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AN ECONOMETRIC MODEL OF POSTWAR JAPAN

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by

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I. Introduction

Every economist would like to know more about the general economic interdependencies in an actual economy. Of the many macroeconomic models that have so far been proposed and studied, the Brookings and FRD-MIT Models, among others, illustrate a recent tendency to include considerably disaggregated markets not only for commodities but also for financial variables. This tendency, which reflects recent intensive studies of the price formation mechanism in its relation to market structures in an economy, undoubtedly promises greater successes for macroeconomic models.

On the other hand, most existing models lack an explicit treatment of the supply of products from the viewpoint of producers' rationality. In other words, models are still largely concerned with demand creation; for example, the role of investment in plants and equipments, is primarily to provide an accelerated impact to final demands, and, to a lesser extent, to affect employee compensation and labor employment. But as is well known, gross fixed investment will raise productive capacity, and thereby affect the rational behavior of producers in the following periods. This rational reaction from the supply side would certainly make a difference in the determination of the level and change of gross national product and other important indicators of economic activities.

In this study, supply behavior with regard to final products is explicitly taken into account, from the viewpoint of producers' rationality. Financial transactions are explicitly analyzed in terms of intersectoral transactions, because such transactions are originally intersectoral and aggregation over economic sectors--such as households, producers, or financial

institutions--would obscure the nature of financial transactions.

This model includes ninety-seven equations, most of which are dynamic and nonlinear. Despite its dynamic characteristics, the multiplier analysis in this paper is confined to one period responses. Analysis of dynamic multipliers will be studied in a future paper.

Nevertheless, some interesting results have been obtained: (i) the impact multiplier on GNP of government current expenditures is significantly higher than that of the supply of money; (ii) the behavior of the supply of final products seems to be very sensitive to the nature of the impact; (iii) the same is true of corporate profits and investment in inventories; (iv) the impact of government transfer payments to individuals naturally has more effect on personal expenditures than on the activities of corporate businesses; (v) corporate income tax rate and tax rate on dividends are considerably effective on the general economic activities including the fixed investment behavior of corporate businesses; (vi) the effects of the change in money wage rate on changes in the prices for the current and the next periods are not negligibly small, and the real wage rate from the viewpoint of employee as consumers may not decline by a ten percent increase in the money wage rate at least for the current and the next periods; and finally (vii) on the whole, fiscal policy appears to have more effect on the economy as a whole than does monetary policy.

It should be noted, however, that this model is not well prepared for the analysis of an economy under full employment, a task which would require more deliberate specification in the equations for investment in plants and equipments, for labor force participation (not present in this model), for the demand for and supply of money and securities and so forth.

II. The Main Characteristics of the Model

II.1. The Outline of the Model

The key objective in constructing this model is, as with most macro-econometric models, to make clear the mechanism of determination of gross national product or income for the economy as a whole. A simple Keynesian multiplier model can be quite useful in providing a clear-cut description of income-determination in an economy; but the impact multipliers derived from such a model may be quite different from our a priori notions and from the multipliers derived from a large-scale model which takes into account the simultaneous interactions of many behavioral relationships. While this does not demonstrate the superiority of complex models, it should at least justify our interest in a greater disaggregation of the commodity market and in the explicit and simultaneous treatment of factors which are often lost in the background--sectoral financial behavior, producers' supply behavior, and so forth.

The model presented here includes as many sectors and behavioral relations as were necessary to bring out the essential features that were desired, and as were permitted by the limits imposed by workability and data availability. The economy as a whole is divided into six sectors: Individuals (households and unincorporated businesses), Incorporated Businesses, Private Financial Intermediaries, The Bank of Japan, General Government, and Foreign Trade. There are four markets--for final products, labor, money, and securities--but the labor market has little detail. The model does emphasize the financial and non-financial (physical) transactions of the three private sectors (Individuals, Incorporated Businesses and Private

Financial Intermediaries) to the extent that about 75 percent of the model's equations (72 equations out of 97) are concerned with explaining the economic behavior of these three sectors.

In explicitly dealing with various types of transactions among the several sectors, it is convenient to introduce variables which are exogenous to certain sectors but endogenous to the model as a whole. In doing so, there is maintained an equality of the net in- and out-flow of funds, caused by financial and non-financial transactions for the current period, and consequently of the asset-debt balance at the end-of-period for each sector.

Thus, the model involves, firstly, the specification of structural equations to explain the behavioral patterns of financial and non-financial transactions for each sector, secondly, the equalization of the demand for and supply of money and securities, and, thirdly, an explicit representation of the dynamic adjustment process triggered by gaps between the potential --not technical but rational--supply of final products and demand for them, and solved by price movements over several time periods.

The dynamic interdependency among sectors is taken into account, particularly in the treatment of the loan behavior of Private Financial Intermediaries and the money demand behavior of Incorporated Businesses. Direct (not open market) operation or loan by the Bank of Japan makes the Private Financial Intermediaries change their asset-debt structure for the current period, and consequently forces them to change their loan policies for the next period, which in turn affects household consumption, investment in dwellings, investment of unincorporated businesses in plant and equipment and so forth.

It is also assumed that there may be an inelasticity of the demand for money or a downward rigidity in the financial transactions of Incorporated Businesses with Private Financial Intermediaries, which brings about excess money holdings in Incorporated Businesses. This excess money is assumed to be used in clearing off a part of trade-credit received in this sector. This leads to an increase in trade-credit granted to Individuals, and consequently an increase in consumption and investment by Individuals for the next period, as will be seen later.

II.2. Four Markets

In this model, the market structures with respect to final products, money, and securities are given explicit detail. Since the nominal wage rate is assumed to be exogenously determined, labor employment is determined, given prices, the level of technology, the production function, the level of production for the current period, and the gross stock of fixed capital at the beginning-of-period. The following is a brief summary of the treatment of the three other markets, and an even briefer word about the four markets.

A) Market for Final Products

The supply of final products is assumed to be determined by the real wage rate, the gross stock of fixed capital at the beginning-of-period, rate of Hicks-neutral technical progress. This can be deduced as follows: Assume profit maximization, and define X as the output level, L as the labor input (manhours), and GK_{-1} as the gross stock of fixed capital at the beginning-of-period. Assume further a production function which is

linearly homogeneous with respect to L and GK_{-1}

$$(1) \quad X = f(L, GK_{-1}, t),$$

where t is a time variable used to express productivity changes according to Hicks-neutral technical progress. The familiar first order condition for profit maximization is:

$$(2) \quad \frac{\partial X}{\partial L} = \frac{w^*}{p},$$

where w^* is the exogenously determined money wage rate and p is the price of output, assumed to be predetermined for at least the current period. From equations (1) and (2), we can deduce a function for desired output X^* ,

$$(3) \quad X^* = f^* \left(\frac{w^*}{p}, GK_{-1}, t \right)^1$$

Estimating the structural parameters included in equation (1) directly and substituting these estimates into the right-hand side of equation (3), we can obtain estimates for the potential supply of output X^* in the observation periods. It should be noted that this potential supply is not the amount technically maximal but rather the amount rationally desired by producers. Also equation (1) does not allow for changes in the degree of utilization of machines, equipment, or plants, but it does take into account changes in the utilization of manhours, given the stock of machines, equipment and plant for the unit time period.

The total demand for final products will be equal to the sum of the sectoral demands--that is, the sum of the demands for consumer goods, investment goods, the goods demanded by the General Government, exports and

imports (negative). If we define the sum of the volume of final demands as D^* , then the potential excess supply of final products E is:

$$(4) \quad E = X^* - D^* .$$

If the potential supply is not cleared up instantaneously through price movements, then it will affect the degree of utilization and the passive (or unintended) investment in inventories. In general, the differential impacts of an excess supply are uncertain, though it is certainly conceivable to assume that the amount of passive investment created will depend on the level of the excess itself, the price level of output,² the availability of funds to producers and wholesalers and so forth.

Thus, an equation for the passive investment in inventories might be written as:

$$(5) \quad U = a_0 + a_1 E + a_2 U_{-1} + a_3 p_w + a_4 M_{c-1}^*$$

where U is the passive investment in inventories; p_w is the wholesale price level; and M_{c-1}^* is the beginning-of-period balance of excess money holdings in the Incorporated Businesses sector, as will be explained in the next chapter.³ The expected sign of the coefficients are:

$$a_1, a_3 \text{ and } a_4 > 0 ; \quad 0 < a_2 < 1 ,$$

and the degree of utilization ρ can be defined as:

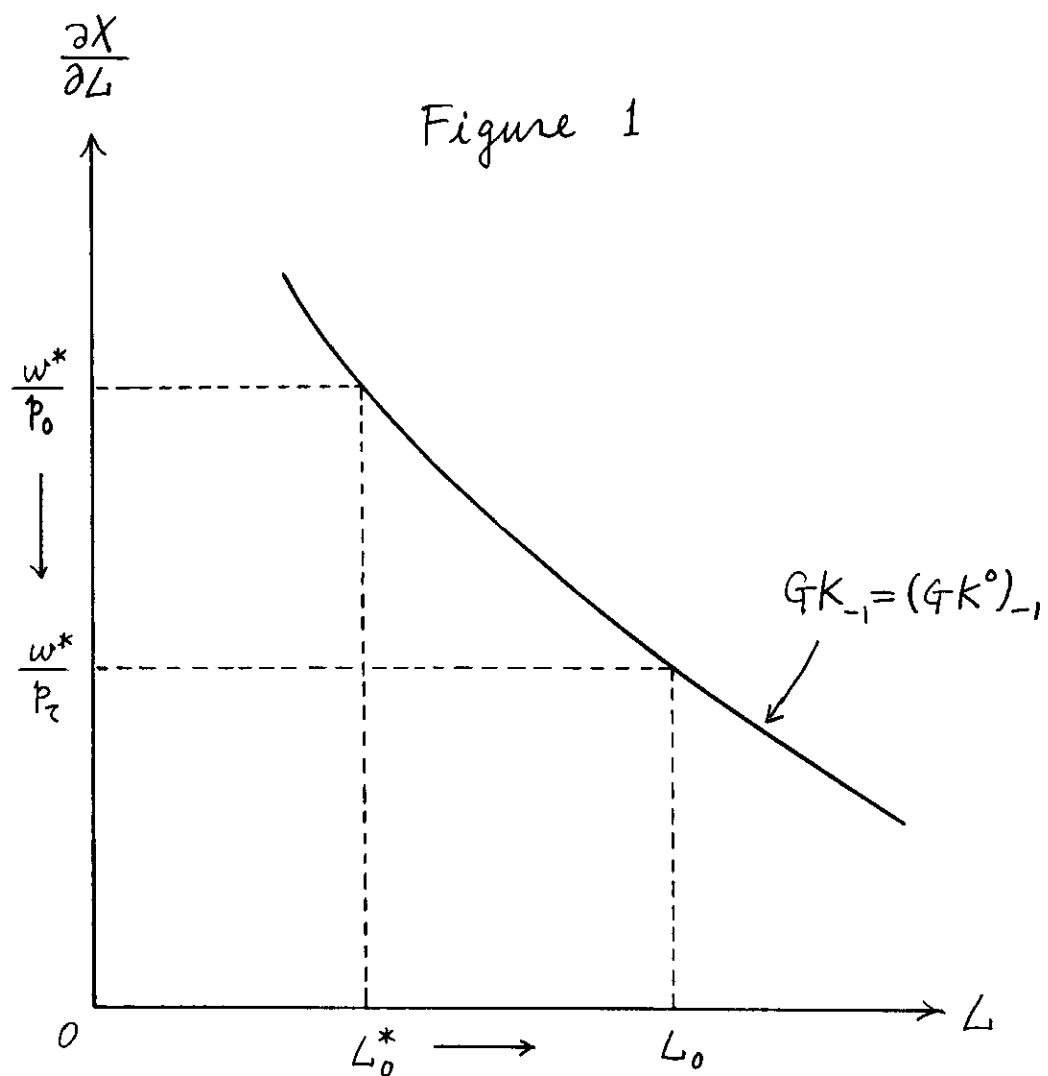
$$(6) \quad \rho = \frac{D^* + U}{X^*} .$$

In equation (5), lagged inventory investment is included in order to allow for a dynamic adjustment process of either the stock adjustment or distributed lag type. As will be seen later in equation (7-4), the estimate for a_2 tells us that the average period of the adjustment is about one year.

It is further assumed that the existence of passive investment in inventories in the current period will cause a decline in the price of output for the next period and later on. Two basic price formation equations are set up at the present stage: one for the price of consumer goods and one for wholesale prices. Other prices are assumed to be dependent on wholesale prices or to be exogenously determined outside of the model, so that the average price of final products, is virtually determined by these two price formation equations.

To explain this process graphically, let us put labor employment (manhours) on a horizontal axis and the marginal productivity of labor on a vertical axis in Figure 1. If the money wage rate and the price of output for the current period are w^* and p_0 respectively, then the real wage rate is w^*/p_0 and consequently the desired labor employment L_0^* , which is derived as a solution from equations (1) and (2). Given L_0^* , the desired level of output X_0^* is determined, as per equation (3). If, however, the actual demand for output D_0^* were greater than the desired level of output X_0^* and if not all of the gap between X_0^* and D_0^* were held in the form of passive disinvestment in inventories, then the actual labor input for the current period would be:

$$(7) \quad L_0 = g(X_0, GK_{-1}^0, t_0) > L_0^*,$$



where the function g is the inverse of the function f in equation (1), and

$$X_0 = D_0^* + U_0,$$

where U_0 is the passive investment in inventories, and should be negative in this case.

For the actual level of output and labor employment to be in the equilibrium position, the real wage rate should be w^*/p_τ ; with the money wage rate fixed, the price of output would, other things being unchanged, have to rise to p_τ .⁴ This adjustment process is assumed to start in the next period and go on for τ unit periods. This process is, in this study, dealt with in combination of passive investment equation and price formation equations. The price formation equations for the price of consumer goods p_c and for wholesale prices p_w are as follows:

$$(8) \quad \Delta p_c = k_c [h_c(U_{-1}, U_{-2}, w^*) - p_{c-1}],$$

$$(9) \quad \Delta p_w = k_w [h_w(U_{-1}, U_{-2}, \Delta i_d) - p_{w-1}],$$

where k_c and k_w are the reaction-coefficients; functions h_c and h_w express desired prices; and Δi_d is the rate of change of the interest rate on discounts. The actual estimates obtained for k_c and k_w imply that the average period of adjustment is about 15 months for the price of consumer goods and 25 months for wholesale prices. The prices for fixed investment goods p_i and for inventories p_j are simply dependent on wholesale prices; that is,

$$(10) \quad p_i = h_i(p_w, w^*, i_L),$$

$$(11) \quad p_j = k_j h_j(p_w) - p_{j-1},$$

where i_L is average interest rate on loans. The average period of adjustment for the price for inventories turns out to be about 10 months. Since the price p in Figure 1 or in equation (3) is a combination of the prices for all GNP components, all of the prices determined above, must be combined with other prices would be assumed to be exogenously determined in order to calculate p , a GNP implicit price deflator.

B) Market for Money

In this model, money includes the cash currency issued both by the Bank of Japan and by the government; post transfer savings to the government; and the deposit currency of private financial intermediaries. The supply of cash currency by the Bank of Japan is, in principle, dependent on the sum of the demands for money by all sectors, but an alternative case, in which the supply is controlled through monetary policies such as operation (not open market), discount business, direct guidance to city banks and so forth, is also examined.

The supply of post transfer savings and deposit currency may also be dependent on the demand for them, and consequently, on the economic activities of individuals, incorporated businesses and general government. Total effective supply of money M^S can be defined as below:

$$(12) \quad M^S = (CAS_n^- + CAS_g^- - CAS_b^+) + (CDG_n^- + CSD_b^- + PTS_g^-)$$

where CAS_n^- , CAS_g^- and CAS_b^- are cash currency issued by the Bank of Japan and the Government and cash holdings of private financial intermediaries respectively, and CDG_n^- , CSD_b^- and PTS_g^- are the government's deposit currency set in the Bank of Japan, deposit currency of individuals, incorporated businesses and the Government set in the private financial intermediaries, and post transfer savings respectively.⁵

Total demand for money is equal to the sum of the sectors' demands. The real demand for money by individuals is a function of the real disposable income and the trade-credit received.⁶ The demand for money by incorporated businesses depends partly on the level of real business activities, but they may have excess or undesired money which would, other things being unchanged, be swept away during the next few periods. The government's demand for money is assumed to be exogenous. Thus, the sum of the sectors' demands for money M^d can be written as

$$(13) \quad M^d = MON_h^+ + MON_c^+ + MON_g^+$$

where MON_h^+ , MON_c^+ and MON_g^+ are the money holdings of individuals, incorporated businesses and the government.

