Detailed Discussion on the Multiplier Effect of Public Investment in Japan: Policy Simulations Using the Short-Term Multi-Sector Econometric Model[1]

By

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ABSTRACT

Using the short-term multi-sector econometric model, this paper discusses in detail the multiplier effect of public investment in Japan. After examining its fundamental characteristics, the difference in government investment multiplier by the pattern of investment distribution among industries and the factors causing such a difference are analyzed. According to the simulation results, the multiplier becomes large when public investment is allocated more to the agriculture, construction, and tertiary industries. The causal factors identified are the sectoral differences in: (1) marginal and average propensity to import; (2) column sum of Leontief inverse matrix coefficients; (3) net indirect tax rate; and (4) marginal propensities to employ and invest.

1. Introduction

The Japanese economy has been in a severe, prolonged recession since the burst of the bubble economy in the early 1990s. As a result, the unemployment rate reaches the highest level of the past. Thus, the large-scale expansive fiscal policy measures have often been implemented during the same period, but it does not lead to the autonomous recovery supported by private demand whereas a fiscal deficit is growing up to be a huge amount because of such a fiscal policy management. Under these circumstances, there is a growing interest in the effect of fiscal policy on the Japanese economy, especially in the government investment multiplier as its short-term effect. At the same time, there is a growing necessity of thoroughly examining how the Japanese government should distribute its expenditure to stimulate the economy effectively and efficiently. However, there are very few previous empirical studies focusing on these controversial issues. In particular, the question of how the multiplier would be affected by

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the change in the pattern of distributing final demand among industries has received far less (or even no) analysis in the case of the Japanese economy, although a few empirical studies have presented a brief analysis to this question in the case of the foreign economy, e.g. Cloutier and Thomassin (1994) for the Canadian economy, West (1995) for the economy of Queensland state in Australia, and Schindler et al. (1997) for the Chicago economy. Moreover, the factors causing a difference in the multiplier by the pattern of final demand distribution have not yet been analyzed in detail even in the case of the foreign economy.

In order to appropriately make an empirical analysis of the government investment multiplier, it is necessary to use the policy simulation model that considers not only the real side but also the price and monetary side of the economy because it is determined through the complicated interactions among these factors. Furthermore, in order to appropriately make an empirical analysis of the difference in the economic impact of government expenditure by its pattern of distribution, it is necessary to use the policy simulation model that is disaggregated into sectors. A multi-sector econometric (MSE) model is the model type that satisfies these conditions. However, there are only a few previous empirical studies using the MSE model because the cost and labor necessary for developing the MSE model, which requires a large number of time series data and forces its scale to be extremely large, are much larger compared with developing other model types.

In such a context, using the short-term multi-sector econometric model of the Japanese macroeconomy (MS-JMACRO) explicitly considering almost all the short-term impact paths of fiscal policy on the economy, this paper provides a detailed discussion on the multiplier effect of public investment in Japan in the following manner. First, its fundamental characteristics are examined in a detailed and quantitative way by focusing on the change in the economic variables due to the additional public investment. Secondly, the difference in the government investment multiplier by the pattern of investment distribution among industries is quantitatively analyzed, and then the factors causing such a difference are identified on the basis of the characteristics of each industry. In both analyses, the results are compared with those of the previous related studies to discuss these issues in more detail.

This paper is organized as follows. The next section presents an overview of the MS-JMACRO model. Section 3 shows the results of policy simulations and factor analyses, and makes policy discussion. Finally, Section 4 provides concluding remarks.

2. Overview of the MS-JMACRO Model

This section provides an overview of the MS-JMACRO model. For more detailed explanations on this model (such as the description of formulations, estimation results, structural change test results, final test results, and source of each data), see Takeshita (2002)[2].

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[2] This literature is available on request to the author (E-mail: taka@yamaji.t.u-tokyo.ac.jp).

2.1. Basic Structure and Characteristics of the MS-JMACRO Model

The MS-JMACRO model is a short-term multi-sector econometric model of non-equilibrium dynamic type developed for the Japanese economy. It is a large-scale model consisting of approximately 1200 time series data and 530 equations. The basic structure of the model is shown in Figure 1. The model describes commodity market, labor market, money market, and foreign bond market and is comprised of 8 blocks: (1) the final demand block; (2) the output block; (3) the labor block; (4) the supply block; (5) the price block; (6) the value added block; (7) the monetary block; and (8) the income and assets block. All the blocks are interdependent, and are solved simultaneously and iteratively by the Gauss-Seidel method until the model converges on a solution. This model is a macroeconomic model at the same time being disaggregated into 17 sectors as shown in Table 1, considering the availability of a consistent set of time series data, and describes the interindustry linkages and the decision rules for economic variables by each sector. In addition, the institutional sectors are classified into households, incorporated enterprises, foreign countries, and general government in the model. The model appropriately describes three aspects of the economy: production, distribution, and expenditure, and explicitly considers almost all the short-term economic impact paths of fiscal policy (i.e. the factors causing the difference in the government investment multiplier), including those through the price and monetary side as well as those through the real side of the economy.

The MS-JMACRO model is developed using open and available annual data[3] on the basis of the System of National Accounts 1968 (SNA68)[4] by 1990 price. The input-output (IO) submodel is a commodity-by-commodity format and is based on the SNA Input-Output Table. The sample period of the behavioral equations is, in principle,

Figure 1: Basic structure of the MS-JMACRO model

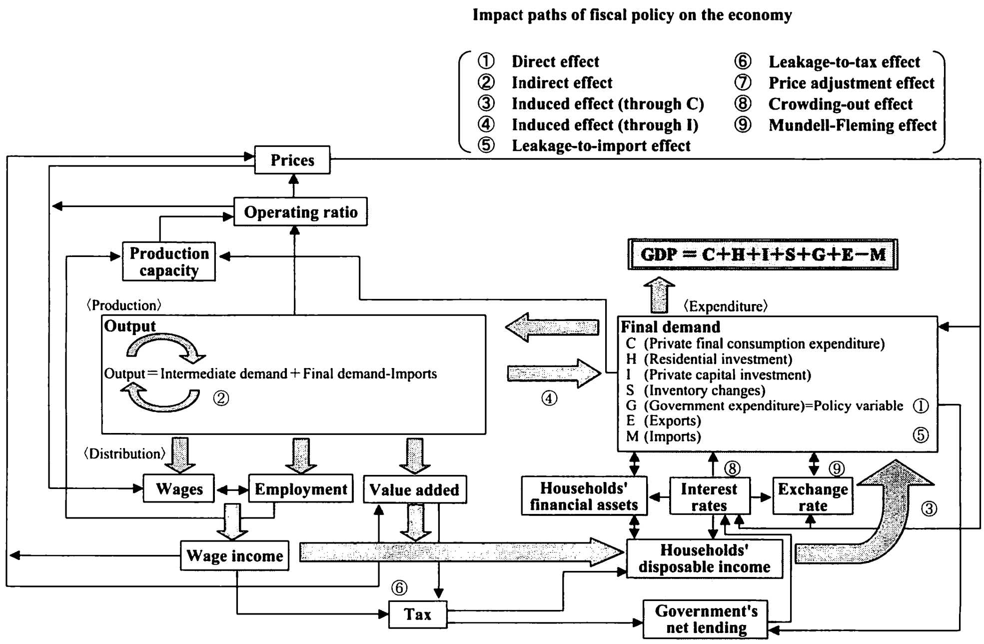

Table 1: Sectoral disaggregation in the MS-JMACRO model

Sector no.	Sector name
(1)	Agriculture, forestry & fishery
(2)	Mining
(3)	Food & beverages
(4)	Textiles
(5)	Pulp, paper & paper products
(6)	Chemicals
(7)	Petroleum & coal products
(8)	Non-metallic mineral products
(9)	Basic metal
(10)	Fabricated metal products & machinery
(11)	Other manufacturing industry
(12)	Construction
(13)	Electricity, gas & water supply
(14)	Transportation & communication
(15)	Services & other tertiary industry
(16)	General government
(17)	Private non-profit institutions serving households

from 1981 to 1998 because of the data limitations. The commodities and industries are classified separately in the model; for example, outputs and prices are determined for each commodity and for each industry. Because of the data limitations on the use matrix, this classification is made not by adopting make-use IO tables but by translating commodity/industry variables into the others statistically, assuming that the row and column sectors are in a one to one correspondence. In addition to the suitable statistical properties of each behavioral equation, the final test results prove that the precision and dynamic stability of the MS-JMACRO model are fairly reasonable (see Takeshita, 2002). It can be argued that this model is a full-scale MSE model competitive with the notable MSE models developed so far[5].

