$$

$$(25.4) \quad PI' = \sum \bar{s}'_{i,i} P_i \quad (=P_9)$$

*Gross capital stock for production by industry:*

$$(26) \quad K_j = K_{j,o} + I_j \quad (j=1, \dots, 13)$$

*Equilibrium in the Financial Market*

*Net worth by sector:*

$$(27.1) \quad NW_H = NW_{H,o} + S_H + (PI - PI_o) K_{H,o} + (PJ - PJ_o) KJ_{H,o}$$

$$(27.2) \quad NW_C = NW_{C,o} + S_C + (PI - PI_o) K_{C,o} + (PJ - PJ_o) KJ_{C,o}$$

$$(27.3) \quad NW_B = NW_{B,o} + S_B + (PI - PI_o) K_{B,o}$$

$$(27.4) \quad NW_G = NW_{G,o} + S_G + (PI - PI_o) K_{G,o}$$

*Net financial assets by sector:*

$$(28.1) \quad AN_H = NW_H - (PI K_H + PJ KJ_H)$$

$$(28.2) \quad AN_C = NW_C - (PI K_C + PJ KJ_C)$$

$$(28.3) \quad AN_B = NW_B - PI K_B$$

$$(28.4) \quad AN_G = NW_G - PI K_G$$

*Asset choice by households:*

$$(29.1) \quad AC_H / NW_H = a_{cH}(\bar{r}_D, \bar{r}_T, GDP)$$

$$(29.2) \quad AD_H / NW_H = a_{dH}(\bar{r}_D, \bar{r}_T, GDP)$$

$$(29.3) \quad AT_H / NW_H = a_{tH}(\bar{r}_D, \bar{r}_T, r_S, GDP)$$

$$(29.4) \quad AS_H / NW_H = a_{sH}(\bar{r}_D, \bar{r}_T, r_S)$$

$$(29.5) \quad AO_H / NW_H = \bar{a}_{oH}$$

$$(29.6) \quad AL_H^* / (PI K_H + PJ KJ_H) = a_{lH}^*(r_L)$$

$$(29.7) \quad AU_H^* / (PI K_H + PJ KJ_H) = a_{uH}^*$$

$$(29.8) \quad AF_H = AN_H - (AC_H + AD_H + AT_H + AS_H + AO_H) + (AL_H^* + AU_H^*)$$

*Asset choice by corporate enterprises:*

$$(30.1) \quad AC_C / NW_C = a_{cC}(\bar{r}_D, \bar{r}_T, GDP)$$

$$(30.2) \quad AD_C / NW_C = a_{dC}(\bar{r}_D, \bar{r}_T, GDP)$$

$$(30.3) \quad AT_C / NW_C = a_{tC}(\bar{r}_D, \bar{r}_T, GDP)$$

$$(30.4) \quad AU_C = AU_H^* + AU_C^*$$

$$(30.5) \quad AO_C / NW_C = \bar{a}_{oC}$$

$$(30.6) \quad AS_C^* / (PI K_C + PJ KJ_C) = a_{sC}^*(r_S, r_L)$$

$$(30.7) \quad AL_C^* / (PI K_C + PJ KJ_C) = a_{lC}^*(r_S, r_L)$$

$$(30.8) \quad AF_C = AN_C - (AC_C + AD_C + AT_C + AU_C + AO_C) + (AS_C^* + AL_C^*)$$

*Asset choice by general government:*

$$(31.1) \quad AD_G = \bar{a}_{DG} NW_G$$

$$(31.2) \quad AT_G = \bar{a}_{TG} NW_G$$

$$(31.3) \quad AO_G = \bar{AO}_G$$

$$(31.4) \quad AS_G^* = \bar{z}_S [(AD_G + AT_G + AO_G + AF_G) - AU_G^* - AN_G] \quad (\bar{z}_S = .815)$$

$$(31.5) \quad AL_G^* = \bar{z}_L [(AD_G + AT_G + AO_G + AF_G) - AU_G^* - AN_G] \quad (\bar{z}_L = .185)$$

$$(31.6) \quad AU_G^* = \bar{AU}_G^*$$

$$(31.7) \quad AF_G = \bar{AF}_G$$

*Asset choice by financial institutions:*

$$(32.1) \quad AS_B = a_{SB} (r_S/\bar{r}_{BJ}, r_L/\bar{r}_{BJ}) [(1-\bar{r}_R) (AD_B^* + AT_B^*) + AO_B^* + \bar{AL}_{BJ}] + \bar{AS}_{BJ}$$

$$(32.2) \quad AL_B = a_{LB} (r_S/\bar{r}_{BJ}, r_L/\bar{r}_{BJ}) [(1-\bar{r}_R) (AD_B^* + AT_B^*) + AO_B^* + \bar{AL}_{BJ}]$$

$$(32.3) \quad AD_B^* = AD_H + AD_C + AD_G$$

$$(32.4) \quad AT_B^* = AT_H + AT_C + AT_G$$

$$(32.5) \quad AO_B^* = AO_H + AO_C + AO_G$$

$$(32.6) \quad AF_B = AN_B - (AS_B + AL_B) + (\bar{AC}_B^* + AD_B^* + AT_B^* + AO_B^*)$$

*Equilibrium for financial assets:*

$$(33.1) \quad AC_H + AC_C = \bar{AC}_B^*$$

$$(33.2) \quad AS_H + AS_B = AS_C^* + AS_G^*$$

$$(33.3) \quad AL_B = AL_H^* + AL_C^* + AL_G^*$$

*Demand for foreign capital (Net financial assets of sector W):*

$$(34.1) \quad AF_W = - (AF_H + AF_C + AF_B + AF_G) \quad [\text{stock in yens}]$$

$$= - (AN_H + AN_C + AN_B + AN_G) \quad [\text{ex post equality}]$$

$$(34.2) \quad F_W ER = AF_W - AF_{W,0} \quad [\text{flow in dollars}]$$



*Equilibrium in the Products and Foreign Exchanges Markets**Demand for products by industry:*

$$(35) \quad Z_i = \sum \bar{s}_{ij} I_j + \bar{s}'_{i1} I' + \bar{s}_{j1} J$$

$$(36) \quad C_i = \omega_{Hi} (1 - \bar{s}_H) Y_H / P_i + \bar{q}_{Gi} C_G$$

$$(37) \quad C_{0i} = \bar{q}_{0i} C_0$$

$$(38) \quad V_i = \sum \bar{a}_{ji} X_j^S$$

*Demand for domestic products and imports:*

$$(39) \quad D_i = d_i (Z_i + C_i + C_{0i} + V_i) \quad (i=3, 9, 10)$$

$$D_3 = X_3^S$$

$$D_i = Z_i + C_i + C_{0i} + V_i \quad (i=9, 10)$$

$$(40) \quad d_i = 1 / g_i (M_i / D_i, 1) = 1 / \bar{B}_i (M_i / D_i)^{\beta_i} \quad (i=3, 9, 10)$$

$$d_3 = D_3 / (Z_3 + C_3 + C_{03} + V_3)$$

$$d_i = 1 \quad (i=9, 10)$$

$$(41) \quad M_i = \phi (PD_i / PM_i) D_i \\ = \beta_i / (1 - \beta_i) (PD_i / PM_i) D_i \quad (i=3, 9, 10)$$

where  $\phi$  is the solution for  $M_i / D_i$  of the marginal condition:  $(\partial g_i / \partial M_i) / (\partial g_i / \partial D_i) = PM_i / PD_i$ .