Using equations (12) and (13), the equilibrium condition for the market for money is:

$$M^s = M^d, \quad \text{or}$$

$$(14) \quad (CAS_n^- + CAS_g^- - CAS_b^+) + (CDG_n^- + CSD_b^- + PTS_g^-) = MON_h^+ + MON_c^+ + MON_g^+.$$

In equation (14), since all the terms except for MON_g^+ on the right-hand

side are determined by the corresponding demand behavior for each, and since GSD_b^- and PTS_g^- are determined elsewhere and CAS_g^- , CDG_g^- and MON_g^+ are assumed to be exogenous, this equation determines the amount of cash currency issued by the Bank of Japan, or alternatively, cash holdings of private financial intermediaries when the supply of cash currency is an exogenous variable (to be controlled by the monetary authority).⁷ In the latter case, an increase in the supply of cash currency leads to an increase in the cash holdings of private financial intermediaries, loans to individuals by private financial intermediaries, the trade-credit received of individuals, and consequently in consumption expenditures, investment in dwellings, investment of unincorporated businesses in plant and equipment and so forth. On the other hand, the adjustment of private financial intermediaries to changes in their asset-debt structure will lead to changes in the demand for securities, which will give rise to changes in the securities holdings of individuals through changes in stock prices.

C) Market for Securities

In the postwar Japanese economy, the market for securities seems to be imperfectly competitive, particularly in their circulation. Even in the stock market, the large portion of transactions of the ready issued stock appears to be covered by the 'securities investment trust' companies, particularly during the periods of 1960-61. Moreover, as the interest rates on loans and discounts and the prices for public bonds, bank debentures and industrial bonds are strongly controlled or directly fixed by the monetary authorities or the government, they do not serve as equilibrators in the markets for money and securities. Considering these factors, stock prices

were chosen as an equilibrator of the demand for and supply of securities and consequently money.⁸

The demand for securities is composed of the sum of the demands for government bonds, local government securities, and public corporation bonds; industrial bonds and stocks; bank debentures; stocks issued by private financial intermediaries; and securities investment trust, so that the demand for a bundle of these various types of securities by sector is dealt with. Thus, the total demand for securities SEC^d is:

$$(15) \quad SEC^d = SEC_h^+ + SEC_c^+ + SEC_b^+ + SEC_n^+ + SEC_g^+,$$

where the subscripts h , c , b , n and g indicate the sectors of Individuals, Incorporated Businesses, Private Financial Intermediaries, the Bank of Japan and the General Government respectively, and the superscripts (+) express the debit-side. The first three terms on the right-hand side are assumed to be endogenously determined.

The supply of securities consists of those listed above, among which the first two (government bonds, local government securities, and public corporation bonds; and industrial bonds and stocks) are assumed to be endogenous. The equilibrium condition of the market for securities can be written as

$$(16) \quad SEC^d = SEC^s$$

The endogenous stock price, as an equilibrator between the demand for and supply of securities, has a very important role for the workability of the model as a whole. For instance, buying operations by the Bank of Japan

(which are oriented to the particular main city banks rather than open market in nature) reduce the securities holdings of private financial intermediaries and lead to an increase in the cash holdings of that sector, which gives rise to increases of deposit currency, stock prices and consequently the supply of industrial bonds and stocks, which in turn leads to increases in the excess money of incorporated businesses, in the trade-credit granted to individuals, in consumption expenditures, in investment in dwellings, and so on....

D) Market for Labor

In order to avoid the complexities involved in wage determination, the money wage rate is assumed to be exogenously determined outside of this model. Labor employment is assumed to be determined by the actual output level, which is the sum of final demands ($D^* + U$), with the gross stock in fixed capital at the beginning-of-period taken as given. This implies that although the demand curve for labor coincides with the marginal productivity curve of labor, the real wage rate is not necessarily equal to the actual marginal productivity of labor for the current period, since prices do not adjust instantaneously as do the demand for and supply of labor.

III. Empirical Results

The observation period is from the first-half of 1955 through the latter-half of 1965. The unit time period is a half-year, so that the sample size is only 24. The reason for this is, as will be shown in Appendix on data, that i) this observation period lies in rather normal situations of the postwar Japanese economy, ii) comparatively reliable flow-of-funds

data is available during this period, and iii) the quarterly flow-of-funds data does not cover all of the financial transactions, particularly of private financial intermediaries, until after 1963.

For this reason, ordinary least square methods were used in estimating all of the equations. Since the production function used is of the CES-type, a sort of the 'steepest ascending' method of non-linear parameter estimation was used.⁹ Seasonal adjustment has not been applied to all data and, instead, a seasonal dummy variable was introduced. In principle, the final selection of the estimated equations is based on a 10 percent significance level for structural parameter estimates and a 5 per cent significance level for serial correlation of the disturbances. Needless to say, the final selection of equations was not automatically based on this criteria.

In the notation below, a small circle before the exposition for a variable indicates an exogenous variable and an asterisk (*), an endogenous variable which was eventually assumed to be exogenous in calculating the impact multipliers. The first of the three figures in front of each equation indicates a sector; the second, debit-side (-1-) and credit-side (-2-) on the accounts for each sector; and the third, the number of the equation in a numerical ordering by sector. Figures in parentheses under the estimated coefficients are the standard deviations of the estimates; \bar{R}^2 is the coefficient of determination adjusted to the degree of freedom; \bar{S} , the standard error of the regression estimates; and d , the Durbin-Watson statistic.

III.1. Alphabetical Listing of Variables

- A = Corporate tax-rate on higher income from private corporations
- B = Tax-rate on dividends
- BF_b^- = Issue amount of bank debentures
- BS_c^- = Issue amount of industrial bonds and stocks
- C = Consumption expenditures
- CAS_b^+ = Cash currency holdings in Private Financial Intermediaries
- CAS_c^+ = Cash currency holdings in Incorporated Businesses
- CAS_g^+ = Cash currency holdings in General Government
- CAS_g^- = Issue amount of subsidiary coins
- CAS_h^+ = Cash currency holdings in Individuals
- CDG_g^+ = Government current deposits to the Bank of Japan
- CDG_n^- = Government current deposits to the Bank of Japan
- C_g = Current expenditures on goods and services by Government
- CND_b^+ = Current deposits of Private Financial Intermediaries to the Bank of Japan
- CND_n^- = Current deposits to the Bank of Japan
- CSD_b^- = Current deposits to Private Financial Intermediaries
- CSD_c^+ = Current deposits of Incorporated Businesses to Private Financial Intermediaries
- CSD_g^+ = Current deposits of Government to Private Financial Intermediaries
- CSD_h^+ = Current deposits of Individuals to Private Financial Intermediaries
- DIV = Dividends received by Individuals
- d_1 = A dummy variable (= 0 before the former half of 1961, and = 1 after the latter half of 1961)

- d_2 = A dummy variable (= 1 between the former half of 1961 and that of 1964, and = 0 for the other periods)
- CAS_n^- = Issue amount of the Bank Notes
- d_3 = A dummy variable (= 1 for the period under the tight money policies and = 0 for the others)
- DEP_c^1 = Provisions for the consumption of fixed capital in Incorporated Businesses
- DEP_c^2 = Provisions for the consumption of dwellings in Incorporated Businesses
- DEP_g = Provisions for the consumption of fixed capital in General Government
- DEP_h^1 = Provisions for the consumption of fixed capital in unincorporated businesses
- DEP_h^2 = Provisions for the consumption of dwellings in Individuals
- DT_b^- = Time and savings deposits (including insurance and trust) to Private Financial Intermediaries
- DT_c^+ = Time and savings deposits (including trust) of Incorporated Businesses to Private Financial Intermediaries
- DT_g^+ = Time and savings deposits (including trust) of General Government to Private Financial Intermediaries
- DT_h^+ = Time and savings deposits (including insurance and trust) of Individuals to Private Financial Intermediaries
- EXP = Exports of goods and services and factor income received from abroad
- $FCRE_f^-$ = Foreign claims
- $FCRE_g^+$ = Foreign claims of General Government
- $FDEB_f^+$ = Foreign debts
- $FDEB_g^-$ = Foreign debts of General Government
- FINC = New supply of industrial funds from Private Financial Intermediaries
- FING = New supply of industrial funds from Government Financial Institutions

- \overline{FM}_f = Gold and foreign exchange reserves: Sector-balancing variable
 FM_g^+ = Gold and foreign exchange reserves held by General Government
 GK = Gross stock in fixed capital of private sectors at the end of period
 (in constant prices)
 GNP = Gross national product
 GNP* = Potential supply of final products
 GNE* = Potential demand for final products
 \overline{h} = Average labor hours per person for six months
 H_c = Inventories in Incorporated Businesses
 H_c^* = Desired level of Inventories in Incorporated Businesses
 I_c = Investment in plants and equipments by Incorporated Businesses
 i_d = Average interest rate on discounts of all banks
 I_g = Gross fixed capital formation in General Government
 I_h = Investment of unincorporated businesses in plants and equipments
 i_L = Average interest rate on loans of all banks
 i_m = A dummy variable (=1 for the periods of high ratio of deposit for
 imports, and = 0 for the other periods)
 \overline{IB}_b = Issue amount of securities investment trust
 IH_c = Investment of Incorporated Businesses in dwellings
 IH_h = Investment of Individuals in dwellings
 IMP = Imports of goods and services and factor income paid abroad
 ITAX = Indirect taxes
 J_c = Investment of Incorporated Businesses in inventories

- J_c^* = Intended Investment of Incorporated Businesses in inventories
 J_g = Investment of General Government in inventories
 J_h = Investment of unincorporated businesses in inventories
 K_c = Fixed capital stock in Incorporated Businesses at the end of period
 K_h = Fixed capital stock in unincorporated businesses at the end of period
 KH_c = Individual stock in dwellings
 L = Number of employees (million persons)
 LO_b^+ = Loans by Private Financial Intermediaries
 LO_c^- = Borrowings of Incorporated Businesses from Private Financial Intermediaries
 LO_h^- = Borrowings of Individuals from Private Financial Intermediaries
 LOG_c^- = Borrowing of Incorporated Businesses from Government Financial Institutions
 LOG_g^+ = Loans by Government Financial Institutions
 LOG_h^- = Borrowings of Individuals from Government Financial Institutions
 LON_b^- = Borrowings of Private Financial Intermediaries from the Bank of Japan
 LON_n^+ = Loans by the Bank of Japan
 M_c^* = Excess money balance in Incorporated Businesses
 MDT_c^+ = Money and time and savings deposits of Incorporated Businesses: Sector-balancing variable
 MON_c^+ = Money holdings (cash, currency, current deposits, ordinary deposits, special deposits, and checks and bills) of Incorporated Businesses
 MON_g^+ = Money holdings of General Government
 MON_h^+ = Money holdings of Individuals

Ope = Operations (buy) by the Bank of Japan

OT_b^- = Other debts of Private Financial Intermediaries

OT_c^- = Other debts of Incorporated Businesses

OT_f^- = Other debts of the Rest of the World

OT_g^+ = Other assets of General Government

OT_h^+ = Other assets of Individuals

OT_n^- = Other debts of the Bank of Japan

p = GNP implicit price-deflator (1960 = 1.00)

p_c = Implicit price-deflator for consumers' goods (1960 = 1.00)

p_{cg} = Implicit price-deflator for government current expenditures (1960 = 1.00)

p_e = Implicit price-deflator for exports (1960 = 1.00)

p_h = Implicit price-deflator for investment in dwellings (1960 = 1.00)

p_i = Implicit price-deflator for investment in plants and equipments
(1960 = 1.00)

p_{ig} = Implicit price-deflator for fixed investment by Government (1960 = 1.00)

p_j = Implicit price-deflator for inventories (1960 = 1.00)

p_j^* = Implicit price-deflator for investment in inventories (= $1/2(p_j + p_{j-1})$),
(1960 = 1.00)

p_{jg} = Implicit price-deflator for investment in inventories by Government
(1960 = 1.00)

p_m = Implicit price-deflator for imports (1960 = 1.00)

p_s = Index of Tokyo Stock Exchange's stock price average (including 225
issues listed on T.S.E. First Section)

p_w = Whole-sale price index (1960 = 1.00)

- PB_g^- = Issue amount of government bonds, local government securities and public corporation bonds
- PS_g^- = Postal savings (including post-office life insurance and postal annuity)
- PS_h^+ = Postal savings of Individuals
- PTS_g^- = Post transfer savings
- PTS_h^+ = Post transfer savings of Individuals
- Q = A seasonal dummy variable (= 0 for the former half-year and = 1 for the latter)
- R_c = Net savings of Incorporated Businesses
- R_c^* = Net savings available for investment in plants and equipments of Incorporated Businesses
- REP = Replacement of gross stock in fixed capital in unincorporated and incorporated businesses
- R_g = Interest on the public debt
- R_h = Interest on consumers' debt
- SB_b^+ = Short-term government securities held by Private Financial Intermediaries
- SB_g^+ = Short-term government securities held by Government Financial Institutions
- SB_g^- = Issue amount of short-term government securities
- SB_h^+ = Short-term government securities held by the Bank of Japan
- SEC_b^+ = Securities holdings of Private Financial Intermediaries (including government bonds, local government securities, public corporation bonds, bank debentures, industrial bonds, stocks, and securities investment trust): Sector-balancing variable
- SEC_c^+ = Securities holdings of Incorporated Businesses
- SEC_g^+ = Securities holdings of Government Financial Institutions

- SEC_h^+ = Securities holdings of Individuals
 SEC_n^+ = Securities holdings of the Bank of Japan
 SGAP = Statistical discrepancy
 SI_h = Social insurance contributions of Individuals
 ST_b^- = Amount of stocks issued by Private Financial Intermediaries
 SUB_g = Current subsidies
 t = Time-trend variable
 TAS_c = Total assets in Incorporated Businesses
 TAX_c = Direct taxes and charges on Private Corporations
 TAX_h = Direct taxes and charges on households and non-profit institutions
 TAX_h^* = The accumulated sum of tax-reductions in the past
 TCR_c^+ = Trade credit granted by Incorporated Businesses
 TCR_c^- = Trade credit received by Incorporated Businesses
 TCR_h^- = Trade credit received by Individuals
 TR_{ch} = Transfers from Incorporated Businesses to Individuals
 TR_{fg} = Transfers from abroad to General Government
 TR_{fh} = Current transfers from abroad to persons
 TR_{gf} = Current transfers from government to abroad
 TR_{gh} = Transfers from government to Individuals
 TR_{hf} = Transfers from Individuals to abroad

TR_{hg} = Transfers from Individuals to government

U = Unintended investment in inventories

V_c = Net sales of Incorporated Businesses

w^* = Wage rate for six months-one million persons (in billion Yen)

Y_c = Income from private corporations

Y_d = Disposable income of persons

Y_g = Income of General Government from property and entrepreneurship

Y_p = Income from unincorporated businesses

Y_r = Income of persons from property

Y_w = Compensation of employees

III.2. Empirical Results

(1) Individuals and Unincorporated Businesses

(1-1-1) Consumption Expenditures

$$\frac{C}{P_c} = 745.48 + 0.7424 \left(\frac{Y_d}{P_c} \right) + 0.2573 \left(\frac{\Delta TCR_h^- + \Delta LO_h^-}{P_c} \right) + 701.44Q_{-1} \quad (61.77)$$