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[3] The main data sources are as follows: Annual Report on National Accounts (Economic Planning Agency); Gross Capital Stock of Private Enterprises (Economic Planning Agency); SNA Input-Output Table (Economic Planning Agency); Economic Statistics Annual (Bank of Japan); Economic and Financial Data (Bank of Japan); Macro Data File (Toyo Keizai Shinpo-sha); Financial Statements Statistics of Corporations by Industry (Ministry of Finance); Annual Report on Indices of Industrial Production (Ministry of International Trade and Industry); Survey of Overseas Business Activities of Japanese Companies (Ministry of International Trade and Industry); Annual Report on the Labor Force Survey (Management and Coordination Agency); and Annual Report on the Monthly Labor Survey (Ministry of Labor).

[4] Although the SNA93 has been adopted since the national accounts for fiscal year 1999, the model is based on the SNA68, because, at this stage, the SNA93 has not been retroacted enough to estimate behavioral equations with sufficient degrees of freedom and is not consistent with the SNA68.

[5] Notable examples of the MSE models of the Japanese economy are the KEO model (Ozaki, 1984), the FORECAST model (Uchida, 1990), the Medium-Term Multi-Sector Econometric Model (Economic Council, 1996), and the COMPASS model (Uno and Meyer, 1999). Those of the foreign

Besides having the general characteristics of the MSE model, the MS-JMACRO model has new notable features summarized as follows. First, in the process of estimating behavioral equations, the CUSUM test results are added to the evaluation criteria to develop the model that is robust against the change in external environment such as policy changes (for details, see Ban (1991)), and the Ramsey's RESET test results are also taken into consideration to avoid the problem of specification error (for details, see Hall and Cummins (1999)). Secondly, structural changes are analyzed in detail in developing the MS-JMACRO model: the time points of structural changes in behavioral equations and their patterns are identified on the basis of the results of the repetitive Chow test[6] and the CUSUM test (while at the same time taking into consideration the analytical reports on the structural changes that have occurred in the Japanese economy such as white papers on the economy (EPA, 1998, 1999, 2000)), and the identified structural changes are reflected in behavioral equations using dummy variables. This process is systematically applied to all the behavioral equations representing consumers' and private firms' behaviors, i.e. households' consumption function, investment functions, labor demand functions, and import functions. Thirdly, the MS-JMACRO model has the advantage of very short computational time on a personal computer without simplifying the characteristics of the MSE model due to the adoption of the block decomposition technique. Such an easy operation feature facilitates carrying out policy simulations repeatedly to make a detailed empirical analysis. The MS-JMACRO model with these characteristics can be the analytical framework suitable for the purpose of this study[7].

2.2. Formulation of the MS-JMACRO Model

The final demand block determines the real final demand components. The households' consumption function at the macro level is derived from the life cycle/permanent income hypothesis (based on microeconomic theory) and the adaptive expectations formation hypothesis of Friedman regarding how consumers expect their permanent income. The consumption function adopted in this model is characterized by its ability to consider the effect of the monetary side factors on households' consumption expenditure due to the introduction of monetary side variables (e.g. interest rates) as explanatory variables. Private residential investment is estimated as a function of real households' net financial assets, lagged private housing stock, and real lending rate. The weighted average of price deflator for private residential investment and land price is

economy include the MSM model (Meyer et al., 1990), the INFORUM model (Almon, 1991), the LIFT model (McCarthy, 1991), the REMI model (Shao and Treyz, 1993), the QUIP model (West, 1994), the E3ME model (Barker et al., 1996), and the CREIM model (Israilevich et al., 1997).

6 The repetitive Chow test means performing Chow tests repetitively, in which each year within the sample period is assumed to be the time point of structural changes. The second Chow test is applicable when analyzing the structural changes near the endpoint of the sample period (for details, see Wago and Ban (1995)).

7 Even in a general context, the recent empirical studies have shown that the use of a MSE model improves the precision of the forecast (Rey and Dev, 1997) and the reliability of the economic impact analysis (West, 1994), compared with the use of other model types. Advantages of a MSE model in short-term economic impact analysis over the other model types are summarized in Takeshita (2002).

used to deflate explanatory variables for the residential investment function to consider the effect of land price on private residential investment. Capital investment by industry is determined by the investment function based on the acceleration principle, into which the user cost of capital (based on the neoclassical investment theory) and the time lag of capital investment are incorporated. Exports are estimated for each commodity as a logarithmic linear function of its relative prices and a given foreign demand. Imports are estimated for each commodity as a logarithmic linear function of its domestic demand, its relative prices, and its given foreign production ratio. The formulation of relative prices in the export and import functions makes it possible to explicitly consider the effect of import duties and exchange rate on exports and imports. The real gross domestic product (GDP) is determined by identity as the sum of real final demand components less real imports. Government expenditures such as public investment are given exogenously as policy variables.

The output block determines sectoral output: the final demand components are fed into the commodity-by-commodity IO submodel and the output is determined for each commodity. The input coefficients and the bridge matrix coefficients allocating each domestic final demand component to each commodity are treated as exogenous based on the assumption of their short-term stability.

The labor block determines the employment and wages by industry, and the unemployment rate. Employment by industry is determined by the labor demand function based on the first postulate in the classical school (using a Cobb-Douglas production function) and the partial adjustment mechanism concerning how employment is adjusted to the optimal employment level. Average wages are determined on the basis of the expectations-augmented Phillips curve. Taking into consideration the stability of the unemployment rate in Japan due to its peculiar employment practice, an average operating ratio rather than the unemployment rate is used as the explanatory variable for average wages. On the basis of the labor productivity principle, wages by industry are then determined as a function of the average wages, its labor productivity, and its operating ratio. The unemployment rate is a function of the average operating ratio.

The supply block determines production capacity and operating ratio for each industry. Capital stock by industry is first determined by an accumulative approach. Then, the linear homogeneous Cobb-Douglas production function is estimated for each industry. The primary factors are assumed to be capital by industry (defined as the product of its lagged capital stock and its capital operating ratio) and labor by industry (defined as the product of its employment and its working hours). Time trend is also used as an explanatory variable for production functions based on the assumption of a neutral technical progress. Production capacity by industry is determined by assuming full operation of capital and labor inputs in its estimated production function, and operating ratio by industry is then defined as the ratio of its actual production determined through the demand side of the economy to its production capacity. The operating ratio plays a role in the dynamic adjustment path to the equilibrium over time by affecting prices and wages.

The price block determines the price variables and the nominal final demand components. Price of product by industry is estimated as a function of its operating ratio and its cost price (defined as its total cost per unit of output) on the basis of the mark-up pricing principle. The import price in dollars before including tax by commodity is given exogenously, and is translated into the import price in yen before/after including tax by commodity by taking into consideration the exchange rate and a given import duties rate by commodity. The export price by commodity is determined by its cost price, its import price, and the exchange rate. These price variables are used to determine other sectoral and macro price variables (such as domestic demand price by commodity, price deflators for final demand components, and consumer/wholesale price index) based on a weighted average or econometric estimation method. Then, nominal final demand components, nominal GDP, and GDP deflator are determined by identity.

The value added block determines value added and its components for each industry. Value added by industry is defined by subtracting its nominal intermediate inputs from its nominal output. Operating surplus by industry is defined as the residual obtained by subtracting its consumption of fixed capital, its wage income (defined as the product of its wages and its employment), and its net indirect tax (defined as the product of its given net indirect tax rate and its nominal output) from its value added. The wage income and operating surplus are used to determine income distribution in the income and assets block.