$$M_3 = (Z_3 + C_3 + C_{03} + V_3) - D_3$$

$$M_i = 0 \quad (i=9, 10)$$

$$(42) \quad E_i = \bar{E}_i (\bar{P}W_i / PWE_i)^{\eta_i} \quad (i=2, 3, 9, 10)$$

$$E_i = 0 \quad (i=2, 3, 9, 10)$$

$$(43) \quad X_i^D = D_i + E_i$$

*Equilibrium for products and foreign exchanges:*

$$(44) \quad X_i^s = X_i^p \quad (i \neq 3)$$

$$PD_3 = PM_3$$

$$(45) \quad \Sigma \overline{P} \overline{W} M_i + (\overline{R} L_w + R A_w + \overline{R} T_w) - \Sigma P W E_i E_i - F_w = 0$$

*GDP Definitions*

$$(46) \quad \begin{aligned} GDP^n &= Y_H + Y_C + Y_B + Y_G + DK + (\overline{R} L_w + R A_w + \overline{R} T_w) ER \\ &= \Sigma (PD_i - \Sigma P_j \overline{a}_{ji} - \overline{b}_{oi} PD_i) X_i^s \\ &\quad + \Sigma (\overline{t} m_i / 1 + \overline{t} m_i) PM_i M_i - \Sigma (\overline{t} e_i / 1 + \overline{t} e_i) PD_i E_i \\ &= \Sigma P_i (C_i + Z_i) + \Sigma (1 / 1 + \overline{t} e_i) PD_i E_i - \Sigma (1 / 1 + \overline{t} m_i) PM_i M_i \end{aligned}$$

$$(47) \quad GDP = \Sigma C_i + \Sigma Z_i + \Sigma (1 / 1 + \overline{t} e_i^0) E_i - \Sigma (1 / 1 + \overline{t} m_i^0) M_i$$

where  $\overline{t} e_i^0, \overline{t} m_i^0$  = base year levels of  $\overline{t} e_i, \overline{t} m_i$

$$(48) \quad PGDP = GDP^n / GDP$$

$$(49) \quad E = \Sigma (1 / 1 + \overline{t} e_i^0) E_i, \quad PE = \Sigma (1 / 1 + \overline{t} e_i) PD_i E_i / E$$

$$(50) \quad M = \Sigma (1 / 1 + \overline{t} m_i^0) M_i, \quad PM = \Sigma (1 / 1 + \overline{t} m_i) PM_i M_i / M$$

*Walras' Law*

$$\begin{aligned} &\Sigma_{i \neq 3} PD_i (X_i^p - X_i^s) + W [\Sigma (L_{s,i} + L_{e,i}) - L^s] \\ &+ ER [\Sigma \overline{P} \overline{W} M_i + (\overline{R} L_w + R A_w + \overline{R} T_w) - \Sigma P W E_i E_i - F_w] \\ &+ (\Sigma AC_k - \overline{AC}_k^*) + (\Sigma AS_k - \Sigma AS_k^*) + (AL_B - \Sigma AL_k^*) = 0 \end{aligned}$$

[N.B. The second term above is to be dropped when  $W = \overline{W}$ .]

Note: Stock variables are measured at the end of each year. Stock variables with subscript 0 mean initial stocks, i.e., stock levels at the end of the previous year.

Table 4. Financial Assets and Liabilities Accounts\*

	<i>Assets</i>				<i>Liabilities</i>			
	(H)	(C)	(B)	(G)	(H)	(C)	(B)	(G)
(AC, )	$AC_H$	$AC_C$	-	-	-	-	$\overline{AC}_B^*$	-
(AD, $\bar{r}_D$ )	$AD_H$	$AD_C$	-	$AD_G$	-	-	$AD_B^*$	-
(AT, $\bar{r}_T$ )	$AT_H$	$AT_C$	-	$AT_G$	-	-	$AT_B^*$	-
(AS, $r_S$ )	$AS_H$	-	$AS_B$	-	-	$AS_C^*$	-	$AS_G^*$
(AL, $r_L$ )	-	-	$AL_B$	-	$AL_H^*$	$AL_C^*$	-	$AL_G^*$
(AU, $\bar{r}_U$ )	-	$AU_C$	-	-	$AU_H^*$	-	-	$\overline{AU}_G^*$
(AO, $\bar{r}_O$ )	$AO_H$	$AO_C$	-	$\overline{AO}_G$	-	-	$AO_B^*$	-
(AF, $\bar{r}_F$ )	$AF_H$	$AF_C$	$AF_B$	$\overline{AF}_G$	( $AN_H$ )	( $AN_C$ )	( $AN_B$ )	( $AN_G$ )

\*The model does not explicitly use the last three interest rates:  $r_U$ ,  $r_O$  and  $r_F$ , which are proxied by other relevant rates in case of necessity. Note that this table does not exactly correspond to the actual accounts of Bank of Japan. This is because some of the domestic assets and liabilities above are in net terms, and all of the foreign assets and liabilities are aggregated into a single concept: net foreign assets.