(0.0228) (0.1752)

$$\bar{R}^2 = 0.990 \quad \bar{S} = 122.63 \quad d = 2.955$$

(1-1-2) Direct Taxes and Charges

$$TAX_h + TAX_h^* = -170.26 + 0.0896 (Y_w) + 0.1352 \sum (Y_p + Y_r) + 40.84Q_{-1} \quad (29.90)$$

(0.0451) -1 (0.0408) 0

$$\bar{R}^2 = 0.991 \quad \bar{S} = 35.32 \quad d = 0.840$$

(1-1-3) Investment of Unincorporated Businesses in Plants and Equipments

$$\frac{I_h}{P_i} = -62.02 + 0.0397 \left(\frac{Y_d}{P_i} \right)_{-1} + 0.0770 \frac{\Delta TCR_h^- + \Delta LO_h^- + \Delta LOG_h^-}{P_i} + 81.73Q \quad (8.94)$$

$$\bar{R}^2 = 0.965 \quad \bar{S} = 19.04 \quad d = 2.586$$

(1-1-4) Investment in Dwellings

$$\frac{IH_h}{P_h} = -197.05 + 0.0997 \left(\frac{Y_d}{P_h} \right) + 0.0309 \left(\frac{\Delta TCR_h^- + \Delta LO_h^- + \Delta LOG_h^-}{P_h} \right)_{-1} - 118.15Q \quad (10.44)$$

$$\bar{R}^2 = 0.981 \quad \bar{S} = 19.41 \quad d = 1.079$$

(1-1-5) Money Holdings

$$\frac{MON_h^+}{P_c} = -120.75 + 0.4289 \left(\frac{Y_d}{P_c} \right) + 0.3057 \left(\frac{TCR_h^-}{P_c} \right)_{-1} - 349.87Q \quad (96.15)$$

$$\bar{R}^2 = 0.991 \quad \bar{S} = 97.07 \quad d = 1.750$$

(1-1-6) Cash Currency Holdings

$$CAS_h^+ = 52.40 + 0.3092 MON_h^+ + 62.65Q \quad (0.0055) \quad (15.00)$$

$$\bar{R}^2 = 0.994 \quad \bar{S} = 34.50 \quad d = 1.262$$

(1-1-7) Deposit Currency Holdings

$$\frac{CSD_h^+}{P_c} = 347.31 + 0.2556 \left(\frac{Y_d - C}{P_c} \right) + 0.6724 \left(\frac{TCR_h^-}{P_c} \right)_{-1} - 0.0920 \left(\frac{P_s}{P_c} \right) - 68.99Q \quad (0.1220) \quad (0.0577) \quad (0.0821) \quad (141.50)$$

$$\bar{R}^2 = 0.984 \quad \bar{S} = 94.97 \quad d = 1.617$$

(1-1-8) Postal Transfer Savings

$$\Delta PTS_h^+ = \Delta MON_h^+ - \Delta(CAS_h^+ + CSD_h^+)$$

(1-1-9) Time and Savings Deposit (including Trust and Life-Insurance)

$$\frac{\Delta DT_h^+}{P_c} = -234.465 + 0.1836 \left(\frac{Y_d}{P_c} \right) - 0.1328 \left(\frac{P_s}{P_c} \right) - 0.0137 \left(\frac{DT_h^+}{P_c} \right)_{-1} - 112.856 Q \quad (84.896)$$

$$R^2 = 0.938 \quad \bar{S} = 72.41 \quad d = 2.303$$

(1-1-10) Postal Savings and Post-Office Life-Insurance and Postal Annuity

$$\frac{\Delta PS_h^+}{P_c} = -2.6653 + 0.0269 \left(\frac{Y_d}{P_c} \right) - 0.0035 \left(\frac{PS_h^+}{P_c} \right)_{-1} - 3.0093 Q \quad (16.279)$$

$$R^2 = 0.914 \quad \bar{S} = 15.63 \quad d = 2.306$$

(1-1-11) Securities Holdings

$$\frac{SEC_h^+}{P_c} = -373.325 + 0.1806 \left(\frac{Y_d}{P_c} \right) + 0.4525 \left(\frac{P_s}{P_c} \right) + 0.5196 \left(\frac{SEC_h^+}{P_c} \right)_{-1}$$

$$R^2 = 0.930 \quad \bar{S} = 277.70 \quad d = 2.561$$

(1-2-1) Compensation of Employees

$$Y_w = hL \cdot w^*$$

(1-2-2) Income from Unincorporated Businesses

$$Y_p = 217.92 + 0.1469 GNP + 782.75 Q \quad (0.0077) \quad (57.63)$$

$$R^2 = 0.975 \quad \bar{S} = 130.56 \quad d = 2.774$$

(1-2-3) Income from Property (excluding Dividends)

$$(Y_r - \text{DIV}) = 17.40 + 0.0170 \sum_1^1 (\text{SEC}_h^+) + 0.0291 \sum_1^1 (\text{DT}_h^+ + \text{PS}_h^+)$$

$$(0.0053)0 \quad -j \quad (0.0015)0 \quad -j$$

$$R^2 = 0.999 \quad \bar{S} = 10.44 \quad d = 0.769$$

(1-2-4) Provisions for the Consumption of Fixed Capital in Unincorporated Businesses

$$\text{DEP}_h^1 = -923.14 + 0.2205 (K_h) - 131.10 i_L + 121.43 Q$$

$$(0.0211) \quad -1 \quad (57.87) \quad (8.17)$$

$$R^2 = 0.968 \quad \bar{S} = 18.83 \quad d = 3.316$$

(1-2-5) Changes in Trade-Credit Net Received

$$\Delta \text{TCR}_h^- = \Delta \text{TCR}_c^+ - \Delta \text{TCR}_c^-$$

(1-2-6) Borrowings from Private Financial Institutions

$$\Delta \text{LO}_h^- = \Delta \text{LO}_b^+ - \Delta \text{LO}_c^-$$

(1-2-7) Changes in Other Assets: Sector-Balancing Variable

$$\Delta \text{OT}_h^+ = (Y_d + \text{DEP}_h^1 + \text{DEP}_h^2 + \Delta \text{TCR}_h^- + \Delta \text{LO}_h^- + \Delta \text{LOG}_h^-) - (C + I_h + \text{IH}_h$$

$$+ J_h + \Delta \text{CAS}_h^+ + \Delta \text{CSD}_h^+ + \Delta \text{PTS}_h^+ + \Delta \text{DT}_h^+ + \Delta \text{PS}_h^+ + \Delta \text{SEC}_h^+)$$

(1-2-8) Disposable Income of Persons

$$Y_d = (Y_w + Y_p + Y_r + \text{TR}_{ch} + \text{TR}_{gh} + \text{TR}_{fh} - R_h) - (\text{TAX}_h + \text{SI}_h + \text{TR}_{hg} + \text{TR}_{hf})$$

(2) Corporate Businesses

(2-1-1) Direct Taxes and Charges on Private Corporations

$$\text{TAX}_c = 608.59 + 0.2940 \frac{2}{(0.0340)} A(\sum_{c-j}^2 - d_1 \sum_{-j}^2 \text{DIV}_{-j}) + 0.7386 \frac{2}{(0.1346)} B \sum_{-j}^2 \text{DIV}_{-j} - 246.65 i_L - 14.69 Q$$

$$(73.74) \quad (8.18)$$

$$R^2 = 0.990 \quad \bar{S} = 19.01 \quad d = 1.412$$

(2-1-2) Dividends to Persons

$$\text{DIV} = 5.16 + 0.0415 Y_c + 0.7824 \text{DIV}_{-1} - 12.62 Q$$

$$(0.0087) \quad (0.0530) \quad (2.53)$$

$$R^2 = 0.994 \quad \bar{S} = 5.53 \quad d = 2.403$$

(2-1-3) Investment in Plants and Equipments

$$\frac{I_c}{P_i} = -10.62 + 0.2156 \left(\frac{R_c^* + \text{DEP}_c^1}{P_i} \right)_{-1} + 0.0992 \Delta \left(\frac{V_c}{P_w} \right) + 0.6929 \left(\frac{I_c}{P_i} \right)_{-1} + 222.99 Q$$

$$(0.1175) \quad (0.0301) \quad (48.79)$$

$$R^2 = 0.970 \quad \bar{S} = 113.08 \quad d = 1.906$$

(2-1-4) Investment in Inventories

$$\text{a) } \frac{J_c}{P_j^*} = \frac{J_c^*}{P_j^*} + U, \quad \text{b) } \frac{J_c^*}{P_j^*} = \frac{H_c^*}{P_j} - \left(\frac{H_c}{P_j} \right)_{-1}, \quad \text{c) } \frac{H_c}{P_j} = \frac{J_c}{P_j^*} + \left(\frac{H_c}{P_j} \right)_{-1}$$

(2-1-5) Normal (or Desired) Level of Inventories

$$\frac{H_c^*}{P_j} = 0.30871 e^{-0.0177t} \left(\frac{V_c}{P_w} \right)$$

(2-1-6) Holdings of Cash Currency

$$\text{CAS}_c^+ = \text{MON}_c^+ - \text{CSD}_c^+$$

(2-1-7) Deposit Currency Holdings

$$CSD_c^+ = -176.56 + 0.9499 \text{ MON}_c^+ + 6.3657 \left(\frac{V_c}{Y_c} \right)$$

(0.0054) (2.7695)

$$R^2 = 0.999 \quad \bar{S} = 32.44 \quad d = 1.918$$

(2-1-8) Changes in Time and Savings Deposits

$$\Delta DT_c^+ = -15.60 + 0.1334 \Delta MDT_c^+ + 0.1282 \sum_{j=0}^1 \Delta LO_{c-j}^-$$

(0.0374) (0.0168)

$$R^2 = 0.922 \quad \bar{S} = 58.28 \quad d = 2.068$$

(2-1-9) Changes in Money Holdings

$$\Delta MON_c^+ = \Delta MDT_c^+ - \Delta DT_c^+$$

(2-1-10) Securities Holdings

$$SEC_c^+ = -20.15 + 0.1372 (R_c^* + DEP_c^1 + DEP_c^2) + 0.0468 P_s + 0.9667 (SEC_c^+)$$

(0.0597) -1 (0.0369) s (0.0391) -1

$$R^2 = 0.998 \quad \bar{S} = 44.10 \quad d = 2.043$$

(2-1-11) Trade Credit Granted

$$TCR_c^+ = 219.04 + 0.3355 \Delta V_c + 1.0019 (TCR_c^+)$$

(0.1172) (0.0224) -1

$$R^2 = 0.993 \quad \bar{S} = 482.84 \quad d = 1.851$$

(2-2-1) Income from Private Corporations

$$Y_c = (\text{GNP} - \text{ITAX} + \text{SUB}_g - \text{DEP}_h^1 - \text{DEP}_h^2 - \text{DEP}_c^1 - \text{DEP}_c^2 - \text{SGAP})$$

$$- (Y_w + Y_p + Y_r - \text{DIV} + Y_g - R_g - R_h)$$

(2-2-2) Net Savings

$$R_c = Y_c - (\text{DIV} + \text{TAX}_c + \text{TR}_{ch})$$

(2-2-3) Net Savings, available for Investment in Plants and Equipments

$$R_c^* = R_c - \frac{1}{2} (P_j + P_{j-1})U$$

(2-2-4) Provisions for the Consumption of Fixed Capital

$$\text{DEP}_c^1 = -286.13 + 0.0748 Y_c + 0.0483 (K_c) + 86.09 d_2 + 22.92 Q$$

(0.0302) (0.0037) -1 (9.63) 2 (8.49)

$$R^2 = 0.998 \quad \bar{S} = 19.20 \quad d = 2.165$$

(2-2-5) Provisions for the Consumption of Dwellings

$$\text{DEP}_c^2 = -2.04 + 0.0204 [KH_c + (KH_c)_{-1}]$$

(0.0005)

$$R^2 = 0.989 \quad \bar{S} = 1.15 \quad d = 2.500$$

(2-2-6) Changes in Issue of Industrial Bonds and Stocks

$$\Delta \text{BS}_c^- = -87.97 + 0.3393 (I_c - \text{FINC} - \text{FING}) - 0.1060 (\text{DT}_c^+ + \text{SEC}_c^+ - 0.2563 \text{LO}_c^-)$$

(0.0950) (0.0230) -1

$$+ 0.4544 (P_s / i_L)$$

(0.1781)

$$R^2 = 0.877 \quad \bar{S} = 67.89 \quad d = 2.569$$

(2-2-7) Changes in Trade Credit Received

$$\Delta \text{TCR}_c^- = 3425.37 + 1.3356 J_c - 1216.90 \Delta i_d - 0.0165 (\text{TCR}_c^-) - 0.6718 (M_c^*)$$

(0.4707) (1265.87) (0.0260) -1 (0.2794) -1

$$- 1373.73 i_d - 117.78 Q$$

(1044.90) (142.29)

$$R^2 = 0.676 \quad \bar{S} = 313.79 \quad d = 1.355$$

(2-2-8) Changes in Borrowings from Private Financial Institutions

$$\begin{aligned} \Delta LO_c^- &= -1574.88 + 0.3103 I_c - 0.2558 d_3(I_c + J_c) - 0.4482 (LO_c^-)_{-1} \\ &\quad (0.1870) \quad (0.0680) \quad (0.1652) \\ &\quad + 0.2100 (TAS_c) + 304.14 Q \\ &\quad (0.0688) \quad -1 \quad (91.99) \\ R^2 &= 0.928 \quad \bar{S} = 199.54 \quad d = 2.399 \end{aligned}$$

(2-2-9) New Supply of Industrial Funds from Private Financial Institutions

$$\begin{aligned} FINC &= 1.5288 + 0.1499 \Delta LO_c^- + 0.5654 (FINC)_{-1} \\ &\quad (0.0185) \quad (0.0638) \\ R^2 &= 0.972 \quad \bar{S} = 34.59 \quad d = 2.568 \end{aligned}$$

(2-2-10) Changes in Money and Time and Savings Deposits: Sector-Balancing Variable

$$\begin{aligned} \Delta MDT_c^+ &= (Y_c + DEP_c^1 + DEP_c^2 + \Delta BS_c^- + \Delta TCR_c^- + \Delta LO_c^- + \Delta LOG_c^- + \Delta OT_c^-) \\ &\quad - (TAX_c + DIV + TR_{ch} + I_c + IH_c + J_c + \Delta SEC_c^+ + \Delta TCR_c^+) \end{aligned}$$

(2-2-11) Total Assets

$$TAS_c = K_c + KH_c + H_c + CAS_c^+ + GSD_c^+ + DT_c^+ + SEC_c^+ + TCR_c^+$$

(2-2-12) Excess Money Balance

$$M_c^* = MON_c^+ - \begin{bmatrix} 0.1114 \\ 0.1176 \end{bmatrix} V_c$$

(3) Private Financial Institutions

(3-1-1) Cash Currency Holdings

$$\begin{aligned} CAS_b^+ &= -6.25 + 0.0165 (CSD_b^- + DT_b^-) + 22.80 Q \\ &\quad (0.0006) \quad (9.69) \\ R^2 &= 0.973 \quad \bar{S} = 22.60 \quad d = 1.621 \end{aligned}$$

(3-1-2) Changes in Short-Term Government Securities

$$\Delta SB_b^+ = \Delta SB_g^- - (\Delta SB_n^+ + \Delta SB_g^+)$$

(3-1-3) Changes in Loans

$$\Delta LO_b^+ = 712.33 + 0.6159 \Delta LON_b^- + 0.7609 \Delta (CSD_b^- + DT_b^- + BF_b^-) + 1.0488 OPe$$

(0.1477) (0.0277) (0.2768)

$$- 104.66 (LO_b^+ / SEC_b^+)$$

(42.06) -1

$$R^2 = 0.989 \quad \bar{S} = 94.42 \quad d = 1.635$$

(3-1-4) Changes in Securities: Sector-Balancing Variable

$$\Delta SEC_b^+ = (\Delta CSD_b^- + \Delta DT_b^- + \Delta BF_b^- + \Delta ST_b^- + \Delta IB_b^- + \Delta LON_b^- + \Delta OT_b^-) - (\Delta CAS_b^+ + \Delta CND_b^+ + \Delta SE_b^+ + \Delta LO_b^+)$$