The monetary block determines the money supply, interest rates, and the exchange rate. The short-term interest rate is given exogenously as a policy variable in the light of the Japanese monetary policy management, and the real money supply is determined by the money demand function. The long-term interest rate is determined by the increase rate of the GDP deflator (expected inflation rate factor), the ratio of general government's net lending to the nominal GDP (fiscal deficit factor), and the term structure of interest rates. The lending and deposit rates are determined by assuming that the trend of the short- and long-term interest rates is reflected in them. The exchange rate is determined on the basis of the assets preference approach and is estimated as a function of the ratio of the wholesale price index in Japan to that in the U.S. (equilibrium exchange rate derived from the theory of purchasing power parity), the difference between the real long-term interest rate in Japan and that in the U.S., and the ratio of the cumulative current account surplus to the nominal GDP (risk premium). Interest rates have an effect on the real side of the economy by affecting households' consumption expenditure through the assets effect, private investment through capital cost, and exports and imports through the exchange rate.

The income and assets block determines income (components), saving-investment balance, and financial assets/debts (components) for each institutional sector. The income components (such as compensation of employees, property income, social security, and taxes) and the saving-investment balance are first determined for each institutional sector on the basis of the income and outlay accounts and the capital finance accounts in the SNA, respectively. Then, the financial assets/debts are determined for each institutional sector by using its saving-investment balance, and their components are determined based on the theory of portfolio selection. Real households' disposable income and real households' net financial assets are fed back into the households' expenditures. Net tax revenue is defined as the sum of the direct tax (whose components are determined as a function of income by the corresponding institutional sector) and the net indirect tax, which affects general government's net lending. Direct tax on households affects households' disposable income, direct tax on incorporated enterprises affects capital investment through the user cost of capital, and net indirect tax affects prices through cost price by industry.

The short-term economic impact of the increase in public investment is replicated by the MS-JMACRO model in the following way. An additional public investment raises GDP directly through the GDP identity (Direct effect). It also creates intermediate demands for the relevant industries through the process of intermediate inputs and induces outputs throughout the economy (Indirect effect). The increase in income and output due to the direct and indirect effects induces final demand such as consumption expenditure and private investment, which in turn raises GDP further (Induced effect). The induced effect creates another induced effect in the same manner and this ripple effect continues until the succeeding effect becomes negligible. On the other hand, part of the generated demand leaks to import (Leakage-to-import effect), and part of the generated income leaks to tax (Leakage-to-tax effect). The increase in prices due to the high economic performance caused by the additional public investment also reduces the generated demand (Price adjustment effect). In addition, the tight money balance and increase in the fiscal deficit caused by the additional public investment raise interest rates, and this crowds out private investment (Crowding-out effect). There are two possible effects of the additional public investment on the exchange rate. One is that the exchange rate appreciates because of the capital inflow due to the increase in domestic interest rates, and the current account becomes worse (Mundell-Fleming effect). The other is that the exchange rate depreciates because of the increase in domestic prices. The relationship between the increase in domestic interest rates and domestic prices due to the additional public investment determines the direction in which the exchange rate moves.

3. Results and Discussion

3.1. Flow of the Analysis

Using the MS-JMACRO model, policy simulations are carried out for the following purposes: (1) the short-term economic impact of the increase in public investment in Japan is examined in a detailed and quantitative way to analyze the fundamental characteristics of the multiplier effect of public investment in Japan; and (2) the difference in the government investment multiplier in Japan by the pattern of investment distribution among industries is quantitatively analyzed, and then the factors causing such a difference are identified on the basis of the characteristics of each industry. For these purposes, four cases are set up for policy simulations as shown in Table 2.

In the 3-year sustained change case and the 3-year sustained change case in nominal terms, the public investment is increased by 1 trillion yen at constant and current prices, respectively, continuously for three years from 1996 to 1998. In the 1-year impact change case, the public investment is increased by 1 trillion yen at constant prices temporarily in one of the years from 1996 to 1998. In these three cases, the additional public investment is allocated to each industry similarly to the actual share in the public investment in Japan in the corresponding year. On the other hand, the assumption of the modified distribution pattern case is as follows: it is first assumed that the public investment actually implemented in Japan in 1998 (approximately 38 trillion yen at constant prices) were distributed widely among industries in the same way as in 1998; and then the public investment is assumed to be increased from this level by 1 trillion yen at constant prices temporarily in 1998 and this additional public investment is assumed to be allocated to one of the industries (i.e. this additional public investment is assumed to lead to an increase in the final demand for one industry). It should be noted that this assumption does not mean that all the public investment created the demand only for one industry in 1998. Rather, the modified distribution pattern case assumes that the pattern of distributing public investment were modified so that it was allocated more to one industry in 1998 and attempts to examine its short-term economic impact. This case is used for analytical purposes to highlight the difference arising from the change in the pattern of public investment distribution and does not attempt to compare the alternative policy options available, because its change is actually accompanied by multiple changes across a range of sectors.

Based on the above four cases, the analyses are made in the following way. First, a comprehensive analysis of the government investment multiplier is made by comparing the results of the 3-year sustained change case, the 3-year sustained change case in

Table 2: Case definitions for the policy simulations

Case name	Time period	Increasing pattern of the public investment	Allocating pattern of the additional public investment	Matter of discussion
3-year sustained change case	1996-98	Continuous increase of ¥1 trillion at constant 1990 prices for 3 years	Similar to the share of each industry in the public investment in the corresponding year	– Change in major economic variables – Contribution of each final demand component to the change in GDP – Cumulative effect
3-year sustained change case in nominal terms	1996-98	Continuous increase of ¥1 trillion at current prices for 3 years	Similar to the share of each industry in the public investment in the corresponding year	– Price adjustment effect
1-year impact change case	1996-98	Temporary increase of ¥1 trillion at constant 1990 prices for 1 year	Similar to the share of each industry in the public investment in the corresponding year	– Change in major economic variables – Contribution of each final demand component to the change in GDP – Rebound effect
Modified distribution pattern case	1998	Temporary increase of ¥1 trillion at constant 1990 prices for 1 year	Allocation to 1 industry[a]	– Difference in the government investment multiplier by the pattern of investment distribution

Notes:

[a] It is assumed that the public investment actually implemented in Japan in 1998 (approximately ¥38 trillion) was allocated to each industry in the same way as in 1998, and that an additional public investment of ¥1 trillion was allocated to one industry.

nominal terms, and the 1-year impact change case. Here, the changes in major economic variables due to the additional public investment are analyzed by examining the results of the 3-year sustained change case and the 1-year impact change case simulated for 1996. The contribution of each final demand component to the change in GDP, the cumulative effect due to the continuous increase in the public investment, and the price adjustment effect are then analyzed by examining the results of the 3-year sustained change case, the 3-year sustained change case in nominal terms, and the 1-year impact change case simulated for the period 1996-98. The rebound effect due to the temporary increase in the public investment is finally analyzed by examining the result of the 1-year impact change case simulated for 1996. Secondly, the modified distribution pattern case is simulated for every industry. By examining and comparing the results, the difference in the government investment multiplier by the pattern of investment distribution among industries is quantitatively analyzed. Then, the factors causing such a difference are identified by focusing on several sectoral indices reflecting the characteristics of each industry. In all cases, the changes in the economic variables from the observed values, referred to as the base case, are analyzed. In this study, the government investment multiplier is defined as

$$\textit{Government investment multiplier} = \frac{\Delta GDP}{\Delta IG} \tag{1}$$

where ΔIG is the increase in the public investment (i.e. 1 trillion yen at constant or current prices in these policy simulations), and ΔGDP is the increase in the real GDP.

Major assumptions for policy simulations are as follows. First, policy simulations are carried out within the sample period throughout this study. This is because it is difficult to appropriately forecast exogenous variables for the out-of-sample period and because these forecasts may have a significant effect on the results of the policy simulations. Secondly, the time span of the policy simulations is restricted to the short-term, 3 years at the longest, in this study. This is because behavioral equations in the MS-JMACRO model are estimated using relatively small samples and because the model does not fully consider the medium- and long-term economic impact paths of fiscal policy through the supply side of the economy (e.g. the productivity effect of social capital) or the theoretical constraints to ensure the equilibrium condition (e.g. the budget constraint of the general government) at this stage of the model. Thirdly, taking into account the Japanese fiscal and monetary policy management, it is assumed that the additional public investment is financed with the issue of public bonds and a short-term interest rate is fixed in the model as a policy variable in carrying out fiscal policy simulations. The assumption of a fixed short-term interest rate implicitly assumes that monetary policy is managed in cooperation with fiscal policy and that it is eased simultaneously in implementing the expansive fiscal policy. It should be noted that the government investment multiplier is largely affected by the assumptions about the finance of public investment and the monetary policy management.