Table 5. Functional Parameters Derived from a Guess  
(Constant Terms and Elasticities) \*

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Labor supply [eq. (8)] :

$$\bar{l}^s = 0.5931, \quad \xi = +0.1$$

Exports ( $i=1\dots 13$ ) [eq. (42)] :

$$\bar{E}_i = \text{actual figure}, \quad \eta_i = +1.0$$

Gross investment ( $k=H, C, B$ ) [eq. (22.1)] :

$$\bar{I}_k = \text{actual figure}$$

$$\delta_{Kk} = +0.1, \quad \delta_{Lk} = -0.1, \quad \delta_{Sk} = -0.1, \quad \delta_{Xk} = +0.5$$

Financial assets and liabilities [eqs. (29) - (32)] :

Sector $H$ :	$\bar{a}_{iH}$	$\epsilon_{ijH}$				
		$(\bar{r}_D)$	$(\bar{r}_T)$	$(r_S)$	$(r_L)$	$(GDP)$
$a_{CH}$	0.0427	-0.5	-0.5	-	-	+1.0
$a_{DH}$	0.0783	+1.0	-0.5	-	-	+1.0
$a_{TH}$	0.5486	-0.5	+1.0	-0.5	-	+1.0
$a_{SH}$	0.0978	-	-0.5	+1.0	-	-
$a_{OH}$	0.1277	-	-	-	-	-
$a_{\bar{L}H}$	0.6267	-	-	-	-1.0	-
$a_{\bar{U}H}$	0.1517	-	-	-	-	-
Sector $C$ :	$\bar{a}_{iC}$	$\epsilon_{ijC}$				
		$(\bar{r}_D)$	$(\bar{r}_T)$	$(r_S)$	$(r_L)$	$(GDP)$
$a_{CC}$	0.0131	-0.5	-0.5	-	-	+1.0
$a_{DC}$	0.2470	+1.0	-0.5	-	-	+1.0
$a_{TC}$	0.4503	-0.5	+1.0	-	-	+1.0
$a_{OC}$	0.0397	-	-	-	-	-
$a_{\bar{S}C}$	0.1595	-	-	-1.0	+0.5	-
$a_{\bar{L}C}$	0.7833	-	-	+0.5	-1.0	-
Sector $B$ :	$\bar{a}_{iB}$	$\epsilon_{ijB}$				
		$(r_S/\bar{r}_{BJ})$	$(r_L/\bar{r}_{BJ})$			
$a_{SB}$	0.1827	+1.0	-0.5			
$a_{LB}$	0.8147	-0.5	+1.0			

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\* Constant terms are all based on actual figures.

Table 6. Comparative Statics (1980): Effects of Oil Price Changes on Selected Endogenous Variables

	Actual	Base solution	Discrepancy rates between shock and base solutions				
			$PWM_3$ changed by		$PWM_3$ changed by		
			-10%	-50%	+10%	+50%	
<i>ER</i>	1.0000	0.9970	-0.0156	-0.0907	0.0177	0.0964	
<i>W</i>	3.0540	3.0540	0.0	0.0053	0.0	0.0	
<i>r<sub>UL</sub></i>	0.020	0.0249	0.0183 #	-0.0000 #	0.0308 #	0.0538 #	
<i>r<sub>L</sub></i>	0.0827	0.0823	-0.0005 *	-0.0022 *	0.0005 *	0.0025 *	
<i>r<sub>S</sub></i>	0.0820	0.0806	-0.0005 *	-0.0019 *	0.0004 *	0.0021 *	
<i>PC<sub>H</sub></i>	1.0000	1.0001	-0.0058	-0.0286	0.0064	0.0340	
<i>PC<sub>G</sub></i>	1.0000	1.0013	-0.0023	-0.0088	0.0027	0.0156	
<i>PI</i>	1.0000	1.0033	-0.0053	-0.0245	0.0060	0.0328	
<i>PE</i>	1.0000	1.0022	-0.0085	-0.0430	0.0092	0.0489	
<i>PM</i>	1.0000	0.9969	-0.0504	-0.2568	0.0532	0.2831	
<i>PGDP</i>	1.0000	1.0020	0.0011	0.0094	-0.0008	-0.0023	
<i>K</i>	525253.5	525147.7	0.0003	0.0009	-0.0002	-0.0010	
<i>L</i>	52734.5	51656.8	0.0074	0.0290	-0.0067	-0.0329	
<i>C<sub>H</sub></i>	142094.4	136629.7	0.0133	0.0652	-0.0131	-0.0649	
<i>C<sub>G</sub></i>	23828.4	23798.1	0.0023	0.0088	-0.0027	-0.0153	
<i>I<sub>P</sub></i>	60728.4	60600.3	0.0010	0.0013	-0.0004	-0.0010	