(3-2-1) Changes in Current Deposits

$$\Delta CSD_b^- = \Delta CSD_n^+ + \Delta CSD_c^+ + \Delta CSD_g^+$$

(3-2-2) Changes in Time and Savings Deposits

$$\Delta DT_b^- = \Delta DT_n^+ + \Delta DT_c^+ + \Delta DT_g^+$$

(4) The Bank of Japan

(4-1-1) Changes in Loans

$$\Delta LON_n^+ = \Delta LON_b^-$$

(4-2-1) Changes in Other Debts: Sector-Balancing Variable

$$\Delta OT_n^- = (\Delta SE_n^+ + \Delta SEC_n^+ + \Delta LON_n^+) - (\Delta CAS_n^- + \Delta CND_n^- + \Delta CDG_n^-)$$

(5) General Government

(5-1-1) Changes in Deposits Current

$$\frac{CSD_g^+}{P_{cg}} = 23.96 + 0.4004 \left(\frac{Y_g}{P_{cg}} \right)_{-1} + 0.1243 \left(\frac{C_g}{P_{cg}} \right)_{-1} - 61.98 Q$$

(0.1519) (0.0401) (9.13)

$$R^2 = 0.775 \quad \bar{S} = 20.98 \quad d = 2.152$$

(5-2-1) Indirect Taxes

$$ITAX = 18.81 + 0.0538 GNP_{-1} + 0.3422 ITAX_{-1} + 78.05 Q$$

(0.0172) (0.2241) (29.35)

$$R^2 = 0.977 \quad \bar{S} = 46.12 \quad d = 2.134$$

(5-2-2) Changes in Post Transfer Savings

$$\Delta PTS_g^- = \Delta PTS_h^+$$

(5-2-3) Changes in Postal Savings

$$\Delta PS_g^- = \Delta PS_h^+$$

(5-1-2) Changes in Government Bonds and Others: Sector-Balancing Variable

$$\begin{aligned} \Delta PB_g^- = & (C_g + SVE_g + TR_{gh} + TR_{gf} + I_g + J_g + \Delta CAS_g^+ + \Delta CSD_g^+ + \Delta CDG_g^+ + \Delta DT_g^+ \\ & + \Delta SB_g^+ + \Delta SEC_g^+ + \Delta LOG_g^+ + \Delta FCRE_g^+ + \Delta FM_g^+ + \Delta OT_g^+) - (TAX_h + TAX_c \\ & + ITAX + SI_h + TR_{hg} + Y_g + DEP_g - R_g + \Delta CAS_g^- + \Delta PTS_g^- + \Delta PS_g^- \\ & + \Delta SB_g^- + \Delta FDEB_g^-) \end{aligned}$$

(6) The Rest of The World

(6-2-1) Imports of Goods and Services and Factor Income Paid Abroad

$$\frac{IMP}{P_m} = -53.76 + 0.0826 \left(\frac{GNP}{P} - \frac{J}{P_j^*} \right) + 0.3527 \left(\frac{J}{P_j^*} \right) + 0.4340 \left(\frac{IMP}{P_m} \right)_{-1}$$

$$\begin{array}{cc} - 41.80 i & - 250.80 Q \\ (25.60) \text{tr} & (34.03) \end{array}$$

$$R^2 = 0.991 \quad \bar{S} = 43.92 \quad d = 2.110$$

(6-2-2) Changes in Gold and Foreign Exchanges Reserves: Sector-Balancing Variable

$$\Delta FM_f = (EXP + TR_{fh} + TR_{fg} + \Delta FDEB_f^+) - (IMP + TR_{hf} + TR_{gf} + \Delta FCRE_f^- + \Delta OT_f^-)$$

(7) The Unifying Sector

(7-1) Potential Supply of Final Products

$$\frac{GNP^*}{P} = 3854.029 e^{0.0024627t} GK_{-1} \frac{w^*}{P} 0.8183092$$

$$\cdot [0.9122997 \{ 0.424569 e^{0.013554t} / \frac{w^*}{P} \} 0.1816908 - 1] 4.5038553$$

(7-2) Production Function (determining the Number of Employees)

$$\frac{GNP}{P} = 0.246616 e^{0.013554t} [0.15006 (GK_{-1})^{-0.222032} + 0.84994 (hL)^{-0.222032}] 4.5038553$$

$$\bar{S} = 324.63 \quad F = 4.000$$

(7-3) Potential Demand for Final Products

$$GNE^* = C + I_h + J_h + IH_h + I_c + J_c^* + IH_c + C_g + I_g + J_g + EXP - IMP$$

(7-3') Gross National Products

$$GNP = GNE^* + p_j^* U$$

(7-4) Passive (Unintended) Investment in Inventories

$$U = -2574.06 + 0.140897 \left(\frac{GNP^* - GNE^*}{P} \right) + 0.53756 U_{-1} + 2558.11 P_w - 29.4207 Q$$

(0.0683) (0.1683) (827.60) (45.691)

$$R^2 = 0.611 \quad \bar{S} = 98.79 \quad d = 1.939$$

(7-5) GNP Implicit Deflator

$$GNP = p \left[\frac{C}{P_c} + \frac{I_h}{P_i} + \frac{J_b}{P_j^*} + \frac{IH_h}{P_h} + \frac{I_c}{P_i} + \frac{J_c}{P_j^*} + \frac{IH_c}{P_h} + \frac{C_g}{P_{cg}} + \frac{I_g}{P_{ig}} + \frac{J_g}{P_{jg}} + \frac{EXP}{P_e} - \frac{IMP}{P_m} \right]$$

(7-6) Net Sales in Incorporate Businesses

$$\frac{V_c}{P_w} = -10335.70 + 3.9101 \frac{GNP}{P} - 5016.80 Q$$

(0.1049) (546.15)

$$R^2 = 0.987 \quad \bar{S} = 1216.93 \quad d = 1.707$$

(7-7) Gross Stock in Fixed Capital in Private Sector

$$GK = GK_{-1} + \left(\frac{I_c + I_h}{P_i} \right) - \left(\frac{REP}{P_i} \right)$$

(7-8) Implicit Deflator for Consumers' Goods

$$P_c = 0.28507 - 0.000012 \sum_{j=1}^2 U_{-j} + 1.3302 w^* + 0.5868 P_{c-1} - 0.0208 Q$$

(0.000013) (0.5884) (0.2214) (0.0117)

$$R^2 = 0.989 \quad \bar{S} = 0.0142 \quad d = 2.872$$

(7-9) Wholesale Price

$$P_w = 0.2509 - 0.000055 \sum_{j=1}^2 U_{-j} - 0.0918 \Delta^1 d + 0.7484 P_{w-1} + 0.0044 Q$$

(0.000015) (0.0732) (0.1906) (0.0072)

$$R^2 = 0.656 \quad \bar{S} = 0.0168 \quad d = 1.560$$

(7-10) Implicit Deflator for Fixed Investment Goods

$$p_i = 1.5998 + 0.4488 p_w + 0.3815 w^* - 0.4944 i_L$$

(0.2980) (0.2452) (0.1286)

$$R^2 = 0.823 \quad \bar{S} = 0.0314 \quad d = 0.813$$

(7-11) Implicit Deflator for Inventories

$$p_j = 0.0625 + 0.4963 p_w + 0.4397 p_{j-1} - 0.0002 Q$$

(0.0961) (0.1164) (0.0044)

$$R^2 = 0.797 \quad \bar{S} = 0.010 \quad d = 0.660$$

(7-12) Implicit Deflator for Investment in Inventories

$$p_j^* = \frac{1}{2} (p_j + p_{j-1})$$

(7-13) Equality of Demand for and Supply of Money

$$(CAS_n^- + CAS_g^- - CAS_b^+) + (CSD_b^- + PTS_g^- + CDG_n^-) = MON_h^+ + MON_c^+ + MON_g^+$$

(7.14) Equality of Demand for and Supply of Securities (in terms of rate of change in stock)

$$PE_g^- + IB_b^- + BF_b^- + ST_b^- + BS_c^- = SEC_h^+ + SEC_c^+ + SEC_b^+ + SEC_n^+ + SEC_g^+$$

Other Identities

$$TCR_h^- = TCR_{h-1}^- + \Delta TCR_h^-$$

$$\Delta SEC_c^+ = SEC_c^+ - SEC_{c-1}^+$$

$$\Delta MON_h^+ = MON_h^+ - MON_{h-1}^+$$

$$DT_c^+ = DT_{c-1}^+ + \Delta DT_c^+$$

$$\Delta CAS_h^+ = CAS_h^+ - CAS_{h-1}^+$$

$$LO_c^- = LO_{c-1}^- + \Delta LO_c^-$$

$$\Delta CSD_h^+ = CSD_h^+ - CSD_{h-1}^+$$

$$TCR_c^- = TCR_{c-1}^- + \Delta TCR_c^-$$

$$\Delta SEC_h^+ = SEC_h^+ - SEC_{h-1}^+$$

$$\Delta CSD_g^+ = CSD_g^+ - CSD_{g-1}^+$$

$$DT_h^+ = DT_{h-1}^+ + \Delta DT_h^+$$

$$K_c = K_{c-1} + I_c - DEP_c^1$$

$$PS^+ + PS_{h-1}^+ + \Delta PS_h^+$$

$$CSD_b^- = CSD_{b-1}^- + \Delta CSD_b^-$$

$$K_h = K_{h-1} + I_h - DEP_h^1$$

$$DT_b^- = DT_{h-1}^- + \Delta DT_b^-$$

$$\Delta TCR_c^+ = TCR_c^+ - TCR_{c-1}^+$$

$$LO_b^+ = LO_{b-1}^+ + \Delta LO_b^+$$

$$\Delta CSD_c^+ = CSD_c^+ - CSD_{c-1}^+$$

$$SEC_b^+ = SEC_{b-1}^+ + \Delta SEC_b^+$$

$$MON_c^+ = MON_{c-1}^+ + \Delta MON_c^+$$

$$\Delta CAS_b^+ = CAS_b^+ - CAS_{b-1}^+$$

III.3. Remarks on the Empirical Results

1) Individuals Sector

The demand for consumer goods, equation (1-1-1), is assumed to be dependent on changes both in net received trade-credit and in borrowings, deflated by the price index for consumer goods, as well as on real disposable income. This implies that the consumption function includes the main sources of funds available to consumers, except for the liquid assets balance. The changes in net received trade-credit are also given an important role in the equations for investment in dwellings (1-1-4) and for investment of unincorporated businesses in plant and equipment (1-1-3).

Needless to say, if data on consumer credit were available, it would be desirable to use this instead of net received trade-credit. However, we

were unfortunately unable to decompose the changes in trade-credit into those attributed to consumers and to unincorporated businesses, and were therefore compelled to use net received trade-credit. The consumption function is a simple Keynesian type, but during the observation period it seems that the function estimated is relatively stable.

The direct taxes and charges equation (1-1-2) is also very simple. The mitigation of taxes on income has so far been done by raising the level of basic exemption without any significant alternation on tax rate structure. The introduction of a variable for the accumulated tax-exemption TAX_n^* into equation (1-1-2) is a convenient way of calculating the effect of the effective tax rate on all the endogenous variables, which will be shown later in Chapter IV. Withholding taxes on income are concentrated in January and July, because of the bonuses paid to employees in December and June. Because the self-assessed income tax and residence tax appear to have considerable lags between the time that the income is produced and the actual tax payment, a one-period lag for income from unincorporated businesses and from property is used.

The real demand for money is based on the transaction motive; real disposable income is used as a proxy variable for current expenditures including household consumption, expenditures on variable costs in the form of cash-payment by unincorporated businesses and trade-credit is introduced because of the need for some reserves for its repayment. Although it would be preferable to introduce compensation of employees, income from unincorporated businesses, and income from property as separate variables, multicollinearity problems precluded reasonable coefficient estimates for these

variables. Estimated coefficients for real disposable income and received trade-credit seem to be permissably stable.

The real demand for deposit currency, which is taken to be mostly held by unincorporated businesses, is assumed to be dependent on the ratio of stock prices to the price for consumer goods, received trade-credit, and real personal savings which is supposed to be a proxy variable for the unincorporated businesses activities. The coefficient estimate for the ratio of stock prices to the price for consumer goods does not appear to be significant, but does seem to be consistent with the estimated results for the securities holdings equation (1-1-11). Postal transfer savings is the difference between money holdings and cash plus deposit currency.

The real demand for time and savings deposits, including trust and life-insurance (1-1-9), depends on the real disposable income, the ratio of stock prices to the price of consumer goods and the beginning-of-period holdings of the real time and savings deposits. Since there was a decline in the interest rate on time and savings deposit only once (in 1961) and the subsequent reaction of time and savings deposit holders seemed to be very gradual, it is almost impossible to take into account the effect of interest rates on the demand for time and savings deposits during the period in question. The average period of the stock adjustment seems to be too long, but a proxy for the short-run restrictions, Y_d appears to explain the changes in time and savings deposits fairly well.

The real demand for postal savings and post office life-insurance and postal annuity (1-1-10) is a function of the real disposable income and the beginning-of-period holdings of the real postal savings. Since

this form of savings come from the lower income class, they could unlikely be motivated by the speculative factors in the financial markets. The coefficient estimate for the beginning-of-period holdings of postal savings is not significant, but the adjusted correlation coefficient seems to be very high.

Securities holdings, deflated by the price of consumer goods (1-1-11), is a function of real disposable income which is supposed to be a proxy for the short-run restrictions, and the ratio of stock prices to the price of consumer goods with distributed lags. The positive coefficient for this ratio could be interpreted as reflecting the use of current stock price changes to indicate future trends, so that people would buy securities expecting capital gains in the future. Indeed, since stock certificates are, in principle, issued and sold at face value and not at market value by incorporated businesses, the purchase of newly issued stock certificates implies some capital gain (equal to the difference between its face value and its market value).

The average period of adjustment is about 12 months. Consequently, a conclusion might be that there is a separation of preference between money (including cash currency, deposit currency, postal transfer savings and postal savings including post office life-insurance and postal annuity), and time and savings deposits and securities, and therefore that there probably exists a preference field specific to the latter group, in which stock prices and the price of consumer goods are considerably influential.

Compensation of employees is the product of labor.

Compensation of employees is the product of labor employment (man-hours) and the nominal wage rate; the former is determined by equation (7-2) and the latter is exogenous. Income from property (excluding dividends) (1-2-3) is assumed to depend on the financial asset holdings at the beginning-of-period and the end-of-period. Changes in net received trade-credit (1-2-5) are wholly dependent on the trade-credit business of the incorporated businesses sector, so that if liquidity availability increases in the incorporated businesses sector, trade-credit is supposed to rise for individuals. The borrowings from private financial intermediaries is treated, here, almost in the same way as trade-credit.

It might appear that almost all the sources of funds for this sector, whether real or financial and internal or external, are assumed to be determined from outside of the sector, and therefore that all of the expenditures or uses of funds by this sector are regulated from the outside. However, this does not necessarily imply that a large part of the uses of funds of this sector is exogenously determined; for instance, the demand for labor (7-2) and consequently compensation of employees (1-2-1) are simultaneously determined, depending on the effective demand for final products, a dominant component of which is consumption.