3.2. Comprehensive Analysis of the Government Investment Multiplier

Table 3 shows the deviation rate from the base case for the major macro variables of the Japanese economy in the 3-year sustained change case and the 1-year impact change case simulated for 1996. Note that the exchange rate is based on the Japanese yen per U.S. dollar exchange rate.

As shown in this table, the major macro variables can be classified into two groups in terms of how they are affected by the additional public investment. The first group consists of GDP, private residential investment, private capital investment, exports, imports, private output, and average operating ratio. The second group consists of private final consumption expenditure, employees, average wages, GDP deflator, interest rates, and exchange rate. The macro variables of the first group increase almost simultaneously with the additional public investment. In the 3-year sustained change case, their deviation rates from the second year of the simulation do not rise so much beyond their levels in the first year. In the 1-year impact change case, they converge on the level in the base case almost simultaneously after the end of the additional public investment. These results mean that these macro variables tend to be affected almost simultaneously by the change in the public investment and that the direct effect, the indirect effect, the induced effect through capital investment, and the leakage-to-import effect have the characteristics of affecting the government investment multiplier almost simultaneously in implementing the additional public investment. On the other hand, the macro variables of the second group increase gradually over time in the 3-year sustained change case. In the 1-year impact change case, they continue to be affected even after the end of the additional public investment: the converging movements of these variables toward their base case levels are slow. These results mean that these macro variables tend to be affected gradually and continuously by the change in the public investment and that the induced effect through consumption expenditure, the price adjustment effect, the crowding-out effect, and the Mundell-Fleming effect have the characteristics of affecting the government investment multiplier gradually and continuously.

It should be noted that the exchange rate depreciates due to the additional public investment. This result is in line with the results derived from the previous studies that have analyzed the economic impact of the additional public investment with a fixed short-term interest rate (e.g. Hori et al., 1998)[8]. This is because when the public investment is increased, the increase in domestic interest rates is moderate because of the assumption of the fixed short-term interest rate whereas the increase in domestic prices is observed. The relationship between the increase in domestic prices and the depreciation of exchange rate determines how exports are affected by the additional public investment. Here, exports increase due to the additional public investment. These results indicate that if monetary policy is eased so that the short-term interest rate is kept constant in implementing the expansive fiscal policy, it is possible that the Mundell-Fleming effect does not appear. Although the short-term interest rate is kept constant, lending rate and long-term interest rate increase because of the increase in domestic prices and fiscal deficit. According to the result of the 3-year sustained change case, private capital investment is continuously induced because of the continuous increase in private output. In contrast, private residential investment is crowded out by the increase in real lending rate, and it becomes smaller than the level in the base case after 1997 because

[8] Hori et al. (1998) pointed out that this is one of the most important results derived from the theoretical analysis where the public investment is increased with a short-term interest rate kept constant.

Table 3: Deviation rate from the base case for the major macro variables of the Japanese economy in the 3-year sustained change case and the 1-year impact change case for 1996 (%)

	3-year sustained change case			1-year impact change case for 1996		
	1996	1997	1998	1996	1997	1998
Private final consumption expenditure	0.07	0.14	0.23	0.07	0.08	0.08
Private residential investment	0.14	–0.03	–0.10	0.14	–0.26	–0.06
Private capital investment	0.66	0.55	0.51	0.66	–0.05	–0.08
Exports	0.19	0.14	0.02	0.19	–0.06	–0.14
Imports	0.43	0.45	0.49	0.43	0.01	0.04
GDP	0.34	0.36	0.37	0.34	0.02	0.00
Private output	0.40	0.41	0.41	0.40	0.01	–0.01
Employees	0.05	0.07	0.09	0.05	0.03	0.03
Average wages	0.17	0.27	0.32	0.17	0.09	0.05
Average operating ratio	0.37	0.34	0.32	0.37	–0.03	–0.03
GDP deflator	0.02	0.09	0.13	0.02	0.07	0.03
Long–term interest rate	0.71	3.20	3.15	0.71	1.88	–0.95
Lending rate	0.17	0.55	0.58	0.17	0.35	–0.01
Exchange rate	0.18	0.26	0.20	0.18	0.07	–0.08

the increase in real households' net financial assets, i.e. the explanatory variable for private residential investment, is moderate. These results imply that it is real lending rate that affects private investment, and that even if the short-term interest rate is fixed, it is possible that the crowding-out effect would appear.

Figure 2 and Table 4 show the government investment multiplier in Japan derived from the 3-year sustained change case, the 3-year sustained change case in nominal terms, and the 1-year impact change case simulated for the period 1996-98. Table 4 shows the contribution of each final demand component to the change in GDP in Japan derived from these three cases, and Figure 3 also shows the results of the 3-year sustained change case and the 1-year impact change case simulated for the period 1996-98 excluding public investment whose contribution is constant over the simulation period, i.e. 1 trillion yen at constant prices.

As shown in these figures and tables, when the public investment is increased, private capital investment, private residential investment (except for the period 1997-98 in the 3-year sustained change cases), private final consumption expenditure, and exports increase and contribute to the increase in GDP. However, the increase in GDP induces imports and the increase in imports contributes to the decrease in GDP. Among the final demand components, the increase in private capital investment is the most important factor for the government investment multiplier in the first year when the public investment is increased. On the other hand, the government investment multiplier in the 3-year sustained change case becomes larger and larger over time than that in the 1-year impact change case due to the continuous increase in the public investment. This is because the induced private final consumption expenditure increases over time due to the continuous increase in the public investment. It is this phenomenon that is called the cumulative effect (West, 1994, 1995). In other words, the contribution of the induced private final consumption expenditure to the government investment multiplier becomes larger and larger over time as the public investment is increased continuously. The reason for the gradual increase in private final consumption expenditure is that employees and wages increase gradually with the additional public investment. The empirical analysis using the Medium-Term Multi-Sector Econometric Model of the Japanese economy (Economic Council, 1996) reaches the same conclusion, describing that private capital investment increases immediately and private final consumption expenditure increases gradually when the public investment is increased.

As for the magnitude of the government investment multiplier, the government investment multiplier in Japan derived from this study is relatively larger than that derived from other empirical studies, as shown in Table 5. The main reason is the difference in the assumption about the monetary policy management. In this study, it is assumed that monetary easing measures are adopted to enhance the economic impact of the additional public investment and the short-term interest rate is fixed in implementing the expansive fiscal policy, as described in the previous subsection. On the other hand, in other empirical studies, a policy reaction function of the short-term interest rate is usually adopted concerning how monetary policy is managed in implementing the expansive fiscal policy.

The government investment multiplier derived from the 3-year sustained change case in nominal terms is smaller than that derived from the 3-year sustained change case or the 1-year impact change case. Moreover, the difference in the government investment multiplier between the 3-year sustained change case and the 3-year sustained change case in nominal terms becomes larger and larger over time. This is because an additional public investment of 1 trillion yen at current prices becomes smaller and smaller in real terms over time than an additional public investment of 1 trillion yen at constant prices because of the continuous increase in prices due to the additional public investment (i.e. the price adjustment effect). In the 3-year sustained change case in nominal terms, the cumulative effect is significantly offset by such a price adjustment effect.