<i>I<sub>G</sub></i>	14691.4	14643.0	0.0054	0.0251	-0.0059	-0.0318	
<i>E</i>	34543.3	34359.4	-0.0071	-0.0498	0.0084	0.0452	
<i>M</i>	37059.6	36194.4	0.0133	0.0796	-0.0129	-0.0607	
<i>GDP</i>	241253.3	235426.5	0.0055	0.0211	-0.0051	-0.0255	
<i>GDP<sup>n</sup></i>	235911.5	235893.7	0.0066	0.0307	-0.0059	-0.0278	
<i>Y<sub>H</sub></i>	170951.1	168690.2	0.0074	0.0348	-0.0068	-0.0332	
<i>Y<sub>C</sub></i>	1704.1	1797.1	0.1733	0.8298	-0.1656	-0.8177	
<i>Y<sub>B</sub></i>	2232.4	2351.9	0.0120	0.0553	-0.0111	-0.0546	
<i>Y<sub>G</sub></i>	29686.0	30915.2	0.0052	0.0216	-0.0040	-0.0171	
<i>S</i>	43523.0	43286.9	0.0170	0.0786	-0.0154	-0.0737	
<i>AF<sub>w</sub></i>	-2791.2	-3929.3	-826.8 *	-4024.9 *	818.1 *	4094.9 *	
<i>F<sub>w</sub></i>	2577.1	2004.9	-810.8 *	-4239.8 *	771.5 *	3570.2 *	
<i>PD<sub>i</sub></i>	<i>PD<sub>1</sub></i>	1.0000	0.9846	-0.0050	-0.0245	0.0058	0.0321
	<i>PD<sub>2</sub></i>	1.0000	1.0042	-0.0036	-0.0143	0.0043	0.0256
	<i>PD<sub>3</sub></i>	1.0000	0.9970	-0.1140	-0.5453	0.1194	0.6445
	<i>PD<sub>4</sub></i>	1.0000	0.9978	-0.0131	-0.0635	0.0143	0.0783
	<i>PD<sub>5</sub></i>	1.0000	0.9966	-0.0865	-0.4105	0.0912	0.4947
	<i>PD<sub>6</sub></i>	1.0000	1.0039	-0.0118	-0.0575	0.0129	0.0705
	<i>PD<sub>7</sub></i>	1.0000	1.0033	-0.0052	-0.0247	0.0059	0.0326
	<i>PD<sub>8</sub></i>	1.0000	0.9985	-0.0062	-0.0296	0.0070	0.0384
	<i>PD<sub>9</sub></i>	1.0000	1.0038	-0.0054	-0.0240	0.0059	0.0327
	<i>PD<sub>10</sub></i>	1.0000	0.9886	-0.0263	-0.1230	0.0290	0.1650
	<i>PD<sub>11</sub></i>	1.0000	1.0018	-0.0161	-0.0759	0.0172	0.0934
	<i>PD<sub>12</sub></i>	1.0000	0.9976	0.0018	0.0107	-0.0014	-0.0059
	<i>PD<sub>13</sub></i>	1.0000	1.0014	-0.0020	-0.0068	0.0024	0.0136
<i>X<sub>i</sub><sup>s</sup></i>	<i>X<sub>1</sub><sup>s</sup></i>	18357.9	18059.0	0.0049	0.0155	-0.0043	-0.0213
	<i>X<sub>2</sub><sup>s</sup></i>	254.6	250.0	0.0101	0.0427	-0.0077	-0.0305
	<i>X<sub>3</sub><sup>s</sup></i>	100.1	98.1	-0.1366	-0.7277	0.1381	0.7033
	<i>X<sub>4</sub><sup>s</sup></i>	27701.4	26955.2	0.0059	0.0217	-0.0054	-0.0270
	<i>X<sub>5</sub><sup>s</sup></i>	17906.2	17512.0	0.0223	0.1292	-0.0203	-0.0892
	<i>X<sub>6</sub><sup>s</sup></i>	46390.4	46142.4	0.0008	-0.0052	-0.0001	0.0003
	<i>X<sub>7</sub><sup>s</sup></i>	74428.1	73040.2	-0.0007	-0.0120	0.0014	0.0086
	<i>X<sub>8</sub><sup>s</sup></i>	73226.4	71161.9	0.0072	0.0304	-0.0068	-0.0338
	<i>X<sub>9</sub><sup>s</sup></i>	55257.3	54472.2	0.0022	0.0077	-0.0018	-0.0088
	<i>X<sub>10</sub><sup>s</sup></i>	11597.7	11337.3	0.0116	0.0546	-0.0113	-0.0550
	<i>X<sub>11</sub><sup>s</sup></i>	37254.5	36224.3	0.0114	0.0512	-0.0109	-0.0533
	<i>X<sub>12</sub><sup>s</sup></i>	15804.1	15377.8	0.0056	0.0222	-0.0051	-0.0248
	<i>X<sub>13</sub><sup>s</sup></i>	176761.7	171659.2	0.0060	0.0247	-0.0057	-0.0287