2) Incorporated Business Sector

Direct taxes and charges on private corporations (2-1-1) are dependent on corporate income. After April 1, 1961, the middle of our observation period, such taxable income was divided into two parts: dividends received and other income, with two different tax rates. Moreover, corporate income includes income assigned to legal reserves and allowances which should be

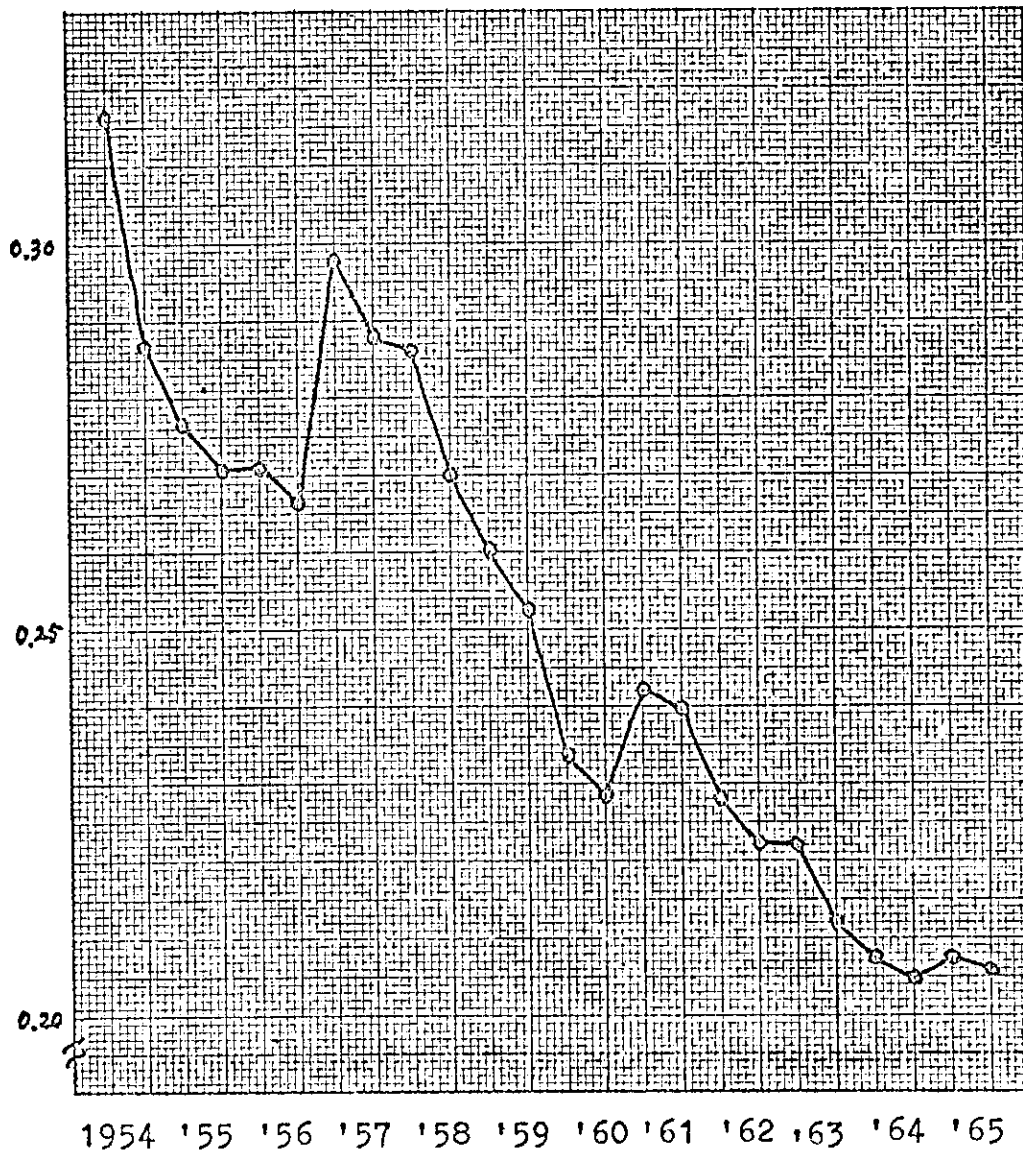
free from taxation. Since these parts are considered to fluctuate pro-cyclically, corporate income taxes would vary, other things being unchanged, in the same direction as business benefits. The estimated result seems to satisfy these requirements stated above. Two estimates for the coefficients of the products of income tax rates and incomes can be interpreted as realization rates for these two rates.¹⁰ Dividends to persons (2-1-2) is a distributed lag function of corporate income.¹¹

Real gross investment in plant and equipment, as shown in many recent empirical studies, seems to be highly correlated with profits, internal funds or real sales.¹² For the sake of simplicity, the so-called "Accelerator-Residual Funds" hypothesis is used.¹³ Gross fixed investment (2-1-3) is a function of real internal funds, changes in real sales and lagged gross fixed investment. The average period of the adjustment is about 20 months.

As equation (2-1-4a) shows, actual investment in inventories is decomposed into desired and undesired or passive investment. The former is determined by equations (2-1-4b) and (2-1-5). During the observation period, the ratio of real inventories to real sales is exponentially declining, as seen in Figure 2, probably reflecting the gradual relaxation of import quotas, which have forced enterprises to keep extra inventories in raw materials and goods in process. Moreover, it is likely that the technical progress have caused the gradual shortening of the production period in the manufacturing industries. As a matter of fact, data or estimates for the passive investment in inventories can be obtained by subtracting the desired investment in inventories from actual changes in inventories.

Securities holdings (2-1-10) are a function of lagged internal funds

Figure 2 The Ratio of Real Inventories to Real Sales



net of passive investment in inventories and stock prices. The estimates for the coefficients of stock prices is positive but not significant. It appears that the coefficient of securities holdings at the beginning-of-period is too high and consequently the average period of the adjustment is too long (about 180 months). However, it should be noted that a part of the securities holdings consists of the stocks issued by companies, most of the fruits of which are supplied to their stock-holders, so that this kind of stock holding may be considered to be just the same as investment in physical assets, which could be done under the long-run projection.

Equation (2-2-3) shows the net savings or retained earnings which are available for investment in plant and equipment. Since passive investment in inventories, if positive, forces businesses to invest funds equal to that amount for the current period, this amount of funds could not be available to this sector. In the case where passive investment is negative, net savings minus passive investment becomes greater than the actual retained earnings and this would be a much more appropriate proxy variable for future expectations about the market for products. This variable was introduced into the equation for investment in plant and equipment (2-1-3) with satisfactory results.

Provisions for the consumption of fixed capital (2-2-4) is a function of corporate income, lagged net stock of fixed capital and two dummy variables, one of which (d_2) is introduced to take into account the tax revision in the first-half of 1964 which allowed firms to reduce the lifetime of machines and apparatus by 15 percent. The estimate for the coefficient of d_2 seems to be significant.¹⁴

Changes in the issue of industrial bonds and stocks (2-2-6) is explained from the supply side. It is assumed that the entrepreneur first uses available internal liquid assets for investment in plant and equipment, because its cost is lower than for all other methods of raising funds.¹⁵ Such liquid assets are, in this model, a proportion of the sum of time and savings deposits and securities minus savings forced by borrowings.¹⁶

Thus, the internal funds initially available are:

$$\alpha_2 (DT_c^+ + SEC_c^+ - \alpha_3 LO_c^-)_{-1},$$

where α_3 is the ratio of forced savings to borrowings from private financial intermediaries, and α_2 is the ratio of available liquid assets to the total, which might be dependent on the distribution of the date of maturity of time and savings deposits and of securities. If these funds are insufficient to fully cover investment expenditures, funds are next raised by borrowing, with the third source of funds assumed to be the issuance of industrial bonds and stocks; that is:

$$\Delta BS_c^- = \alpha_0 + \alpha_1 [(I_c - FINC - FING) - \alpha_2 (DT_c^+ + SEC_c^+ - \alpha_3 LO_c^-)_{-1}],$$

where α_1 is the marginal ratio of industrial bonds and stocks to be issued to the deficit of funds, which may also be affected by the condition of the issue market for bonds and stocks. To take this into account, the estimated equation includes the ratio of stock prices to the average interest rate on loans.

Changes in money and time and savings deposits (2-2-10) are determined by the difference between the sources of funds and the uses of funds excluding

changes in cash currency, deposit currency and time and savings deposits of this sector; in other words, this is a sector-balancing variable.

Changes in time and savings deposits (2-1-8) are dependent on change in the sum of money and time and savings deposits and on change in borrowings from private financial intermediaries for the current and previous periods. Since the estimated coefficient for the change in borrowings is 0.1282 for two periods, an estimate for the ratio of time and savings deposits forced by city banks to borrowings turns out to be about 26 per cent, which appears to be slightly (but not unrealistically) higher than the average ratio during the observation period.

The change in money holdings (2-1-9) is determined by subtracting the change in time and savings deposits from the sum of the changes in money and time and savings deposits. The assumptions made here about the demand for money by this sector are somewhat different than those ordinarily made, because of the specific circumstances in our economy, where the indirect financing system is dominant and the downward rigidity of financial transactions between incorporated businesses and private financial intermediaries appears to be prevailing over the business community. In other words, even a big business wishes to maintain the transactions with its banks at the level not less than the certain minimum during the recession period. This may be because of the entrepreneur's feeling that there has been the permanent excess demand for money in the postwar market. Moreover, the opportunities for investment in physical assets have been so lucrative during the postwar periods that the entrepreneur may not have dared to engage in speculative investment in securities. Thus, the actual money balance,

showing a rather smooth trend during the observation period, is divided into two portions: active money and excess money. The former is simply assumed to be proportional to sales, and the latter is the rest. Let us define $MONA_c^+$ as active money balance, V_c as sales and δ as a constant, then:

$$MONA_c^+ = \delta V_c$$

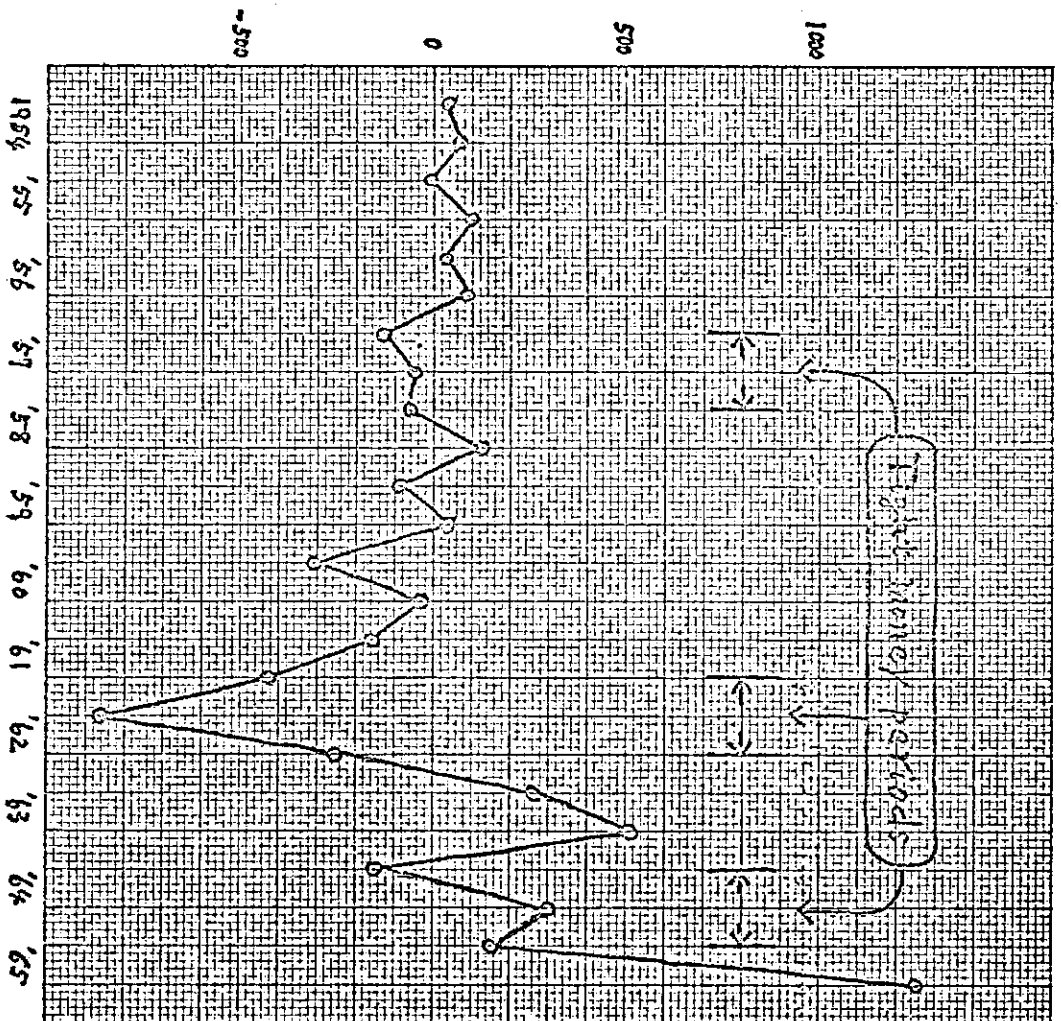
and consequently, the excess money balance (2-2-12) is:

$$M_c^* = MON_c^+ - \delta V_c = 0,$$

where the value of δ is assumed to be approximated by the average value of the actual money-sales ratios in each sub-period ($\delta = 0.1114$ for the period of 1954-60 and $\delta = 0.1176$ for the period of 1961-65). The excess money is supposed to be used to reduce the trade-credit received and not borrowings if it is positive, and vice versa if negative.¹⁷

Figure 3 shows the fluctuations of actual excess money balances during the years in question. Clearly, the excess money turns out to be negative during the periods under tight money policy, in particular, in the periods of the first-half of 1957 through that of 1958 and the latter-half of 1961 through that of 1962, but it begins to increase in the latter-half of 1964, which is also a period of tight money policy. However, it should be noted that after the first-half of 1965, investment in plant and equipment by this sector remained almost constant until the end of the observation period. Now, it is plausible, in the light of preliminary research concerning the estimation of the effects of excess money on changes in borrowings, to

Figure 3
 Estimates for Excess Money
 (billion Yen)



assume that members of this sector do not want to reduce the amount of financial transactions with private financial intermediaries who are considered to be main suppliers of a large proportion of the sum of sources of funds to this sector, so that even if this sector had the excess money and at the same time, were borrowing from city banks, they would not get money back to city banks, but rather keep it as deposit in the banks, or otherwise, use it to reduce trade-credit received. This is the reason why the excess money is introduced in equation for change in trade-credit received (2-2-7).^{1b}

In contrast with equation (2-2-7), the equation for changes in borrowings from private financial intermediaries (2-2-8) is based on the assumption of debt-asset adjustment, which is strongly due to Anderson [1]; that is, changes in borrowings may be adjusted to the limit of borrowing capacity in the long-run. The entrepreneur's borrowing behavior, if affected by the tightness of money, which leads to the introduction of a dummy variable d_3 (= 1 for the periods under tight money policy and = 0 otherwise). According to Anderson, the implied estimate here for the "debt-limit" ratio is about 0.47 (= 0.2100/0.4482) which seems to be very plausible.

3) Private Financial Intermediaries Sector

The most important relationship in the sector is the loan behavior or change in loans equation (3-1-3), since loans may have a considerable influence on the general activities of the economy, particularly in light of the indirect financing system which dominates the Japanese economy. In general, changes in loans may be restricted by the main sources of bank funds, such as demand deposits, time and savings deposits and bank debentures issues, but they may also be dependent: on changes in borrowing from the

Bank of Japan, which is controlled by the money authorities; on buying and selling operations of the Bank of Japan; and on the assets structure of the sector. If the portfolio were biased to loans as compared with securities holdings, this bias would gradually be adjusted towards the normal ratio.

Changes in the securities held by this sector (3-1-4) are determined by the difference between the sum of the sources of funds and the uses of funds excluding change in securities. Thus, the government deficit policy as well as selling or buying operations by the Bank of Japan, could be assumed to make city banks change their portfolio, and consequently to cause them to shift their loan behavior.

4) The Bank of Japan

Equation (4-2-1) residually determines changes in Other Debt; the reason for explicitly presenting this equation is to show that cash currency issued by the Bank of Japan should be accompanied by an increase of securities holdings, including an increase by a buying operation, or by loans by this sector. Needless to say, $\Delta OT_n^{\bar{}}$ could be positive, zero and negative, the last of which might include the purchase of foreign exchange, which is not explicitly dealt with here.

5) General Government Sector

Equation (5-1-2) is also an equation determining a sector balancing variable: changes in government bonds and others. In principle, the deficit of this sector is supposed to be eliminated by the issuance of government bonds. In the case where this increase is purchased by the Bank of Japan,

the supply of cash currency increases through equation (4-2-1), fixing OT_n^- at a certain level temporarily, which should cause an increase in the securities holdings of this sector.

6) Foreign Trade Sector: The Rest of the World

This sector is dealt with very simply and needs no explanatory comments.