In the case of introducing the impulse-type external shock, e.g. the temporary increase in the public investment, to a macroeconomic model, the rebound effect is often reported by several previous empirical studies (e.g. Hori et al., 1998). The rebound effect means the phenomenon that GDP becomes smaller than the level in the base case for a few years after the end of the additional public investment. The reason for this phenomenon is that the upward trend of the price and monetary side variables (e.g. prices and interest rates) continues even after the end of the additional public investment whereas most of the real side variables (e.g. final demand components) converge on the level in the base case immediately after its end. In this study, the rebound effect is observed in the 1-year impact change case simulated for the period before 1992. However, in the 1-year impact change case simulated for the period thereafter, GDP does not become smaller than the level in the base case, although such variables as private capital investment and private output become smaller than their levels in the base case after the end of the additional public investment. This is because the extent of the increase in prices due to the additional public investment becomes smaller over time. This implies that the rebound effect is not so important in the current economic situ-

Figure 2: Government investment multiplier in Japan derived from the 3-year sustained change case, the 3-year sustained change case in nominal terms, and the 1-year impact change case

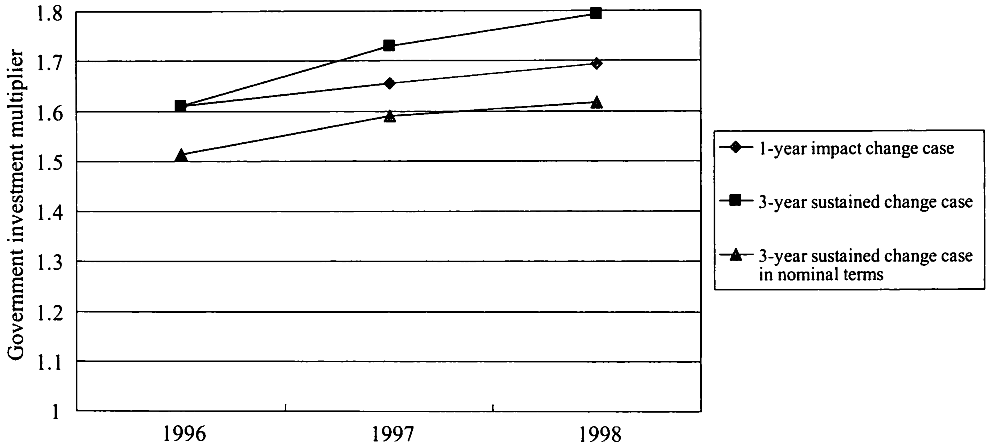
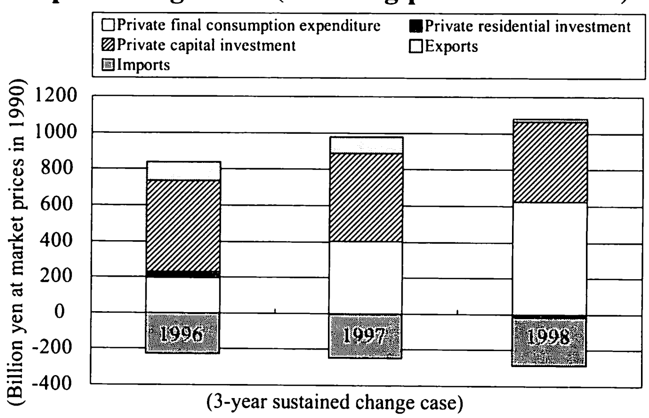
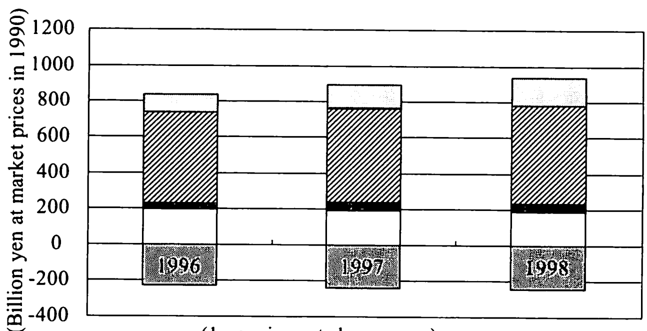


Figure 3: Contribution of each final demand component to the change in GDP in Japan derived from the 3-year sustained change and 1-year impact change cases (excluding public investment)



(3-year sustained change case)



(1-year impact change case)

Table 4: Government investment multiplier and contribution of final demand components in Japan derived from the 3-year sustained change case, the 3-year sustained change case in nominal terms, and the 1-year impact change case

(3–year sustained change case)

		1996	1997	1998
Change in final demand components (billion yen at market prices in 1990)				
	Private final consumption expenditure	196.406	401.719	624.219
	Private residential investment	34.379	–6.742	–18.824
	Private capital investment	502.438	487.313	438.875
	Public investment	1000.000	1000.000	1000.000
	Exports	105.719	89.855	16.578
	Imports	227.988	243.023	267.738
Government investment multiplier		1.611	1.729	1.793

(3–year sustained change case in nominal terms)

		1996	1997	1998
Change in final demand components (billion yen at market prices in 1990)				
	Private final consumption expenditure	184.656	373.156	575.500
	Private residential investment	32.459	–7.143	–18.424
	Private capital investment	472.125	447.523	391.305
	Public investment	939.822	916.611	901.535
	Exports	99.047	82.914	8.867
	Imports	214.270	222.902	242.223
Government investment multiplier		1.514	1.590	1.617

(1–year impact change case)

		1996	1997	1998
Change in final demand components (billion yen at market prices in 1990)				
	Private final consumption expenditure	196.406	191.313	187.656
	Private residential investment	34.379	45.174	46.391
	Private capital investment	502.438	529.516	546.844
	Public investment	1000.000	1000.000	1000.000
	Exports	105.719	127.594	155.516
	Imports	227.988	238.375	242.164
Government investment multiplier		1.611	1.655	1.694

Table 5: Comparison of the government expenditure multiplier in Japan derived from the related studies based on sustained change simulations[a]

Model name	Author/ Institution	Year of publication	Sample period	Government expenditure multiplier derived from sustained change simulations		
				1st year	2nd year	3rd year
Short-run macro econometric model of the Japanese economy	Hori et al.	1998	1985-1997 (quarterly model)	1.21	1.31	1.24
				1.22[b]	1.43[b]	1.50[b]
Medium-term multi-sector econometric model of the Japanese economy	Economic council	1996	1975-1990 (half-yearly model)	1.30	1.45	1.24
				1.40[b]	2.01[b]	2.08[b]
NEEDS model for the Japanese economy	Nikkei Quick Information Technology Co., Ltd.	1997	1986-1996 (quarterly model)	1.07[c]	1.65[c]	1.80[c]
DENKEN macro model	Central Research Institute of Electric Power Industry	1996	1980-1994 (annual model)	1.38	1.89	1.90
MS-JMACRO model	Takeshita	2002	1981-1998 (annual model)	1.61[b]	1.73[b]	1.79[b]

Notes:

[a] Part of this table is based on the information by Hori et al. (1998).

[b] The multiplier derived from the case with a fixed short-term interest rate.

[c] The multiplier derived from the case assuming an increase in public investment in nominal terms.

ation in Japan which is characterized by a widening deflationary gap and a slow price adjustment speed.

3.3. Quantitative Analysis of the Difference in the Government Investment Multiplier by the Pattern of Investment Distribution

Figure 4 and Table 6 show the comparison of the government investment multiplier in Japan derived from the modified distribution pattern case. As shown in this figure, even if the same amount of the additional public investment is implemented, there is a great difference in the government investment multiplier by the pattern of investment distribution among industries. The government investment multiplier is largest in the case of allocating the additional public investment to the services & other tertiary industry, followed by the cases of allocating it to the agriculture, forestry & fishery industry, the construction industry, and the other manufacturing industry. On the contrary, the government investment multiplier is small in the case of allocating it to the mining industry, the petroleum & coal products industry, the basic metal industry, and the textiles industry. It can be seen that the government investment multiplier is generally larger in the case of allocating the additional public investment to the agriculture, construction, and tertiary industries than in the case of its allocation to the manufacturing industries.