# Level of shock solution.

\* Difference between shock and base solutions.

A COMPUTABLE GENERAL EQUILIBRIUM MODEL  
OF THE JAPANESE ECONOMY

Table 7. Comparative Statics (1980): Effects of Oil Price Changes — The Case of Flexible Nominal Wage\*\*—

	Actual	Base solution	Discrepancy rates between shock and base solutions				
			$\overline{PWM}_3$ changed by		$\overline{PWM}_3$ changed by		
			-10%	-50%	+10%	+50%	
<i>ER</i>	1.0000	1.0020	-0.0243	-0.1175	0.0261	0.1526	
<i>W</i>	3.0540	3.0364	0.0108	0.0450	-0.0101	-0.0431	
<i>r<sub>UL</sub></i>	0.0	-0.0000	-0.0000 #	-0.0000 #	-0.0000 #	0.0 #	
<i>r<sub>L</sub></i>	0.0827	0.0822	-0.0002 *	-0.0011 *	0.0002 *	0.0013 *	
<i>r<sub>S</sub></i>	0.0820	0.0805	-0.0003 *	-0.0012 *	0.0003 *	0.0012 *	
<i>PC<sub>H</sub></i>	1.0000	0.9970	-0.0000	-0.0068	0.0009	0.0151	
<i>PC<sub>G</sub></i>	1.0000	0.9974	0.0049	0.0183	-0.0041	-0.0102	
<i>PI</i>	1.0000	0.9999	0.0011	0.0001	-0.0001	0.0121	
<i>PE</i>	1.0000	0.9994	-0.0033	-0.0229	0.0043	0.0339	
<i>PM</i>	1.0000	1.0020	-0.0587	-0.2750	0.0623	0.3563	
<i>PGDP</i>	1.0000	0.9975	0.0095	0.0403	-0.0086	-0.0336	
<i>K</i>	525253.5	525142.4	0.0003	0.0010	-0.0002	-0.0006	
<i>L</i>	52734.5	51827.2	0.0011	0.0051	-0.0011	-0.0059	
<i>C<sub>H</sub></i>	142094.4	136746.7	0.0115	0.0560	-0.0117	-0.0617	
<i>C<sub>G</sub></i>	23828.4	23890.9	-0.0049	-0.0180	0.0041	0.0103	
<i>I<sub>P</sub></i>	60728.4	60548.0	0.0026	0.0082	-0.0020	-0.0020	
<i>I<sub>G</sub></i>	14691.4	14693.6	-0.0011	-0.0001	0.0001	-0.0120	
<i>E</i>	34543.3	34629.4	-0.0211	-0.0968	0.0217	0.1148	
<i>M</i>	37059.6	36113.8	0.0171	0.0939	-0.0165	-0.0765	
<i>GDP</i>	241253.3	235985.1	0.0010	0.0042	-0.0012	-0.0074	
<i>GDP<sup>n</sup></i>	235911.5	235397.3	0.0105	0.0446	-0.0098	-0.0408	
<i>Y<sub>H</sub></i>	170951.1	168313.3	0.0115	0.0489	-0.0109	-0.0475	
<i>Y<sub>C</sub></i>	1704.1	1788.3	0.1803	0.8354	-0.1767	-0.8503	
<i>Y<sub>B</sub></i>	2232.4	2349.2	0.0140	0.0612	-0.0134	-0.0605	
<i>Y<sub>G</sub></i>	29686.0	30892.9	0.0064	0.0262	-0.0054	-0.0149	
<i>S</i>	43523.0	43181.5	0.0213	0.0928	-0.0199	-0.0843	
<i>AF<sub>w</sub></i>	-2791.2	-3994.6	-706.2 *	-3449.7 *	720.7 *	3896.6 *	
<i>F<sub>w</sub></i>	2577.1	1929.6	-674.4 *	-3644.2 *	652.0 *	3118.6 *	
<i>PD<sub>i</sub></i>	<i>PD<sub>1</sub></i>	1.0000	0.9819	0.0000	-0.0052	0.0010	0.0174
	<i>PD<sub>2</sub></i>	1.0000	1.0010	0.0023	0.0087	-0.0015	0.0064
	<i>PD<sub>3</sub></i>	1.0000	1.0020	-0.1219	-0.5587	0.1287	0.7289
	<i>PD<sub>4</sub></i>	1.0000	0.9962	-0.0099	-0.0495	0.0114	0.0754
	<i>PD<sub>5</sub></i>	1.0000	1.0004	-0.0924	-0.4204	0.0982	0.5615
	<i>PD<sub>6</sub></i>	1.0000	1.0020	-0.0081	-0.0421	0.0095	0.0651
	<i>PD<sub>7</sub></i>	1.0000	1.0002	0.0006	-0.0023	0.0004	0.0143
	<i>PD<sub>8</sub></i>	1.0000	0.9957	-0.0009	-0.0089	0.0020	0.0230
	<i>PD<sub>9</sub></i>	1.0000	1.0001	0.0016	0.0023	-0.0005	0.0100
	<i>PD<sub>10</sub></i>	1.0000	0.9891	-0.0271	-0.1214	0.0302	0.1891
	<i>PD<sub>11</sub></i>	1.0000	0.9992	-0.0113	-0.0556	0.0129	0.0843
	<i>PD<sub>12</sub></i>	1.0000	0.9939	0.0088	0.0362	-0.0008	-0.0315
	<i>PD<sub>13</sub></i>	1.0000	0.9973	0.0056	0.0212	-0.0047	-0.0135
<i>X<sub>i</sub><sup>S</sup></i>	<i>X<sub>1</sub><sup>S</sup></i>	18357.9	18120.7	-0.0015	-0.0086	0.0015	0.0068
	<i>X<sub>2</sub><sup>S</sup></i>	254.6	252.2	-0.0057	-0.0155	0.0070	0.0426
	<i>X<sub>3</sub><sup>S</sup></i>	100.1	99.2	-0.1551	-0.7644	0.1594	0.8571
	<i>X<sub>4</sub><sup>S</sup></i>	27701.4	27038.8	0.0001	-0.0006	-0.0002	-0.0023
	<i>X<sub>5</sub><sup>S</sup></i>	17906.2	17550.8	0.0181	0.1116	-0.0167	-0.0723
	<i>X<sub>6</sub><sup>S</sup></i>	46390.4	46298.2	-0.0054	-0.0271	0.0057	0.0309
	<i>X<sub>7</sub><sup>S</sup></i>	74428.1	73297.9	-0.0072	-0.0342	0.0075	0.0415
	<i>X<sub>8</sub><sup>S</sup></i>	73226.4	71293.0	0.0035	0.0157	-0.0036	-0.0189
	<i>X<sub>9</sub><sup>S</sup></i>	55257.3	54476.1	0.0020	0.0069	-0.0016	-0.0045
	<i>X<sub>10</sub><sup>S</sup></i>	11597.7	11352.9	0.0089	0.0434	-0.0090	-0.0446
	<i>X<sub>11</sub><sup>S</sup></i>	37254.5	36310.4	0.0068	0.0319	-0.0070	-0.0366
	<i>X<sub>12</sub><sup>S</sup></i>	15804.1	15415.6	0.0009	0.0045	-0.0009	-0.0048
	<i>X<sub>13</sub><sup>S</sup></i>	176761.7	172073.2	0.0014	0.0069	-0.0016	-0.0104