7) Market Equations: The Unifying Sector

Equation (7-2) is a production function of the CES type which was directly estimated, and gave estimates for the substitution parameter of 0.222032, for the distribution parameter of 0.15006, for the efficiency parameter of 0.246616, and 0.013554 as an estimate for the rate of Hicks Neutral technical progress.¹⁹ A CES type function was used because during the observation period there seems to have been a dramatic increase in the relative labor-income share for the economy, as shown in Figure 4. Many recent empirical results also indicate that it may be generally more desirable to introduce a CES type production function.²⁰

Equation (7-1) can be deduced from equation (7-2) and the equality between the real wage rate and the marginal productivity of labor (which can be obtained by differentiating equation (7-2) with respect to labor input hL).²¹ Figure 5 shows the estimates for the difference between the potential supply implied by equation (7-1) and the demand for final products determined by equation (7-3). It is clearly observed that after the early stages of a period of tight money, the potential excess supply begins to increase and, within a year, this excess becomes significantly positive. The potential excess begins to increase in the latter-half of

Figure 4 Fluctuation of Relative Labor-Income Share

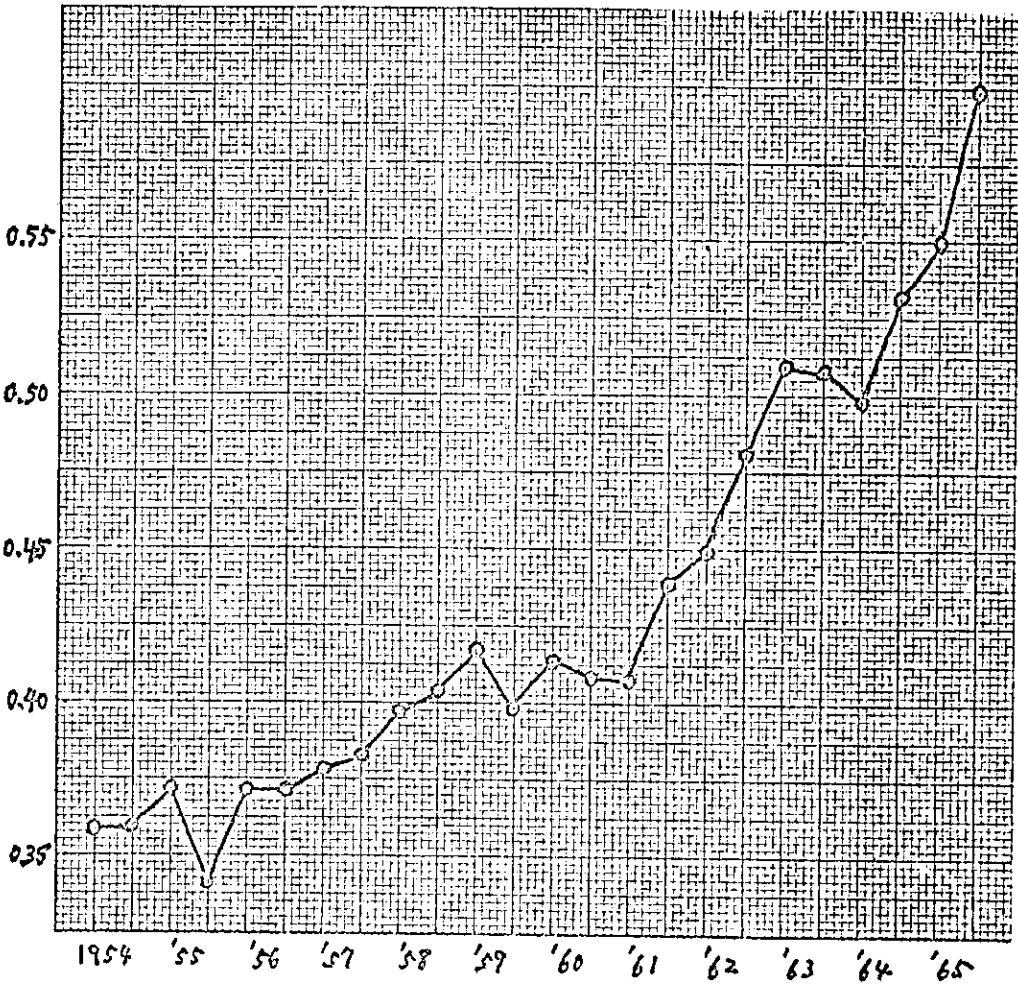
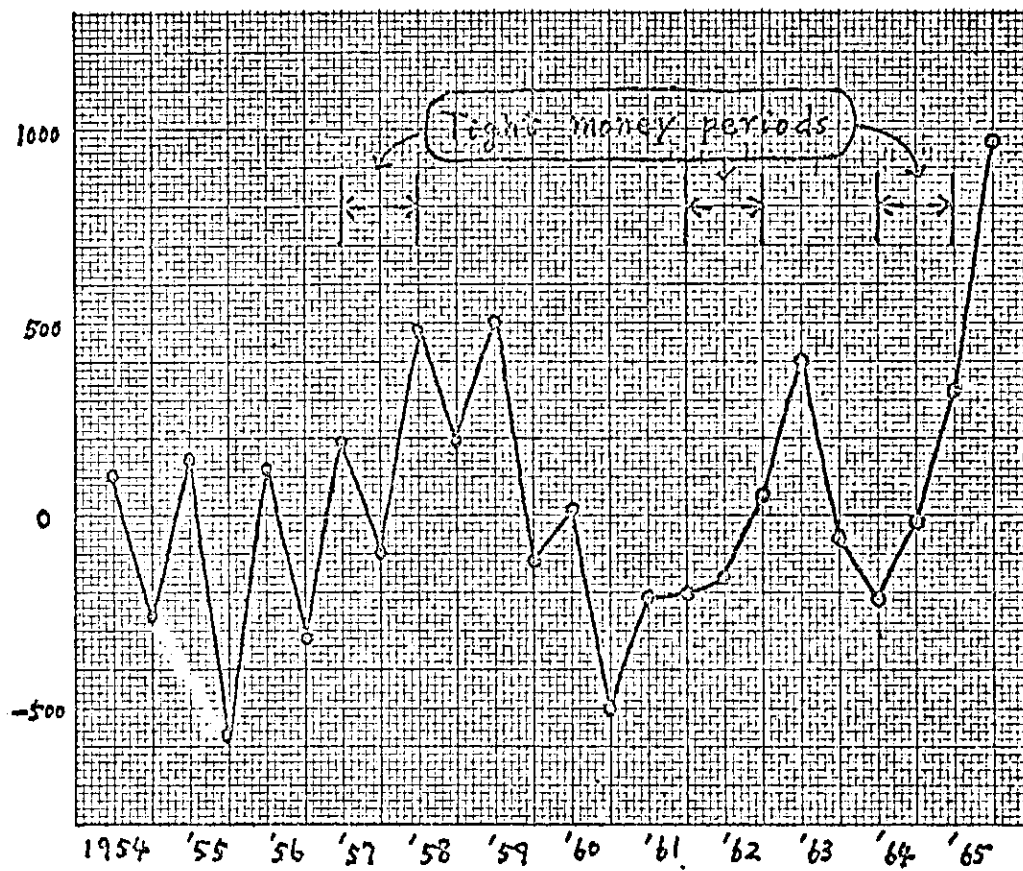


Figure 5 Estimates for Potential Excess Supply
(1960 constant prices, billion Yen)



1964 lagging one period behind the start of tight money policy and this tendency goes on until the end of our observation period. As a matter of fact, the estimates for potential excess supply could be considered to be almost plausible.

Equation (7-4) determines passive investment in inventories, using the estimates for the potential excess supply just mentioned above. Although the coefficient of determination is not very high, the estimate for the coefficient of potential excess supply seems to be substantially stable.

The estimate for the coefficient of passive investment in equation (7-8) is not significant, and this seems to suggest that the price formation mechanism in the market for consumer goods is probably much more complicated, reflecting a multi-stage interim process through which consumer goods are distributed from producers to final purchasers. This might be closely connected with the fact that the estimate for the coefficient of the money wage rate is significant. In contrast with this equation, the estimate for the coefficient of passive investment in inventories in the wholesale price equation (7-9) seems to be satisfactorily significant, so that the existence of a potential excess supply of final products appears to be mostly reflected in changes in wholesale prices.

Finally, although not shown explicitly in the model, an equation determining changes in "Other Debts" in the Foreign Trade Sector is existent, but is dropped because of "Walras' Law."²² This equation can be written explicitly as below:

$$\Delta OT_f^- = \Delta OT_h^+ + \Delta OT_g^+ - \Delta OT_c^- - \Delta OT_b^- - \Delta OT_n^- .$$

IV. Multiplier Analysis of the Model

IV.1. Procedures in Calculating Multipliers

In a model such as this (a system of simultaneous dynamic nonlinear equations), the calculation of the multipliers is not as simple as in the case of a linear system. Roughly, there are two methods for calculating multipliers for a simultaneous nonlinear system: one is the direct calculation-of-convergence method and the other is the Newton's approximate method of solution, but essentially, these two methods are akin to each other.²³ As a first approximation, the latter method is applied to this model. Goldberger [9] and Evans [8] have tried to estimate impact multipliers for the United States economy by this method. Needless to say, estimates arrived at by this method will involve biases, particularly for the so-called "dynamic multipliers," since it is not the original equation system but a system of "tangent-plane" equations that is actually used to calculate multipliers for each period. The following is a general description of the procedures employed in calculating the multipliers in this paper.

The original system of nonlinear equations can be written in the general form:

$$i) \quad G_i[(y_1)_t, \dots, (y_p)_t, (y_1)_{t-1}, \dots, (y_p)_{t-\tau}, (z_1)_t, \dots, (z_k)_{t-e}] = 0, \\ (i = 1, 2, \dots, p)$$

where $(y_1)_t, \dots, (y_p)_t$ are endogenous variables; $(y_1)_{t-1}, \dots, (y_p)_{t-\tau}$ are lagged endogenous variables and $(z_1)_t, \dots, (z_k)_{t-e}$ are exogenous variables. Let us define vectors for these variables:

$$\Delta Y_t^0 = [(\Delta y_1)_t \dots (\Delta y_p)_t] ;$$

$$\Delta GY_t^0 = (\Delta Y_t^0 \Delta Y_{t-1}^0 \dots Y_{t-\tau}^0) ;$$

$$\Delta GZ_t^0 = [(\Delta z_1)_t \dots (\Delta z_1)_{t-e} \dots (\Delta z_k)_t \dots (\Delta z_k)_{t-e}] ;$$

$$(\Delta z^*)^0 = (1 \ 0 \ \dots \ 0 \ 1 \ 0 \ \dots \ 0 \ 1 \ 0 \ \dots) ,$$

where ΔY_t^0 is a row vector of p degree, ΔGY_t^0 a row vector of $p(1+\tau)$ degree, ΔGZ_t^0 a row vector of $k(1+\theta)$ degree, and $(\Delta z^*)^0$ a row vector of $k(1+\theta)$ degree. Then, expand functions G_i ($i = 1, 2, \dots, p$) linearly in a Taylor's series about a set of values for all the y 's and z 's for the period t_0 , and take the first differences with respect to all the y 's and z 's. In this manner, we can get the so-called "tangent plane" equations system; that is,

$$ii) \quad A_1(GY_{t_0}, GZ_{t_0})\Delta Y_t + A_2(GY_{t_0}, GZ_{t_0})\Delta GY_{t-1} + B(GY_{t_0}, GZ_{t_0})\Delta GZ_t = 0 ,$$

where A_1 , A_2 and B are the coefficient-matrices for the endogenous variables, lagged endogenous variables and exogenous variables respectively, which depend on the values of those variables for period t_0 .

Suppose some of the components of the column vector ΔGZ_t have zero values and others unity for the period t_1 with all the lagged endogenous variables fixed at the level of the period t_0 . Then, the impact multipliers of these components for all the endogenous variables $\Delta Y_{t_1}^*$ can be written as below:

$$iii) \quad \Delta Y_{t_1}^* = -[A_1(GY_{t_0}, GZ_{t_0})]^{-1} \cdot B(GY_{t_0}, GZ_{t_0})\Delta Z^* ,$$

where the first factor on the right-hand side is the inverse matrix of A_1 .²⁴ As has been noted above, the calculation of dynamic multipliers has not been done at the present stage, except for those for prices for the second period.

IV.2. Impact Multipliers for Fiscal and Monetary Policy

The impact (first period) multipliers based on the values of all variables in the latter-half of 1965 were calculated, using equation (iii). The multipliers were selected so as to include several important variables for fiscal and monetary policy.

The model has been reduced to a fifty equation system by substituting identities and even some behavioral equations, thereby eliminating some variables and dropping such equations as those for the provisions for the consumption of dwellings, changes in short-term government securities holdings by private financial intermediaries, provisions for the consumption of fixed capital in unincorporated businesses, and changes in the deposit currency of general government. Moreover, the indirect tax equation was excluded, because all the effect of indirect taxes do not appear until the second and later periods.

Tables 1 and 2 show the estimates for impact multipliers for the principal GNP components, financial assets and debts in several sectors, prices, and the real wage rate.

A) Impact Multipliers for Fiscal Policy

The first columns in Table 1 are the impact multipliers of current expenditures by the general government. The impact multiplier for GNP is 1.7486, that for potential supply of final products is 3.7343,²⁵ and that for passive investment in inventories is 0.2356,

which seems to be larger than that for intended investment in inventories, $J_c^*(0.2171)$. So, in the next and later periods, prices will presumably (other things being unchanged) begin to decline, although changes in prices for the next period appear to be negligibly small.

The multiplier for personal disposable income is 0.4871 and for consumption, 0.3616. It seems that the multipliers for financial transactions are generally higher than those for nonfinancial transactions. This may be partly because the investment of incorporated businesses in plants and equipments reacts very slowly, so that the excess money increases by 0.9420, which will stimulate the trade-credit granted to the individual sector for the next period.

The reason why the increase in corporate profits, Y_c is so remarkably large (1.2142) is that the increase in GNP is greater than that of unincorporated business income and income from property; unincorporated business income is simply dependent on GNP, the coefficient of which is 0.1469, and income from property is dependent on securities holdings and time and savings deposits; the coefficient for the former is not high and its multiplier is less than unity, and the multiplier for the latter is very small.²⁶ The increase in supply of cash currency by the Bank of Japan is, after all,

TABLE 1: THE IMPACT MULTIPLIERS

	C_g	TR_{gh}	A	B	EXP
C	0.3616	0.8828	-0.1055	-0.1055	0.4008
TAX _h	0.0069	0.0054	-0.0139	-0.0071	0.0067
I _h	0.0175	0.0308	-0.4754	-0.2438	0.0195
IH _h	0.0486	0.1186	-0.0276	-0.0142	0.0538
MON _h ⁺	0.2089	0.5100	-0.1188	-0.0609	0.2316
CAS _h ⁺	0.0646	0.1577	-0.0367	-0.0188	0.0716
CSD _h ⁺	0.0172	0.0073	1.8975	0.9733	0.0896
DT _h ⁺	0.0680	0.1159	2.7144	1.3923	0.1771
PS _h ⁺	0.0131	0.0320	-0.0075	-0.0038	0.0145
SEC _h ⁺	-0.1006	-0.0750	-9.3235	-4.7824	-0.4582
Y _w	0.1860	-0.0082	-0.0668	-0.0338	0.2261
Y _p	0.2569	0.1630	-0.1233	-0.0632	0.2707
Y _r	0.0510	0.0398	-0.1017	-0.0522	0.0498
Y _d	0.4871	1.1892	-0.2770	-0.1421	0.5399
TCR _h ⁻	-0.2887	-0.2957	0.1595	0.0818	-0.2774
LO _h ⁻	0.5160	0.6961	-6.3331	-3.2484	0.5309
TAX _c	0.1363	0.0994	9.6697	4.9600	0.1408
DIV	0.0504	0.0367	-0.0220	-0.0113	0.0520
I _c	0.0997	-0.0044	-0.0353	-0.0181	0.1212
J _c	0.4586	0.2108	-0.2052	-0.1052	0.5023
H _c	0.4635	0.2131	-0.2074	-0.1064	0.5077
J _c [*]	0.2171	-0.0095	-0.0768	-0.0394	0.2638
CSD _c ⁺	0.5165	0.6613	-11.1312	-5.7097	0.3832
DT _c ⁺	0.1171	0.1286	-1.8182	-0.9226	0.0973
MON _c ⁺	0.7312	0.8368	-11.8006	-6.0531	0.5960
SEC _c ⁺	0.0076	0.0361	-0.9745	-0.4999	-0.0275
TCR _c ⁺	0.3238	-0.0141	-0.1146	-0.0588	0.3935
Y _c	1.2142	0.8854	-0.5306	-0.2722	1.2541

Note: Supply of money is assumed to be endogenously determined by equation (7-13). Multiplicands A and B are one percent increase for each point.