Figure 4: Government investment multiplier in Japan derived from the modified distribution pattern case

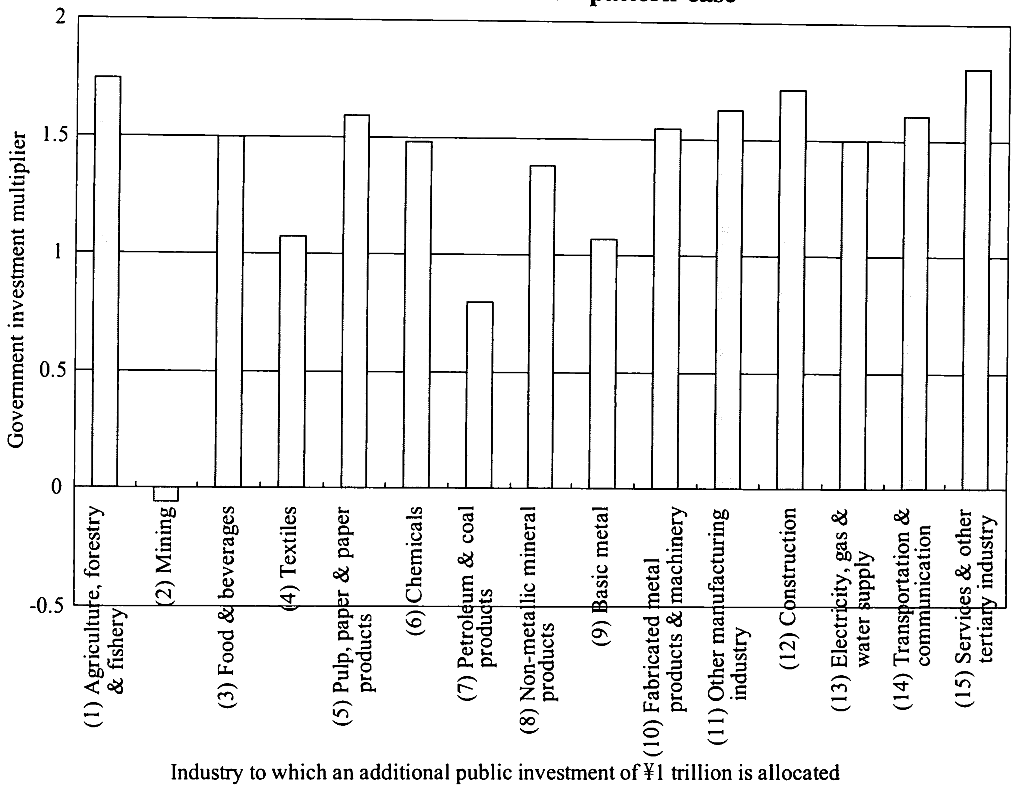


Table 6: Government investment multiplier in Japan derived from the modified distribution pattern case, and five important sectoral indices

	Government investment multiplier	Product of self-sufficiency ratio and column sum of inverse matrix coefficients	Marginal propensity to employ
(1) Agriculture, forestry & fishery	1.746 (2)	1.495 (13)	NA
(2) Mining	−0.060 (15)	0.274 (15)	1.699 (14)
(3) Food & beverages	1.500 (8)	1.892 (5)	5.196 (8)
(4) Textiles	1.073 (12)	1.531 (12)	66.055 (1)
(5) Pulp, paper & paper products	1.592 (6)	1.999 (2)	3.260 (12)
(6) Chemicals	1.482 (10)	1.813 (7)	4.026 (9)
(7) Petroleum & coal products	0.801 (14)	1.229 (14)	2.128 (13)
(8) Non-metallic mineral products	1.385 (11)	1.729 (8)	14.288 (5)
(9) Basic metal	1.070 (13)	2.123 (1)	3.272 (11)
(10) Fabricated metal products & machinery	1.547 (7)	1.918 (4)	9.617 (7)
(11) Other manufacturing industry	1.626 (4)	1.820 (6)	13.114 (6)
(12) Construction	1.718 (3)	1.971 (3)	14.294 (4)
(13) Electricity, gas & water supply	1.499 (9)	1.580 (11)	3.839 (10)
(14) Transportation & communication	1.607 (5)	1.615 (10)	21.036 (3)
(15) Services & other tertiary industry	1.813 (1)	1.623 (9)	23.230 (2)

Notes: Numbers in parentheses denote the rank. The marginal propensity to employ represents the marginal change in employment per billion-yen increase in industrial output.

Table 6: *Continued*

	Marginal propensity to invest	Marginal propensity to import	Net indirect tax rate
(1) Agriculture, forestry & fishery	0.008 (15)	0.052 (10)	0.035 (10)
(2) Mining	0.019 (13)	1.051 (1)	0.048 (6)
(3) Food & beverages	0.038 (12)	0.084 (9)	0.114 (2)
(4) Textiles	0.010 (14)	0.466 (2)	0.054 (5)
(5) Pulp, paper & paper products	0.100 (8)	0.105 (8)	0.038 (9)
(6) Chemicals	0.148 (5)	0.147 (5)	0.035 (11)
(7) Petroleum & coal products	0.043 (11)	0.048 (11)	0.260 (1)
(8) Non-metallic mineral products	0.178 (3)	0.117 (7)	0.048 (7)
(9) Basic metal	0.072 (9)	0.171 (4)	0.034 (12)
(10) Fabricated metal products & machinery	0.127 (7)	0.124 (6)	0.029 (15)
(11) Other manufacturing industry	0.217 (2)	0.185 (3)	0.033 (13)
(12) Construction	0.053 (10)	0.000 (14)	0.030 (14)
(13) Electricity, gas & water supply	0.166 (4)	0.000 (14)	0.072 (3)
(14) Transportation & communication	0.132 (6)	0.043 (12)	0.058 (4)
(15) Services & other tertiary industry	0.251 (1)	0.021 (13)	0.046 (8)

Notes: Numbers in parentheses denote the rank.

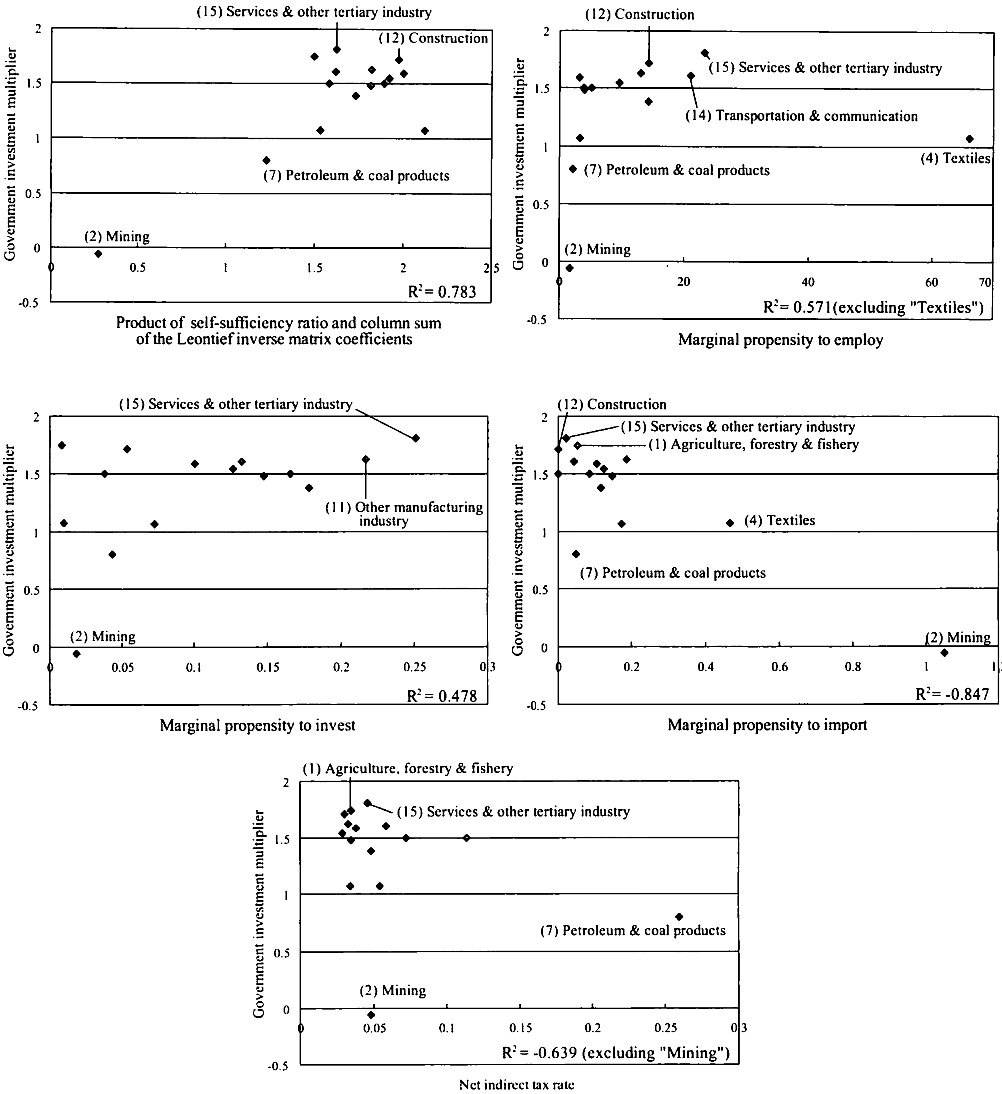
Of the manufacturing industries, it can also be seen that the government investment multiplier is larger in the case of allocating the additional public investment to the processing and assembly industries (numbered (10)-(11)) than in the case of its allocation to the material industries (numbered (4)-(9)).