\*\* Minimum wage ( $\bar{w}$ ) equals zero and labor supply excludes totally unemployed labor force in 1980. # Level of shock solution. # Difference between shock and base solutions.

Table 8. Comparative Statics (1980): Effects of Fiscal and Monetary Policies on Selected Endogenous Variables.\*\*

	$\overline{C}_G^*$	$\overline{I}_G^*$	$\overline{AC}_B^*$ , $\overline{AS}_{BJ}$	$\overline{ty}_H$	$\overline{ty}_C$ , $\overline{ty}_B$	$\overline{td}_i (i=1..13)$
	increased by +1000.0	increased by +1000.0	increased by + 250.0 <sup>a</sup>	changed by - 7% <sup>b</sup>	changed by - 9% <sup>b</sup>	changed by - 6% <sup>b</sup>
<i>ER</i>	-0.0181	-0.0200	0.0356	-0.0149	0.0027	-0.0060
<i>W</i>	0.0	0.0	0.0	0.0	0.0	0.0
<i>r<sub>UL</sub></i>	0.0186 #	0.0186 #	0.0135 #	0.0195 #	0.0232 #	0.0188 #
<i>r<sub>L</sub></i>	-0.0001 *	-0.0001 *	-0.0007 *	-0.0000 *	0.0001 *	-0.0001 *
<i>r<sub>S</sub></i>	0.0001 *	0.0002 *	-0.0010 *	0.0002 *	0.0004 *	0.0001 *
<i>PC<sub>H</sub></i>	-0.0008	-0.0017	0.0084	-0.0005	0.0008	-0.0028
<i>PC<sub>G</sub></i>	0.0011	-0.0001	0.0056	0.0007	0.0006	-0.0018
<i>PI</i>	-0.0018	-0.0010	0.0082	-0.0013	0.0008	-0.0029
<i>PE</i>	-0.0024	-0.0023	0.0101	-0.0017	0.0010	-0.0035
<i>PM</i>	-0.0181	-0.0200	0.0356	-0.0149	0.0027	-0.0060
<i>PGDP</i>	0.0015	0.0014	0.0042	0.0014	0.0006	-0.0024
<i>K</i>	129.3	1142.6	550.3	111.8	119.9	106.1
<i>L</i>	338.9	341.1	559.5	287.1	84.5	335.2
<i>C<sub>H</sub></i>	983.6	1100.8	241.3	1729.5	96.7	1265.0
<i>C<sub>G</sub></i>	971.7	3.3	- 132.2	-17.0	-14.8	42.4
<i>I<sub>P</sub></i>	99.3	122.4	679.1	90.2	133.0	60.5
<i>I<sub>G</sub></i>	25.9	1012.5	- 119.4	18.3	-12.4	42.9
<i>E</i>	- 639.1	- 610.3	867.3	- 453.8	57.6	-86.3
<i>M</i>	460.1	548.3	- 238.3	448.5	8.9	251.8
<i>GDP</i>	1081.4	1080.5	1775.4	918.9	251.3	1072.8
<i>GDP<sup>a</sup></i>	1435.3	1423.6	2787.9	1247.5	385.1	509.7
<i>Y<sub>H</sub></i>	1075.8	1076.8	1719.4	2043.2	261.3	1077.3
<i>Y<sub>C</sub></i>	196.4	183.8	199.0	167.6	914.8	225.3
<i>Y<sub>B</sub></i>	17.7	17.0	34.0	21.9	142.4	24.7
<i>Y<sub>G</sub></i>	240.0	227.2	541.5	- 908.4	- 942.7	- 693.1
<i>S</i>	- 341.5	632.6	1101.2	- 330.7	164.2	- 238.4
<i>AF<sub>w</sub></i>	423.7	506.8	- 180.4	419.9	18.6	242.7
<i>F<sub>w</sub></i>	469.7	558.6	- 243.6	467.8	13.2	257.0
<i>PD<sub>1</sub></i>	-0.0018	-0.0016	0.0102	-0.0004	0.0011	-0.0019
<i>PD<sub>2</sub></i>	-0.0023	-0.0021	0.0083	-0.0015	0.0008	-0.0018
<i>PD<sub>3</sub></i>	-0.0181	-0.0200	0.0356	-0.0149	0.0027	-0.0060
<i>PD<sub>4</sub></i>	-0.0028	-0.0035	0.0132	-0.0018	0.0013	-0.0029
<i>PD<sub>5</sub></i>	-0.0147	-0.0162	0.0315	-0.0119	0.0025	-0.0123
<i>PD<sub>6</sub></i>	-0.0039	-0.0031	0.0133	-0.0028	0.0013	-0.0032
<i>PD<sub>7</sub></i>	-0.0023	-0.0017	0.0092	-0.0016	0.0009	-0.0035
<i>PD<sub>8</sub></i>	-0.0022	-0.0024	0.0096	-0.0012	0.0009	-0.0053
<i>PD<sub>9</sub></i>	-0.0015	-0.0004	0.0076	-0.0010	0.0008	-0.0027
<i>PD<sub>10</sub></i>	-0.0023	-0.0025	0.0208	-0.0001	0.0022	-0.0018
<i>PD<sub>11</sub></i>	-0.0030	-0.0034	0.0105	-0.0021	0.0010	-0.0035
<i>PD<sub>12</sub></i>	0.0020	0.0017	0.0063	0.0025	0.0008	-0.0005
<i>PD<sub>13</sub></i>	0.0014	0.0002	0.0051	0.0010	0.0006	-0.0017
<i>X<sub>1</sub><sup>s</sup></i>	11.3	39.0	213.0	55.8	27.1	99.0
<i>X<sub>2</sub><sup>s</sup></i>	- 2.3	- 2.5	7.1	- 1.5	0.7	0.7
<i>X<sub>3</sub><sup>s</sup></i>	- 2.1	- 2.3	3.8	- 1.8	0.3	- 0.5
<i>X<sub>4</sub><sup>s</sup></i>	47.8	38.0	266.2	68.6	33.9	126.6
<i>X<sub>5</sub><sup>s</sup></i>	58.2	75.3	126.9	75.6	21.3	110.4
<i>X<sub>6</sub><sup>s</sup></i>	- 158.2	40.3	636.3	- 110.2	74.9	60.7
<i>X<sub>7</sub><sup>s</sup></i>	- 280.3	18.6	1030.2	- 179.4	115.4	100.0
<i>X<sub>8</sub><sup>s</sup></i>	288.2	421.0	479.8	441.8	83.9	503.9
<i>X<sub>9</sub><sup>s</sup></i>	115.2	780.9	400.2	97.0	87.0	93.6
<i>X<sub>10</sub><sup>s</sup></i>	47.8	54.4	51.3	56.5	9.4	58.6
<i>X<sub>11</sub><sup>s</sup></i>	141.5	142.4	269.4	193.2	41.0	204.4
<i>X<sub>12</sub><sup>s</sup></i>	66.2	53.9	118.3	69.2	17.0	76.5
<i>X<sub>13</sub><sup>s</sup></i>	1495.6	767.3	950.5	1006.4	156.9	939.0

\*\* Discrepancy rates for price variables and differences for quantity and value variables.  
 #Level of shock solution. \*Differences between shock and base solutions. <sup>a</sup>Approximately equivalent with one-trillion-yen increase in narrow money supply (M1) in 1980.  
<sup>b</sup>Approximately equivalent with one-trillion-yen tax reductions in 1980.

Table 9. Comparative Statics (1980): Effects of Fiscal and Monetary Policies—The Case of Flexible Nominal Wage—\*\*