TABLE 1 (continued)

	C_g	TR_{gh}	A	B	EXP
R_c^*	0.7860	0.5290	-10.0499	-5.1551	0.8228
DEP_c^1	0.0908	0.0662	-0.0397	-0.0204	0.0938
BS_c^-	0.0670	0.1644	-4.4851	-2.3006	-0.0869
TCR_c^-	0.6125	0.2816	-0.2740	-0.1406	0.6709
LO_c^-	0.0309	-0.0013	-0.0109	-0.0056	0.0376
FINC	0.0046	-0.0002	-0.0016	-0.0008	0.0056
MDT_c^+	0.8483	0.9654	-13.6188	-6.9857	0.6933
TAS_c^+	1.0044	1.1581	-14.6817	-7.5309	0.8074
M_c^*	0.9420	0.8276	-11.8753	-6.0914	0.8523
CAS_b^+	0.0119	0.0151	-0.1376	-0.0706	0.0123
LO_b^+	0.5469	0.6947	-6.3440	-3.2541	0.5685
SEC_b^+	0.1600	.2032	-1.8559	-0.9520	0.1663
PB_g^-	0.7166	0.5182	-7.6688	-3.9337	-0.2324
IMP	0.2373	0.1292	-0.1099	-0.0564	0.2552
GNP*	3.7343	2.9063	-1.8918	-0.9704	3.8067
hL	0.8160	-0.0360	-0.2887	-0.1481	0.9918
GNE*	1.5071	0.8892	-0.7108	-0.3646	1.6040
GNP	1.7486	1.1095	-0.8391	-0.4304	1.8425
U	0.2356	0.2149	-0.1252	-0.0642	0.2327
P	0.0001	0.0001	-0.0001	-0.00003	0.0001
V_c	0.9651	-0.0421	-0.3415	-0.1752	1.1729
GK	0.1100	0.0249	-0.4795	-0.2459	0.1321
P_s	0.1616	0.7716	-20.8227	-10.6809	-0.5870
w^*/p	-0.00002	-0.00001	0.00001	n.s.	-0.00002

Note: The mark "n.s." is used for a negligibly small figure. The figures of the columns for A and B are in billion yen.

0.2912 (the sum of the increases in the cash holdings of individuals, 0.0646, that of incorporated businesses, 0.2147 (= 0.7312 - 0.5165), and that of private financial intermediaries, 0.0119).

The second columns in Table 1 show the multipliers of current transfers from the government to households and non-profit institutions. Although the multiplier of the transfer for GNP(1.1095) is smaller than that of the government current expenditures C_g (1.7486), the multipliers of the former for consumption, investment in dwellings, and investment of unincorporated businesses in plants and equipments are larger than those of C_g . Also increases in corporate profits, excess money, potential supply of final products and so on are smaller for TR_{gh} than for C_g . In this point, these two types of multipliers seem to be in contrast to each other.

The third and fourth columns of Table 1 give the effects of increases in the corporate income tax rate and the tax rate on dividends (a one percent increase for each point), most of which are negative except for the individuals' holdings of deposit currency, time and savings deposits, and the received trade-credit, which accompany a decline in stock prices. It is much surprising that a rise in these tax rates is considerably effective on the general economic activities; for instance, the combination of a two percent rise in both the corporate income tax rate and the tax rate on dividends will presumably lead to a decrease of about 2.54 billion yen in GNP which is about 1.45 times as large as the effect of a decrease of one billion yen in the government current expenditures on GNP.

A rise of the corporate income tax rate is also effective on a decline of the incorporated businesses net savings available for investment in plants

and equipments R_C^* . This fact will lead to a conclusion that the fixed investment behavior of the incorporated businesses sector may be considerably sensitive to changes in the corporate income tax rate.

B) Impact Multipliers for Monetary Policy

The first four columns of Table 2 give the effects of buying operations oriented to particular main city banks by the Bank of Japan, borrowings of private financial intermediaries from the Bank of Japan, borrowings by individuals from government financial institutions, and the interest rates on loans by private financial intermediaries. As is clearly shown in Table 2, the impact multipliers for GNP of these three multiplicands are less than one tenth of that of C_g . Also the borrowings of individuals from government financial institutions seems to increase deposit currency and the time and savings deposit holdings of individuals, but reduces the general financial activities of corporate businesses and stock prices.

On the contrary, buying operations raises the level of financial activities of the private sectors, and stock prices rise by about three points. However, it should again be noted that the impacts of these monetary policies do not seem to be as strong as the impacts of fiscal policies. For instance, the supply of cash currency induced by loans from the Bank of Japan increases by only 0.0062 billion yen for the current period.

The same is true of the effects of the interest rates on loans, which are shown in the fourth columns of Table 2. Multiplicand i_L is a one percent increase of annual rate. Interest rates appear to not be especially effective, at least for the first period, but they do cause a reduction in

TABLE 2: THE IMPACT MULTIPLIERS

	Ope	LON _n ⁺	LOG _h ⁻	i _L	w*
C	0.0301	0.0133	0.0200	15.118	563.381
TAX _h	0.0019	-0.0002	-0.0009	-0.003	-0.049
I _h	0.0713	0.0525	0.0893	-3.707	-11.886
IH _h	0.0040	0.0018	0.0027	2.030	75.104
MON _h ⁺	0.0174	0.0077	0.0116	8.734	336.705
CAS _h ⁺	0.0054	0.0024	0.0036	2.701	104.109
CSD _h ⁺	-0.2593	0.1018	0.2610	-0.408	132.170
DT _h ⁺	-0.3708	0.1486	0.3791	1.215	143.692
PS _h ⁺	0.0011	0.0005	0.0007	0.548	19.803
SEC _h ⁺	1.2742	-0.5014	-1.2844	1.337	298.828
Y _w	0.0099	0.0074	0.0126	17.734	650.040
Y _p	0.0184	0.0120	0.0198	2.647	110.658
Y _r	0.0142	-0.0037	-0.0143	-0.020	9.445
Y _d	0.0405	0.0180	0.0270	20.364	753.302
TCR _h ⁻	-0.0237	-0.0145	-0.0239	11.119	-669.463
LO _h ⁻	0.9498	0.6970	0.1840	-11.892	475.696
TAX _c	0.0090	0.0069	0.0118	-5.471	0.004
DIV	0.0033	0.0026	0.0044	-0.094	0.001
I _c	0.0053	0.0040	0.0068	-5.066	-60.970
J _c	0.0306	0.0205	0.0343	14.768	323.469
H _c	0.0309	0.0208	0.0347	14.926	326.930
J _c [*]	0.0115	0.0086	0.0147	20.677	-159.181
CSD _c ⁺	0.4303	-0.1238	-0.3427	-15.609	281.110
DT _c ⁺	0.0719	-0.0184	-0.0527	-2.893	43.340
MON _c ⁺	0.4654	-0.1208	-0.3444	-17.284	299.738
SEC _c ⁺	0.1333	-0.0512	-0.1318	0.890	-7.040
TCR _c ⁺	0.0172	0.0129	0.0220	30.843	-237.438
Y _c	0.0798	0.0616	0.1055	-2.263	0.034

Note: Multiplicands i_L and w^* are one percent and ten percent increases for each point respectively. Figures of the last two columns are in billion yen.

TABLE 2 (continued)

	Ope	LON _n ⁺	LOG _h ⁻	i _L	w*
R _c [*]	0.0485	0.0402	0.0697	9.211	-482.621
DEP _c ¹	0.0060	0.0046	0.0079	-0.169	0.026
BS _c ⁻	0.6136	-0.2337	-0.6031	-0.196	-52.052
TCR _c ⁻	0.0409	0.0274	0.0458	19.724	432.025
LO _c ⁻	0.0016	0.0012	0.0021	-1.572	-18.926
FINC	0.0002	0.0002	0.0003	-0.236	-2.837
MDT _c ⁺	0.5373	-0.1392	-0.3971	-20.178	143.078
TAS _c ⁺	0.6836	-0.1831	-0.5174	-40.102	839.410
M _c [*]	0.4766	-0.1124	-0.3301	-28.095	145.102
CAS _b ⁺	-0.0021	0.0018	0.0040	-0.292	9.905
LO _b ⁺	0.9515	0.6982	0.1861	-13.464	456.770
SEC _b ⁺	-1.0773	-0.5918	0.0545	-3.939	133.629
PB _g ⁻	-0.2833	0.0893	-0.7587	-1.516	-120.187
IMP	0.0164	0.0108	0.0180	5.121	135.787
GNP*	0.2814	0.1790	0.2959	-28.781	458.099
hL	0.0434	0.0325	0.0554	77.779	-599.083
GNE*	0.1059	0.0695	0.1155	23.932	270.638
GNP	0.1250	0.0814	0.1351	18.022	753.287
U	0.0186	0.0116	0.0191	-5.765	470.878
P	0.00001	0.00001	0.00001	-0.001	0.075
V _c	0.0513	0.0384	0.0656	91.931	-707.715
GK	0.0719	0.0531	0.0902	10.858	-84.315
P _c	-----	-----	-----	-----	0.030
P _i	-----	-----	-----	-0.010	0.087
P _s	2.8479	-1.0939	-2.8172	19.007	-150.433
w*/p	n.s.	n.s.	n.s.		0.040

Note: It should be noted that the money wage rate is measured as per million persons per hour in billion yen. To see the effect of an increase in wage rate, all figures of the last column should be divided by one million.

the excess money of corporate businesses, which will reduce the trade-credit granted to individuals, and consequently consumption, investment in dwellings, investment of unincorporated businesses in plants and equipments and so forth for the later periods. It seems that the interest rates are, in general, effective on the financial activities of incorporated businesses.

The reason why disposable personal income and consumption increased, is that an increase in interest rates raised income from property which contributed to an increase in personal income.

C) Effects of Money Wage Rate and Exports

The last columns in Table 2 give the effects of changes in the money wage rate. The money wage rate was increased by ten percent per one million persons per hour. To see the effects of a ten percent increase in the money wage rate per one thousand persons per hour, the decimal point has to be moved by two digits to the left side. The following will be concerned with the effects of a ten percent increase (not relative but absolute) of the money wage rate per one thousand persons per hour.

Now, this increase brings about an increase of 7.5 billion yen in GNP (about 4.3 times the government current expenditures C_g multiplier for GNP), an increase of 7.5 billion yen in personal disposable income, a decline of 4.83 billion yen in corporate net savings available for investment, a decline of 0.61 billion yen in investment of corporate businesses in plants and equipments, and a decline of 1.59 billion yen in intended investment in inventories respectively.

The decline in the investment of corporate businesses in plants and equipments will slow down the rate of growth of fixed capital, which will

retard increases in the technical productivity of labor and bar an immediate recovery of the general price level. Moreover, the decline in corporate net savings and in excess money will strengthen this tendency by slowing the recovery of investment in plants and equipments and in inventories. Although GNP increases by 7.53287 billion yen, as the price level rises by 0.00075, the real GNP declines by 1.771 billion yen in 1960 constant prices, so does the labor employment by 5.991 thousand man-hours.

TABLE 3: EFFECTS OF MONEY WAGE RATE ON PRICES FOR

	The first period	The second period
P_c	0.00030	0.00031
P_w	-----	-0.00020
P_i	0.00087	0.00037
P_j	-----	-0.00009

Note: These figures are at semi-annual rate. To see the changes by percentage point, the decimal point should be moved by two digits to the right side.

Using equations (7-8)-(7-11), the effects of money wage rate on prices can be estimated at least for the current and the next periods, which are shown in Table 3. The increase in the prices for consumer goods appears to be accelerated, but on the contrary, the speed of increase in the prices for fixed investment goods seems to be slowing down. Despite the rapid increase in the prices for consumer goods, the real wage rate from the viewpoint of employees as consumers will not decline, on the average, at all;

it increases by 21 yen per person an hour for a month for the first period and 5 yen for the second period respectively. The results concerning the changes in wholesale prices and the prices for inventories clearly tell that the increases in those prices are not negligibly small, so that the decline in corporate net savings could partly be offset.

The impact multipliers of exports which are given in the last columns of Table 1, are almost the same as those of current expenditures by the general government. However, the former does not increase the government deficit or the pressures for an increase in the issuance of government bonds. The impact multiplier for GNP is 1.8425, which is a little higher than that of current government expenditures, reflecting partly the difference in price deflators and the consequent effect on the determination of the level of real gross national product. Another interesting fact is that an increase in exports leads to a decrease in the issuance of government bonds, which reduces the securities holdings of individuals and corporate businesses, which in turn induces a decline in stock prices and in the issuance of industrial bonds and stocks.

Since there are reactions for the first period, it is not certain, but it seems probable that exports affect the financial structure differently than do changes in current government expenditures.

V Appendix: Remarks on Data

1) General Characteristics

In order to observe the general interdependence among the economic sectors in their relations to financial and non-financial transactions, it may be necessary to obtain, at least, data on the transactions of final products, money, and securities among the sectors; in the present case, the time-series data from the National Income Accounts reported by the Economic Planning Agency of the Japanese Government and on the Flow-of-Funds Tables reported by the Bank of Japan are available for the periods after 1954.

However, since these surveys have been made independently of each other, according to their own purposes and consequently subject to their own criteria, the problem of consolidation or combination has turned out to be difficult from the viewpoint of the internal consistency among some particular items; for instance, the difference between savings and investment in real assets by sector does not necessarily coincide, but is always at variance with the so-called "Excess funds" of that sector, mainly because of the fact that the concepts assigned to those accounts are different from each other.

In the National Income Accounts, investment does not include purchases of land; also profits to financial intermediaries are included in the corporate businesses sector, and personal or individual income includes imputed income, such as interest, rent and so forth.

On the other hand, in the Flow-of-Funds Tables, any transaction, whether financial or non-financial, it might be recorded here, although the in- or out-flow

of funds is reported in terms of net-flow. Stock transactions, however, are treated differently from others, because (though the stock-issues are recorded at their issue-price) each sector's holdings are not evaluated at their current prices, but at their original (purchase) prices, and the consequent gaps are included in "Other Transactions".

As these examples should show, the author was forced to make the sector balancing item include the statistical discrepancy for each sector and for the economy as a whole. Of course, this item thus made is very different from the sector balancing variable included and specified by the identity in the Model, which has a clear economic meaning.

2) Division of Sectors

The Flow-of-Funds Tables reported by the Bank of Japan are, in this study, reclassified into six sectors: Individuals including households and unincorporated businesses; Incorporated Businesses; Private Financial Intermediaries; The Bank of Japan; General Government including government financial institutions, local governments and public corporations; and Foreign Trade sector. This division is due mainly to the simplicity of the Model and the need for consolidation of this table with the National Income Accounts.

Unincorporated businesses have two functions, the first of which is essentially that of a consumer or household and the second, that of an entrepreneur. However, most of them are of a considerably small scale and have not yet been much modernized. Moreover, most of the agricultural and small scale fishing enterprises are also included here.

In the Incorporated Businesses sector, the security corporations are included, which should properly be separated from this sector as an independent

sector, but to do that, we need more detailed informations than that currently available. This sector covers all private incorporated businesses in all industries except for financial intermediaries.

Financial institutions are divided into three groups: (1) the Bank of Japan, which executes various types of monetary policies, such as the supply of cash currency, indirect credit-control, operations to particular city banks, official rates of interest and so forth; (2) Government Financial Institutions, which supply long-term loans to the enterprises according to the industrial policies of the Government; and (3) the Private Financial Intermediaries, which also include the insurance and trust companies.