Next, the following discussion attempts to identify the factors causing such a difference in the government investment multiplier on the basis of the characteristics of each industry. In other words, the focus is placed on identifying what characteristics of each industry cause the difference in the government investment multiplier by the pattern of investment distribution among industries. For this purpose, taking into consideration the short-term economic impact paths of fiscal policy summarized in Section 2, the correlation between the difference in the government investment multiplier by the pattern of investment distribution among industries and the sectoral difference in the following indices[9] is examined: (1) the product of the self-sufficiency ratio and the column sum of the Leontief inverse matrix coefficients of competitive imports type by in-

[9] The self-sufficiency ratio and the Leontief inverse matrix are derived from the SNA Input-Output Table for calendar year 1998. The net indirect tax rate is defined for each industry as the ratio of net indirect tax to nominal output in 1998. The marginal propensity to invest is defined for each industry as the derivative of its capital investment with respect to its output, and is derived from the estimation results of the investment function by industry. The marginal propensity to employ is defined for each industry as the product of output elasticity of labor demand by industry (derived from the estimation results of the labor demand functions) and the ratio of employed persons to output in 1998 by industry (i.e. average propensity to employ). Similarly, the marginal propensity to import is defined for each industry as the product of domestic demand elasticity of import by industry (derived from the estimation results of the import functions) and import ratio in 1998 by industry (i.e. average propensity to import).

dustry (the factor reflecting the sectoral difference in the direct and indirect effects); (2) the marginal propensity to employ by industry (the factor reflecting the sectoral difference in the induced effect through consumption expenditure); (3) the marginal propensity to invest by industry (the factor reflecting the sectoral difference in the induced effect through capital investment); (4) the marginal propensity to import by industry (the factor reflecting the sectoral difference in the leakage-to-import effect); and (5) the net indirect tax rate by industry (the factor reflecting the sectoral difference in the leakage-to-tax effect). In Figure 5, the government investment multiplier in Japan derived from the modified distribution pattern case is plotted against the product of each industry's self-sufficiency ratio and its column sum of the Leontief inverse matrix coefficients, its marginal propensities to employ, invest, and import, and its net indirect tax rate. Table

Figure 5: Plot of the government investment multiplier in Japan derived from the modified distribution pattern case, versus five important sectoral indices



6 shows the numerical values for all these indices. In the plot of the government investment multiplier derived from the modified distribution pattern case versus each industry's marginal propensity to employ, the agriculture, forestry & fishery industry is excluded because the labor demand function is formulated by the decreasing trend for this industry.

As shown in these figures, there is a high positive correlation between the government investment multiplier in the case of allocating the additional public investment to one industry and the product of its self-sufficiency ratio and its column sum of the Leontief inverse matrix coefficients. In addition, there is a high negative correlation between the government investment multiplier in the case of allocating the additional public investment to one industry and two indices relating to leakage factors: its marginal propensity to import and its net indirect tax rate. It can also be seen that there is a moderate positive correlation between the government investment multiplier in the case of allocating the additional public investment to one industry and its marginal propensities to employ and invest. These results imply that the government investment multiplier tends to become large if the public investment is allocated more to the industry with the following characteristics: (1) the product of self-sufficiency ratio and column sum of the Leontief inverse matrix coefficients (the direct and indirect effects) is large; (2) the marginal propensity to import (the leakage-to-import effect) and/or the net indirect tax rate (the leakage-to-tax effect) are small; and/or (3) the marginal propensity to employ (the induced effect through consumption expenditure) and/or the marginal propensity to invest (the induced effect through capital investment) are large.

This finding can, for the most part, explain the rank of industries with respect to the government investment multiplier arising from allocating the additional public investment to one industry. The high rank of the agriculture, construction, and tertiary industries is mainly due to their low average and marginal propensity to import, and the mining industry is ranked last mainly because it depends heavily on imports. Another reason for the high rank of the construction and tertiary industries compared with the manufacturing industries is the labor-intensive feature of the construction and tertiary industries. The lower rank of the material industries compared with the processing and assembly industries is considered to be caused mainly by the two factors: the stronger backward linkage effects of the processing and assembly industries; and the material industries' large energy consumption in the process of intermediate inputs which results in a leakage to import. Indeed, such features are partly reflected in the rank of each industry with respect to the product of its self-sufficiency ratio and its column sum of the Leontief inverse matrix coefficients, but not exclusively. Although not shown here, it is proved that the import inducement coefficient by industry Δm_j defined as equation (2) can appropriately explain the lower rank of the basic metal industry.

$$\Delta m_j = \sum_i \hat{M}_X \left[I - (I - \hat{M})A\right]^{-1}, \qquad \hat{M}_X = \begin{pmatrix} \frac{IM_1}{Q_1} & 0 & \cdots & 0 \\ 0 & \frac{IM_2}{Q_2} & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \frac{IM_{17}}{Q_{17}} \end{pmatrix} \tag{2}$$

where IM denotes imports by commodity, Q denotes output by commodity, A denotes the input coefficients matrix, and $\hat{M}$ denotes the diagonal matrix of import ratios. The basic metal industry is ranked 5th with respect to the import inducement coefficient, reflecting the large share of coal products in overall intermediate inputs by this industry. It is likely that this factor contributes to the lower rank of the basic metal industry with respect to the government investment multiplier. The textiles industry can be regarded as an outlier in the plot of the government investment multiplier derived from the modified distribution pattern case versus each industry's marginal propensity to employ. This is because employed persons per unit of output, i.e. the average propensity to employ, are much larger for the agriculture, forestry & fishery industry (not shown in this

Table 7: Comparison of the GDP multiplier arising from the same amount increase in the final demand for one industry in question among the related studies[a]

	Closed IO multiplier in Canada[b]	Short-term MSE multiplier in Queensland[c]	Short-term MSE multiplier in Japan[d]
Primary industry			
Agriculture, forestry & fishery	1.347 (1)	0.809 (3)	1.746 (2)
Secondary industry			
Mining	NA	0.857 (1)	−0.060 (15)
Food & beverages	1.094 (2)	0.756 (6)	1.500 (8)
Textiles	NA	Part of 0.670 (11)	1.073 (12)
Pulp, paper & paper products	NA	0.588 (12)	1.592 (6)
Chemicals	0.859 (3)	Part of 0.670 (11)	1.482 (10)
Petroleum & coal products	NA	Part of 0.670 (11)	0.801 (14)
Non–metallic mineral products	NA	0.699 (9)	1.385 (11)
Basic metal	NA	0.744 (7)	1.070 (13)
Fabricated metal products & machinery	NA	0.551 (13)	1.547 (7)
Other manufacturing industry	NA	Part of 0.670 (11)	1.626 (4)
Construction	NA	0.711 (8)	1.718 (3)
Tertiary industry			
Electricity, gas & water supply	NA	0.766 (5)	1.499 (9)
Transportation & communication	NA	0.801 (4)	1.607 (5)
Wholesale and retail trade	NA	0.855 (2)	Part of 1.813 (1)
Finance and business services	NA	0.434 (14)	Part of 1.813 (1)
Recreation, personal & other services	NA	0.672 (10)	Part of 1.813 (1)

Notes:

[a] It should be noted that the classification of industries is not always the same across these studies. Numbers in parentheses denote the rank in each study.

[b] This denotes the closed IO multiplier in Canada arising from 1 million Canadian dollar increase in the final demand for the industry in question (Cloutier and Thomassin, 1994).

[c] This denotes the short-term MSE (QUIP) multiplier in Queensland state in Australia arising from 1 Australian dollar increase in the final demand for the industry in question (West, 1995).

[d] This denotes the short-term MSE (MS-JMACRO) multiplier in Japan arising from ¥1 trillion increase in the final demand for the industry in question.

plot for the above reason) and the textiles industry than other industries; in other words, labor productivity is much lower in these industries.