	$\bar{C}_c^e$	$\bar{I}_c^e$	$\bar{AC}_B^*, \bar{AS}_{BJ}$	$\bar{t}_{yH}$	$\bar{t}_{yC}, \bar{t}_{yB}$	$\bar{td}_i (i=1..13)$
	increased by -1000.0	increased by -1000.0	increased by + 250.0	changed by - 7%	changed by - 9%	changed by - 6%
<i>ER</i>	-0.0266	-0.0285	0.0085	-0.0237	-0.0007	-0.0142
<i>W</i>	0.0105	0.0104	0.0047	0.0079	0.0044	0.0100
<i>r<sub>UL</sub></i>	0.0000 #	-0.0000 #	-0.0000 #	-0.0000 #	-0.0000 #	-0.0000 #
<i>r<sub>L</sub></i>	0.0002 *	0.0002 *	-0.0001 *	0.0001 *	0.0003 *	0.0001 *
<i>r<sub>S</sub></i>	0.0003 *	0.0003 *	-0.0003 *	0.0002 *	0.0007 *	0.0002 *
<i>PC<sub>H</sub></i>	0.0048	0.0039	0.0051	0.0032	0.0035	0.0026
<i>PC<sub>G</sub></i>	0.0081	0.0069	0.0048	0.0057	0.0039	0.0050
<i>PI</i>	0.0045	0.0052	0.0054	0.0030	0.0038	0.0031
<i>PE</i>	0.0027	0.0028	0.0055	0.0015	0.0035	0.0014
<i>PM</i>	-0.0266	-0.0285	0.0084	-0.0237	-0.0007	-0.0142
<i>PGDP</i>	0.0096	0.0096	0.0047	0.0073	0.0043	0.0054
<i>K</i>	139.9	1149.2	184.3	108.3	215.0	117.6
<i>L</i>	28.9	33.2	- 2.2	24.3	4.5	38.4
<i>C<sub>H</sub></i>	758.7	879.1	- 119.5	1562.2	89.6	1048.0
<i>C<sub>G</sub></i>	801.2	- 162.9	- 113.1	- 136.4	-92.6	- 118.0
<i>I<sub>P</sub></i>	195.7	216.7	263.2	143.9	269.3	154.2
<i>I<sub>G</sub></i>	-66.1	918.7	-78.4	-44.3	-56.4	-45.2
<i>E</i>	-1011.2	-1081.3	102.4	- 873.7	- 144.3	- 538.6
<i>M</i>	601.2	688.9	-64.7	578.4	90.9	381.9
<i>GDP</i>	77.2	81.4	119.4	73.4	-25.3	118.6
<i>GDP<sup>n</sup></i>	2342.0	2322.1	1235.7	1797.9	990.2	1381.4
<i>Y<sub>H</sub></i>	1751.9	1748.4	716.7	2472.4	707.7	1723.4
<i>Y<sub>C</sub></i>	210.5	197.9	47.7	169.6	1747.6	238.5
<i>Y<sub>B</sub></i>	22.5	21.8	10.2	23.8	10.0	29.3
<i>Y<sub>G</sub></i>	280.0	266.6	154.6	- 906.7	-1549.7	- 655.2
<i>S</i>	- 154.0	818.5	348.7	- 243.6	342.4	-59.9
<i>AF<sub>w</sub></i>	539.8	620.2	-62.1	523.6	93.1	351.6
<i>F<sub>w</sub></i>	606.2	693.8	-77.6	582.1	94.3	383.7
<i>PD<sub>1</sub></i>	0.0031	0.0033	0.0053	0.0027	0.0036	0.0028
<i>PD<sub>2</sub></i>	0.0037	0.0037	0.0052	0.0025	0.0034	0.0036
<i>PD<sub>3</sub></i>	-0.0266	-0.0285	0.0084	-0.0237	-0.0007	-0.0142
<i>PD<sub>4</sub></i>	0.0003	-0.0004	0.0056	-0.0002	0.0030	0.0001
<i>PD<sub>5</sub></i>	-0.0211	-0.0226	0.0078	-0.0188	0.0001	-0.0184
<i>PD<sub>6</sub></i>	-0.0003	0.0004	0.0058	-0.0010	0.0032	0.0002
<i>PD<sub>7</sub></i>	0.0034	0.0039	0.0055	0.0022	0.0037	0.0020
<i>PD<sub>8</sub></i>	0.0030	0.0027	0.0054	0.0021	0.0034	-0.0004
<i>PD<sub>9</sub></i>	0.0052	0.0062	0.0054	0.0036	0.0040	-0.0037
<i>PD<sub>10</sub></i>	-0.0032	-0.0034	0.0059	-0.0020	0.0026	-0.0027
<i>PD<sub>11</sub></i>	0.0017	0.0012	0.0055	0.0008	0.0032	0.0010
<i>PD<sub>12</sub></i>	0.0088	0.0084	0.0047	0.0073	0.0041	0.0060
<i>PD<sub>13</sub></i>	0.0087	0.0074	0.0048	0.0062	0.0039	0.0053
<i>X<sub>1</sub><sup>s</sup></i>	-99.8	-71.7	6.1	-40.8	- 6.3	- 7.5
<i>X<sub>2</sub><sup>s</sup></i>	- 6.1	- 6.3	0.5	- 4.9	- 0.7	- 2.9
<i>X<sub>3</sub><sup>s</sup></i>	- 4.1	- 4.3	0.4	- 3.5	0.6	- 2.4
<i>X<sub>4</sub><sup>s</sup></i>	- 102.9	- 111.7	- 1.0	-61.5	-13.0	-17.8
<i>X<sub>5</sub><sup>s</sup></i>	-10.9	6.3	- 6.5	16.1	3.2	43.8
<i>X<sub>6</sub><sup>s</sup></i>	- 435.4	- 236.4	59.6	- 358.2	- 8.8	- 204.6
<i>X<sub>7</sub><sup>s</sup></i>	- 737.2	- 437.4	110.5	- 587.2	-29.1	- 338.1
<i>X<sub>8</sub><sup>s</sup></i>	44.3	179.1	-30.0	234.3	37.6	269.2
<i>X<sub>9</sub><sup>s</sup></i>	104.5	768.5	100.2	79.4	149.4	83.8
<i>X<sub>10</sub><sup>s</sup></i>	19.2	26.0	- 3.3	32.5	3.7	31.0
<i>X<sub>11</sub><sup>s</sup></i>	-15.7	-13.6	-13.2	59.8	- 0.9	53.6
<i>X<sub>12</sub><sup>s</sup></i>	-13.3	-14.2	- 1.6	11.0	- 2.1	10.8
<i>X<sub>13</sub><sup>s</sup></i>	738.2	17.8	- 133.7	388.3	-60.9	214.8

\*\* See footnotes to Table 8 and Table 7. #Level of shock solution. \* Difference between shock and base solutions.



Table 10. Comparative Statics (1980): Effects of Various Policy Measures on the Current Balance of Payments ( $-F_w$ ) \*\*