It goes without saying that all of the transactions of all domestic sectors with foreign countries are assigned to one quasi-sector--the Foreign Trade sector.

3) Consolidation and Rearrangement of Financial Items

For simplicity's sake, some of the financial items listed in the Flow-of-Funds Tables were eliminated or offset on a debit-side and a credit-side in each sector's accounts; therefore, "Other Assets," or "Other Debts" in each sector includes the residuals caused by the adjustments. The reason for this is that they were considered to not be very important from the viewpoint of economic theory and/or to be negligibly small, compared with other items.

The neglected items are as follows: (i) Government deposits, (ii) Personal contributions or direct investments, (iii) Foreign currency reserves, (iv) Foreign exchange and (v) Foreign claims of all sectors except for those in the Government and Foreign Trade sectors.

Call money was offset in the Private Financial Intermediaries sector. Most of the transactions of Call are within this sector and, as is well known, their role is in smoothing short-term financial transactions between the demanders (main city banks) and the suppliers (local banks, credit associations or agricultural co-operative associations).

Each financial item in the Individuals sector is computed as the residual between total holdings of the asset and total issues of the debt in other sectors except for the Foreign sector, in order to hold the ex post equality between the sum of the asset and that of the debt issued.

The end-of-period balance or stock for each financial item in each sector and in the economy as a whole is obtained, respectively, by adding up the net financial in- or out-flow in each period to the initial (the latter-half of 1954 calendar year) balance cumulatively.

4) Consolidation of Flow-of-Funds Tables and National Income Accounts

As stated above, it is very difficult to properly treat the gaps between savings-investments and changes in debt-assets -- in other words, the net deficit or surplus of funds in each sector. In this study, investments in land (purchases of land) are neglected, and therefore the gap in question in each sector includes investments in land. Moreover, the fact that profits of financial institutions are included in the Incorporated Businesses sector will also cause this gap to swell up. Data on investments in land, and on profits to financial institutions are not, in general, available.

Consolidated flow accounts by sector in each half-calendar year are as follows:

1. Individuals (h)

C	Y_w
TAX _h	Y_p
SI _h	Y_r (-DIV)
TR _{hg}	DIV
TR _{hf}	TR _{ch}
	TR _{gh}
	TR _{fh}
	$-R_h$
-----	-----
L _h	DEP _h ¹
IH _h	DEP _h ²
J _h	
-----	-----

ΔCAS_h^+	ΔTCR_h^-
ΔCSD_h^+	ΔLO_h^-
ΔPTS_h^+	ΔLOG_h^-
ΔDT_h^+	
ΔPS_h^+	
ΔSEC_h^+	
ΔOT_h^+	

3. Private Financial Intermediaries

ΔCAS_b^+	ΔCSD_b^-
ΔCND_b^+	ΔDT_b^-
ΔSB_b^+	ΔBF_b^-
ΔSEC_b^+	ΔST_b^-
ΔLO_b^+	ΔIB_b^-
	ΔLON_b^-
	ΔOT_b^-

2. Incorporate Businesses

TAX _c	Y_c
DIV	
TCR _{ch}	
-----	-----
I _c	DEP _c ¹
J _c	DEP _c ²
IH _c	
-----	-----
ΔCAS_c^+	ΔBS_c^-
ΔCSD_c^+	ΔTCR_c^-
ΔDT_c^+	ΔLC_c^-
ΔSEC_c^+	ΔLOG_c^-
ΔTCR_c^+	ΔOT_c^-

4. The Bank of Japan

ΔSB_n^+	ΔCAS_n^-
ΔSEC_n^+	ΔCND_n^-
ΔLON_n^+	ΔCDG_n^-
	ΔOT_n^-

6. Foreign Trade

EXP	IMP
TR _{fh}	TR _{hf}
TR _{fg}	TR _{gf}
-----	-----
$\Delta FDEB_f^+$	$\Delta FCRE_f^-$
ΔOT_f^-	ΔFM_f^-

5. General Government

C_g	TAX_h
SUB_g	TAX_c
TR_{gh}	$ITAX$
TR_{gf}	SI_g
	TR_{hg}
	$-R_g$
	Y_g

I_g	DEP_g
J_g	

ΔCAS_g^+	ΔCAS_g^-
ΔCSD_g^+	ΔPTS_g^-
ΔCDG_g^+	ΔPS_g^-
ΔDT_g^+	$\Delta FDEB_g^-$
ΔSB_g^+	
ΔSEC_g^+	
ΔLOG_g^+	
$\Delta FCRE_g^+$	
ΔFM_g^+	
ΔOT_g^+	

7. Final Products

Y	GNP
DEP_h^1	
DEP_h^2	
DEP_c^1	
DEP_c^2	
DEP_g	
$ITAX$	
$-SUB_g$	
$SGAP$	

<u>8. Distribution and Expenditures</u>	
C	Y_w
C_g	Y_p
$I(=I_h+I_c)$	$Y_r(-DIV)$
$+I_g+IH_h$	DIV
$IH_c)$	TR_{ch}
$J(=J_h+J_c)$	TAX_c
$+J_g)$	
EXP	R_c
$-IMP$	Y_g
	$-R_g$
	$-R_h$

	$DEP_h^1+DEP_h^2$
	$+DEP_h^1+DEP_h^2$
	$+DEP_g$
	$ITAX$
	$-SUB_g$

5) Variables Other than Those for National Income Accounts and Flow-of-Funds Tables

The Model includes many variables which do not appear in the National Income Accounts and Flow-of-Funds Tables. They are listed in the Table below:

Miscellaneous Variables

Variables	Sources:
L	Labor Forces Survey; Statistical Department, the Prime Minister's Office.
h	Monthly Report of Labor Statistics; the Ministry of Labor.
w*	(Compensation of employees) divided by (The number of employees) times (the average labor-hour per person for six months).
p	Annual Report of National Income Statistics; Economic Research Institute, Economic Planning Agency.
P _i	
P _j	
P _h	
P _e	The same as p above.
P _m	
P _c	
P _{ig}	
P _{cg}	
P _{jg}	
P _w	Monthly Report of Economic Statistics; the Bank of Japan.

Miscellaneous Variables (continued)

Variables	Sources:
P_s	
I_L	
i_N	The same as P_w above.
Ope	
V_c	Quarterly Report of Incorporated Business Survey; the Ministry of Finance.
TAX*	Main Tax Division, The Ministry of Finance.
A	The Annual Report of Tax Statistics, Tax Administration Agency.
B	The same as A above.

6) Aggregation and Disaggregation over Time

Time series data on the National Income Accounts are available in each quarterly period, but to make these series correspond or coincide with the Flow-of-Funds, they were summed up into semi-annual series. As already noted above, data on the quarterly Flow-of-Funds does not seem to be reliable, mainly because of the coverage of that survey; that is, the quarterly series do not include the financial flows of all insurance companies until 1963. Annual data on all sectors, on the other hand, are available throughout our observation periods, so that data on half-year Flow-of-Funds were obtained by dividing an annual figure into two portions for each half-calendar year, subject to the weights derived from the corresponding quarterly series.

Let A_t be the flow value of certain variable in calendar year t ; $Q_{t,i}$ ($i = 1, 2, 3$ and 4), the flow value of the quarterly variable corresponding to A_t at the i th quarter of the calendar year t . Then, the half-year flow values of the variable $F_{t,j}$ ($j = I$ and II) are:

$$F_{t,I} = \frac{\sum_{i=1}^2 Q_{t,i}}{\sum_{i=1}^4 Q_{t,i}} A_t \quad ; \quad F_{t,II} = \frac{\sum_{i=3}^4 Q_{t,i}}{\sum_{i=1}^4 Q_{t,i}} A_t$$

respectively.

FOOTNOTES

1. Kuh (19), Knowles and Warden, Jr. (18), Okun (28), and Anderson and Babcock (2) have so far analysed potential output in terms of technical conditions and full-employment for the U.S. economy. Particularly, Kuh (19) introduced a dynamic production function in order to derive a long-run production relation and, combining the latter with a labor participation equation, he arrived at an estimate of the productive capacity at full-employment. However, all these attempts are obviously concerned with the nation's productive capacity from the viewpoint of technology. There is also a need for a derivation of the desired level of potential output from the viewpoint of producers' rationality -- and these two concepts do not necessarily coincide with each other.
2. The price level of output probably indicates the general market conditions under which this passive changes in inventories holdings would be easily swept away sooner or later.
3. Needless to say, U could be positive, negative, or zero subject to the sign of $(X^* - D^*)$, so that a negative value, for instance implies that producers are forced with passive disinvestment in inventories because of greater demand for output compared with the desired level, and perhaps at the same time, they should raise the degree of utilization too.
4. It should be noted that the equilibrium level of prices would be more exactly be somewhere between p_0 and p_τ , because the increasing prices would depress the demand for output. In most macroeconomic models, the changes in prices are supposed to be completely dependent on changes in final demands and costs of production. Since the simple stock adjustment inventories equation implies that a constant fraction of the actual change in inventories consists of unintended changes in inventories, the introduction of inventory investment into the price-formation equation does partially take into account the gap between the supply of and demand for output. Eckstein and Fromm (7) recently analyzed the price equation in an ingenious and sophisticated way, taking into account the undesired drawdown of suppliers' inventory, the build-up of unfilled orders backlog and abandoned orders.
5. Since cash currency can be issued by the Bank of Japan through changes in loans to city banks, acceptance of government bonds newly issued, operations oriented to particular main city banks -- in this sense, this is not of open market -- and purchasing of foreign exchange, it may be possible to estimate the effects of the various types of monetary policies, which will show significantly different results for each.

6. After considerable attempts to introduce interest rates into the equation for demand for money, no satisfactory result could be obtained, but in the equation for the demand for deposit currency, the larger part of which is held by unincorporated businesses, a slightly significant coefficient for stock prices was obtained.
7. In the case where cash currency is assumed to be exogenous, equation (14) determines cash holdings of private financial intermediaries at first, so that the equation for cash holdings of private financial intermediaries should be dropped from the model. This was done when the impact multipliers were estimated for an increase in the supply of cash currency by the Bank of Japan through a change in loans or operation oriented to particular main city banks. The results were not very different from the case where the supply of money was endogenous except that all of the effects were slightly higher than in the case where it was endogenous.
8. In my early paper (12), stock prices had been considered an exogenous variable, and this seemed to have made the model rather stiffened, so that an endogenous stock price has been introduced as an equilibrator in the market for securities and also for money, which has made the model itself more flexible. Otherwise, the gap between the demand for and supply of securities should have adjusted itself quantitatively as in the early paper.
9. The computation program for "Least Squares Estimation of Nonlinear Parameters" is available at the Yale Computer Center. Charles W. Bischoff kindly assisted me in using and revising the program. Suggestions of the program by Roger Klein were also helpful.
10. This specification is due to a study paper of the fiscal behavior project headed by Y. Ichikawa, Economic Research Institute, Economic Planning Agency, the Japanese Government. See Y. Ichikawa and H. Ikeda, "Measurement of Tax Functions," Keizai-bunseki (Economic Analysis), No. 19, September, 1966, Economic Research Institute, Economic Planning Agency.
11. See J. Lintner (23).
12. Meyer and Kuh (26), Kuh (20) and Meyer and Glauber (27) show a wide variety of empirical results, using cross-section and time series data. Another remarkable attempt has been done by Jorgenson, based on a neo-classical theory of capital accumulation and a generalized distributed lag structure. See Jorgenson (13), (14) and (15). See also F. Hamada (10 and (11)).
13. See Meyer and Kuh (26) and Meyer and Glauber (27). Of course, it might be more plausible to apply the neoclassical theory of capital accumulation for empirical analysis of investment behavior, but specification of a fixed investment function in such a highly aggregative (both over industries and over time) model, would probably not lead to a successful result without drastic simplification.

14. Before this 1964 revision, another big revision had been made in 1961, but preliminary estimation, taking into account both revisions was unsuccessful, so that in the final results another dummy variable corresponding to this other revision was dropped.
15. Duesenberry (4) attempted to analyze the costs of raising funds and corporate finance behavior, but this work has not yet been applied to empirical study. In this study, the ordinal ranking of the costs of raising funds is reflected in the order of selection of funds.
16. These forced savings will soon be explained in their relation to time and savings deposits (2-1-8).
17. Baumol (3) and Tobin (29) developed the theory of the transactions demand for money and Meltzer (24) and (25) applied it to empirical studies, using cross section and time series data, with apparently unsuccessful results. Tobin (30) advanced a sophisticated theory of liquidity preference, but in the field of empirical studies, remarkably little has yet been done. Kisselgoff (16) and Klein (17) attempted to estimate an equation for the demand for idle money, and the author himself also tried to explain the excess money with a formulation very similar to that of Kisselgoff's, but the result was miserable:

$$\frac{M^*}{P_j} = 3142.47 - 1385.28 i_L + 4634.27 p_w$$

$$(1326.27) \quad (4921.02)$$

$$\bar{R}^2 = 0.120 \quad \bar{S} = 527.85 \quad d = 0.979$$

18. Duesenberry pointed out for the United States economy almost the same thing that is stated here. See Duesenberry (5, particularly p. 11).
19. Estimation was done under the constraints as below:

$$\gamma_0, \gamma_1 \text{ and } \rho > 0; \quad 0 < \delta < 1$$

Many cases were attempted, varying the initial guesses for these parameters, and for most of them the estimates were very tightly distributed. The final selection was thus made so as to choose the set of parameters for which the standard error of the regression estimates turned out to be minimum.

20. See Kuroda and Tsujimura (21), Hamada (10) and elsewhere.
21. To make the estimates for the potential supply of final products more plausible, a mark-up factor of 2.002 was introduced, which was inversely derived from the average ratio of potential supply (with this mark-up factor unity) to real GNP. In the case of a Cobb-Douglas type function, which had been used in my earlier paper (12), the value of this factor was about 1.028, which seems more plausible than the value derived from the CES type function.

22. See Lange (22).
23. See Fromm and Klein, "Solutions of the Complete System;" in Duesenberry et. al. (6).
24. Dynamic multipliers for the periods t_2, t_3, \dots , can be expressed as follows:

$$\Delta Y_{t_2}^* = - \left[A_1(GY_{t_1}^*, GZ_{t_1}^*) \right]^{-1} \cdot \left[A_2(GY_{t_1}^*, GZ_{t_1}^*) \begin{matrix} \Delta Y_{t_1}^* \\ 0_1 \end{matrix} \right. \\ \left. + B(GY_{t_1}^*, GZ_{t_1}^*) \Delta GZ_{t_2}^* \right] \\ \Delta Y_{t_3}^* = - \left[A_1(GY_{t_2}^*, GZ_{t_2}^*) \right]^{-1} \cdot \left[A_2(GY_{t_2}^*, GZ_{t_2}^*) \begin{matrix} \Delta Y_{t_2}^* \\ \Delta Y_{t_1}^* \\ 0_2 \end{matrix} \right. \\ \left. + B(GY_{t_2}^*, GZ_{t_2}^*) \Delta GZ_{t_3}^* \right], \text{ and so on,}$$

where 0_1 and 0_2 are zero vectors of $(p \times \tau)$ degree and of $p(\tau-1)$ degree respectively, and

$$\Delta GZ_{t_2}^* = \begin{bmatrix} \Delta Z^* \\ \Delta Z^* \end{bmatrix}; \quad \Delta GZ_{t_3}^* = \begin{bmatrix} \Delta Z^* \\ \Delta Z^* \\ \Delta Z^* \end{bmatrix}.$$

25. The reason why the multiplier for potential supply of final products is positive, may be that an increase in current expenditures lets the GNP implicit price deflator p increase (simply because of an increase in the relative weight of government expenditures, the price for which is relatively high) and this increase in p causes a decline in the real wage rate (-0.00002), since the money wage rate is fixed. However, it is very interesting that potential supply of final products seems to have a considerably sensitivity to the various types of impacts.
26. The reaction of investment in inventories, as well as corporate profits, seems to be very rapid, which seems plausible.

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