Table 7 compares the GDP multiplier arising from the same amount increase in the final demand for one industry in question (as shown in Table 6) with that derived from previous related studies: Cloutier and Thomassin (1994) and West (1995). Cloutier and Thomassin (1994) estimated and compared the multiplier in Canada arising from a 1 million Canadian dollar increase in the final demand for one industry, using the closed IO model that is extended to consider the difference in the average propensity to consume and consumption pattern by income group, the difference in the income coefficients and revenue source by industry, and the income of the unemployed and their consumption expenditure. West (1995) estimated and compared the multiplier in Queensland state in Australia arising from a 1 Australian dollar increase in the final demand for one industry using the short-term MSE model, QUIP. Note that there is a great structural difference among the three models compared, and that the classification of industries is not always the same across these three models. Nevertheless, this comparison provides some insights into the general characteristics of each industry and the difference between the economies.

Although these three studies focus on different regions, the rank of industries shows a similar tendency among the three model applications. It is similarly estimated that the multiplier is generally larger in the case of an increase in the final demand for the agriculture and tertiary industries than for the manufacturing industries. This might be because the general characteristics of each industry, more specifically the rank of industries with respect to the factors causing a difference in the multiplier (as identified in Figure 5) are similar among the economies compared here. Data limitations make a detailed discussion difficult, but the examples of such a similarity among the economies might include the relative importance of industries in the magnitude of the leakage-to-import and employment inducement effects: the leakage to import might be less and the employment inducement effect might be larger in the case of an increase in the final demand for the agriculture and tertiary industries than for the manufacturing industries. Another important factor for the high rank of the agriculture industry in three studies might be the relatively lower indirect tax and higher subsidies for this industry. On the contrary, the rank of the mining industry is completely different between these studies. It is ranked first in West's study and is ranked last in this study. This is due to the great difference in the domestic mining resource production between Australia and Japan. Australia has a plentiful mining resource, especially coal, and hence much of the demand for the mining resource can be met domestically. In contrast, Japan satisfies almost all the demand for the mining resource by import, which significantly decreases the rank of the mining industry in Japan. This can also explain the difference in the rank of the basic metal industry between West's study and this study, because the production of basic metal (especially steel) requires a large amount of coal products as intermediate inputs as described above.

Table 8 compares the government investment multiplier in Japan derived from the modified distribution pattern case with the actual allocation of public investment in Japan in 1998. It is interesting to note that the rank of industries with respect to the actual share in public investment allocation in 1998 is well in line with the rank with respect to the government investment multiplier derived from the modified distribution pattern case. This implies that the current distribution pattern of public investment in Japan is appropriate at least in terms of enhancing the short-term economic impact, although the policy discussion on this issue should not be made only from this viewpoint.

Table 8: Comparison of the government investment multiplier in Japan derived from the modified distribution pattern case with the actual allocation of public investment in Japan in 1998

	Government investment multiplier	Actual share of each industry in public investment allocation in 1998
(1) Agriculture, forestry & fishery	1.746 (2)	0 (7)
(2) Mining	-0.060 (15)	0 (7)
(3) Food & beverages	1.500 (8)	0 (7)
(4) Textiles	1.073 (12)	0.0001 (6)
(5) Pulp, paper & paper products	1.592 (6)	0 (7)
(6) Chemicals	1.482 (10)	0 (7)
(7) Petroleum & coal products	0.801 (14)	0 (7)
(8) Non-metallic mineral products	1.385 (11)	0 (7)
(9) Basic metal	1.070 (13)	-0.0012 (15)
(10) Fabricated metal products & machinery	1.547 (7)	0.1698 (2)
(11) Other manufacturing industry	1.626 (4)	0.0095 (4)
(12) Construction	1.718 (3)	0.7820 (1)
(13) Electricity, gas & water supply	1.499 (9)	0 (7)
(14) Transportation & communication	1.607 (5)	0.0028 (5)
(15) Services & other tertiary industry	1.813 (1)	0.0369 (3)

Notes: Numbers in parentheses denote the rank. The minus share of the basic metal industry is due to the adoption of the Stone method, implying the scrap of iron arising from public institutions.

4. Concluding Remarks

This paper has discussed in detail the multiplier effect of public investment in Japan using the short-term multi-sector econometric model of non-equilibrium dynamic type developed for the Japanese economy (MS-JMACRO), which is characterized by its explicit consideration of almost all the short-term economic impact paths of fiscal policy (i.e. the factors causing the difference in the government investment multiplier). First, the fundamental characteristics of the multiplier effect of public investment have been examined in a detailed and quantitative way by focusing on the change in the economic variables due to the additional public investment. Secondly, the difference in the government investment multiplier by the pattern of investment distribution among industries has been quantitatively analyzed, and then the factors causing such a difference have been identified on the basis of the characteristics of each industry. The major findings derived from these analyses can be summarized as follows.

1. The direct effect, the indirect effect, the induced effect through capital investment, and the leakage-to-import effect have the characteristics of affecting the government investment multiplier immediately. The increase in private capital investment due to the additional public investment is the major factor for the government investment multiplier in the first year when the public investment is increased. On the other hand, the induced effect through consumption expenditure, the price adjustment effect, the crowding-out effect, and the Mundell-Fleming effect have the characteristics of affecting the government investment multiplier gradually and continuously. In the case of increasing the public investment with the short-term interest rate kept constant, the crowding-out effect appears, but the Mundell-Fleming effect does not appear and the exchange rate depreciates.
2. There is a great difference in the government investment multiplier in Japan by the pattern of investment distribution among industries. The government investment multiplier tends to become large if the public investment is allocated more to the industry with the following characteristics: (1) the marginal and/or average propensity to import are small; (2) the column sum of the Leontief inverse matrix coefficients is large; (3) the net indirect tax rate is low; and/or (4) the marginal propensities to employ and/or invest are large. In concrete terms, the government investment multiplier is generally large in Japan in the case of allocating the additional public investment to the agriculture, construction, and tertiary industries.

It can be argued that this study could provide a more detailed empirical analysis of the economic impact of the increase in public investment in Japan compared with the previous related studies. Furthermore, to the author's knowledge, the quantitative analysis of the difference in the government investment multiplier in Japan by the pattern of investment distribution among industries and the detailed analysis of the factors causing such a difference on the basis of the characteristics of each industry are new contributions. The finding that the induced private investment is the major factor for the government investment multiplier suggests the danger associated with the economic impact analysis using the conventional IO model that does not consider the induced effect through capital investment. The findings derived from this study may be useful for the discussion of fiscal policy, and provide important policy implications. However, it should be kept in mind that we need to discuss how fiscal policy should be managed from the viewpoints of creating productive capacity, providing public goods, redistributing income, and the soundness of public finance as well as the viewpoint of creating demand to enhance the short-term economic impact. For example, given the lower productivity of the agriculture, construction, and tertiary industries in Japan, the finding suggests the possibility that the policy for enhancing the short-term economic impact (such as allocating the additional public investment to these industries) might prevent its long-term economic growth through preserving the lower productivity of these industries.

It should be noted that the results and conclusions drawn here are subject to some reservations and limitations, which are going to be addressed in future analyses. First, some of the economic variables showing the trend of sharp and irregular fluctuations, such as private inventory change and asset prices, are treated as exogenous in the current policy simulations to avoid the spread of errors in the model. However, in order to carry out more rigorous policy simulations, it is necessary to endogenize these variables. Furthermore, taking into consideration the increasing importance of the monetary and assets sectors in the Japanese economy, it is necessary to specify these sectors in more detail in the model. Secondly, because of the large-scale and complicated feature of the Japanese economy, a more detailed sectoral disaggregation than the current configuration of the MS-JMACRO model is, strictly speaking, desirable to more accurately reflect the sectoral differences. Thirdly, in order to more accurately discuss the difference in the government investment multiplier by the pattern of investment distribution among industries, it is desirable to adopt the households' consumption function disaggregated into each income class or each industry in which households are engaged[10] because this is regarded as another important factor reflecting the sectoral difference in the induced effect through consumption expenditure. Fourthly, labor market is separated by each occupation or by each industry in the actual economy, and thus not only the unemployment caused by the lack of demand but also the structural unemployment, which is usually not resolved by the increase in labor demand, occurs. Taking into consideration the increasing importance of the structural unemployment in the Japanese economy, it is desirable to incorporate such an imperfect mobility of labor into the model, which may lead to the decline in the government investment multiplier derived from the model.

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