	Zero tariff rates in all industries ( $\overline{tm}_i=0.0$ , $i=1,3\sim 8,13$ )	Zero tariff rates in agriculture ( $\overline{tm}_1=0.0$ )	Zero tariff rates in petroleum ( $\overline{tm}_3=0.0$ )	Zero tariff rates in manufacturing ( $\overline{tm}_i=0.0$ , $i=4\sim 8$ )	Import subsi- dies of 1% in manufacturing ( $\overline{tm}_i=-0.01$ , $i=4\sim 8$ )	Expor duties of 1% in all industries ( $\overline{te}_i=-0.01$ , $i=1\sim 13$ )	Increase in ODA grant by 0.1% of GDP ( $\overline{TR}_w$ : +250.0)
<i>ER</i>	0.0118	0.0008	-0.0022	0.0130	0.0153	0.0063	0.0018
<i>W</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>r<sub>UL</sub></i>	0.0196 #	0.0247 #	0.0215 #	0.0232 #	0.0229 #	0.0268 #	0.0244 #
<i>r<sub>L</sub></i>	0.0000 *	0.0000 *	-0.0001 *	0.0001 *	0.0001 *	0.0000 *	0.0001 *
<i>r<sub>S</sub></i>	0.0003 *	0.0000 *	0.0000 *	0.0003 *	0.0003 *	-0.0001 *	0.0001 *
<i>PC<sub>H</sub></i>	-0.0021	-0.0001	-0.0013	-0.0013	-0.0006	0.0004	0.0004
<i>PC<sub>G</sub></i>	0.0002	0.0001	-0.0003	0.0005	0.0005	-0.0000	0.0003
<i>PI</i>	-0.0020	-0.0000	-0.0012	-0.0008	-0.0010	0.0004	0.0004
<i>PE</i>	-0.0016	0.0001	-0.0022	0.0006	0.0005	0.0105	0.0005
<i>PM</i>	0.0111	0.0008	-0.0021	0.0130	0.0153	0.0063	0.0018
<i>PGDP</i>	-0.0039	-0.0002	-0.0012	-0.0025	-0.0029	0.0009	0.0002
<i>K</i>	0.0002	0.0000	0.0001	0.0000	0.0000	-0.0001	0.0000
<i>L</i>	0.0057	0.0002	0.0036	0.0018	0.0022	-0.0020	0.0004
<i>C<sub>H</sub></i>	0.0077	0.0003	0.0049	0.0024	0.0028	-0.0024	0.0000
<i>C<sub>G</sub></i>	-0.0002	-0.0001	-0.0003	-0.0005	-0.0005	0.0000	-0.0003
<i>I<sub>P</sub></i>	0.0009	0.0001	0.0009	-0.0001	-0.0001	-0.0006	0.0003
<i>I<sub>G</sub></i>	0.0020	0.0000	0.0012	0.0008	0.0010	-0.0004	-0.0004
<i>E</i>	0.0134	0.0008	0.0000	0.0125	0.0148	-0.0042	0.0013
<i>M</i>	0.0175	0.0009	0.0039	0.0125	0.0146	-0.0049	-0.0005
<i>GDP</i>	0.0041	0.0002	0.0026	0.0012	0.0015	-0.0014	0.0003
<i>GDP<sup>n</sup></i>	0.0001	-0.0000	0.0014	-0.0013	-0.0014	-0.0005	0.0005
<i>Y<sub>H</sub></i>	0.0056	0.0002	0.0036	0.0017	0.0021	-0.0020	0.0004
<i>Y<sub>C</sub></i>	0.1104	0.0032	0.0720	0.0340	0.0411	-0.0355	0.0041
<i>Y<sub>B</sub></i>	0.0092	0.0004	0.0056	0.0031	0.0037	-0.0029	0.0006
<i>Y<sub>G</sub></i>	-0.0340	-0.0015	-0.0118	-0.0204	-0.0240	0.0086	-0.0073
<i>S</i>	-0.0150	-0.0008	-0.0025	-0.0117	-0.0137	0.0030	-0.0047
<i>AF<sub>w</sub></i>	666.7 *	35.9 *	140.6 *	483.9 *	564.6 *	-168.3 *	237.2 *
<i>-F<sub>w</sub></i>	-637.6 *	-34.3 *	-145.6 *	-453.4 *	-527.5 *	180.3 *	-233.8 *

\*\* Figures are all discrepancy rates except for those with # (level of shock solution) and those with \* (difference). ( $-F_w$ ) should be divided by 242.0 to get figures in terms of US dollars.

Table 11. Sensitivity Test: Comparative Statics (1980) under Different Parameter Values in the Case of 10% Decrease in Oil Price (PWM<sub>3</sub> changed by -10%) \*\*

Parameters shown in Table 5 ##	Parameter(s) in Table 5 changed as:					
	$\xi = 0.0$	$\eta_i = 0.5$ ( $i=1\dots 13$ )	$\eta_i = 2.0$ ( $i=1\dots 13$ )	$\delta_{ik} \times 2.0$ ( $i=K, L, S, X$ $k=H, C, B$ )	$\varepsilon_{ijk} \times 0.5$ ( $i=C, D, T, S, L$ $j=D, T, S, L, X$ $k=H, C, B$ )	
ER	-0.0156	-0.0155	-0.0206	-0.0119	-0.0137	-0.0170
W	0.0	0.0	0.0	0.0	0.0	0.0
r <sub>UL</sub>	0.0183 #	0.0177 #	0.0171 #	0.0191 #	0.0170 #	0.0264 #
r <sub>L</sub>	-0.0005 *	-0.0005 *	-0.0006 *	-0.0005 *	-0.0005 *	-0.0007 *
r <sub>S</sub>	-0.0005 *	-0.0005 *	-0.0005 *	-0.0004 *	-0.0005 *	-0.0006 *
PC <sub>H</sub>	-0.0058	-0.0058	-0.0063	-0.0054	-0.0056	-0.0061
PC <sub>G</sub>	-0.0023	-0.0023	-0.0025	-0.0022	-0.0023	-0.0025
PI	-0.0053	-0.0053	-0.0058	-0.0050	-0.0052	-0.0056
PE	-0.0085	-0.0085	-0.0090	-0.0083	-0.0083	-0.0088
PM	-0.0504	-0.0504	-0.0550	-0.0470	-0.0485	-0.0514
PGDP	0.0011	0.0011	0.0013	0.0010	0.0010	0.0009
K	0.0003	0.0003	0.0003	0.0002	0.0001	0.0002
L	0.0074	0.0074	0.0082	0.0067	0.0068	0.0069
C <sub>H</sub>	0.0133	0.0133	0.0146	0.0122	0.0125	0.0130
C <sub>G</sub>	0.0023	0.0023	0.0025	0.0022	0.0023	0.0025
I <sub>P</sub>	0.0010	0.0010	0.0011	0.0008	-0.0006	0.0007
I <sub>G</sub>	0.0054	0.0054	0.0058	0.0050	0.0052	0.0056
E	-0.0071	-0.0070	-0.0058	-0.0074	-0.0054	-0.0083
M	0.0133	0.0133	0.0162	0.0116	0.0118	0.0134
GDP	0.0055	0.0055	0.0060	0.0050	0.0051	0.0051
GDP*	0.0066	0.0066	0.0073	0.0059	0.0061	0.0061
Y <sub>H</sub>	0.0074	0.0074	0.0082	0.0067	0.0069	0.0069
Y <sub>C</sub>	0.1733	0.1735	0.1875	0.1613	0.1592	0.1754
Y <sub>B</sub>	0.0120	0.0121	0.0132	0.0109	0.0114	0.0113
Y <sub>G</sub>	0.0052	0.0052	0.0061	0.0046	0.0046	0.0045
S	0.0170	0.0171	0.0190	0.0154	0.0158	0.0159
AF <sub>w</sub>	- 826.8 *	- 826.4 *	- 901.9 *	- 764.0 *	- 871.2 *	- 816.7 *
F <sub>w</sub>	- 810.8 *	- 810.5 *	- 887.6 *	- 748.7 *	- 863.2 *	- 819.1 *

\*\* Figures are all discrepancy rates except for those with # (level of shock solution) and those with \* (difference).

## The same as in Table 6.

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