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Analyses of Public Investment Shock in Japan: Factor Augmented Vector Autoregressive Approach[1]

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Abstract

In this study, we investigate the effect of a positive public investment shock on Japan's private consumption, real wages, and real effective exchange rate using a factor augmented vector autoregressive (FAVAR) model applied to a rich dataset. We demonstrate that private consumption increases, confirming previous literature involving structural VAR analysis of fiscal policy, but the real effective exchange rate appreciates. Our results resolve one of the two fiscal policy puzzles, which consist of qualitative different results among theory and empirical about private consumption and real effective exchange rate, discussed, and we explain them by using the new open economy macroeconomics model with rule of thumb consumers.

JEL classification: E62, H32, H54

Keywords: factor augmented vector autoregressive model, fiscal policy puzzle, new open economy macroeconomics model

1. Introduction

Vector autoregression (VAR) is commonly employed to study the effects of fiscal and monetary policy on macroeconomic variables. Although the standard VAR is criticized because it can incorporate only a small amount of information into its analysis, it more easily accommodates a different problem—restricted degrees of freedom. On the other hand, fiscal and monetary authorities, firms, investors, and consumers may, in fact, rely on an enormous quantity of data. If so, the limited information capacity of a standard VAR model cannot capture behaviors potentially based on voluminous data.

Disagreement between results of (Structural) VAR models and small open economy dynamic stochastic general equilibrium (DSGE) or new open economy macroeconomic (NOEM)model present two puzzles about predicted effects of a government spending shock on private consumption and the real exchange rate.[2] A structural VAR analysis generally finds that private consumption responds positively (i.e. (consumption) crowding-in) to an increase in government spending and that the real exchange rate depreciates. Conversely, standard DSGE models predict private consumption will decline (i.e. (consumption) crowding-out), although the traditional Mundell-Fleming IS-LM model predicts it will increase. Moreover, both NOEM and the Mundell-Fleming models predict that the real exchange rate will appreciate.

These differences in analytical results arise because the VAR model does not nest the NOEM model. Although the VAR model is low-dimensional because of its degrees of freedom, NOEM deals with more variables. In addition, fiscal policy analysis via VAR models excludes forward-looking variables that embody expectations, notably various prices, not only commodity prices but also asset ones. To address these problems, Bernanke et al. (2005) regard estimation of the factor augmented vector autoregressive (FAVAR) model as comprising additional economic information not fully captured by variables in the standard VAR. Further, they argue that variables representing unobserved factors can be summarized by observable variables constructed over an extensive time series.

Monetary policy analysis employs the FAVAR approach, as in

[2] In this paper, the real exchange rate is similar in meaning to that of the real effective exchange rate because the NOEM model assumes two countries (home and the rest of the world), and then the real exchange rate is similar to the real effective exchange rate in NOEM model.

Bernanke et al. (2005) and Shibamoto (2007). As for fiscal policy analyses, Forni and Gambetti (2011) analyze the impulse responses of macroeconomic variables to public capital using a FAVAR model, but they omit the real exchange rate from their dataset[3]. Fujii et al. (2012) analyze the response of sectoral private capital investment to public investment using Japanese time series data.

This paper analyzes the dynamic interaction between macroeconomic time series and public investment shocks in Japan using FAVAR as advocated by Bernanke et al. (2005). We produce two main empirical results. First, private consumption rises following a fiscal policy stimulus. This result confirms previous literature employing a structural VAR analysis of fiscal policy and Forni and Gambetti (2011), who adopt structural factor analysis.[4] Second, we find that the real exchange rate appreciates following a fiscal stimulus, which contradicts previous empirical literature such as Kim and Roubini (2008) and Monacelli and Perotti (2010). Moreover, we investigate the effect of public investment on Japanese stock prices and show that stock price targeting suggested by Fukuda and Yamada (2011) did not increase stock prices.

This paper is structured as follows. Section 2 presents the fiscal policy puzzles that arises from employing different analytical models. Section 3 presents the FAVAR econometric model. Section 4 specifies the FAVAR model using factors summarizing large quantities of informative variables from macroeconomic time series in Japan and analyzes the reaction of each variable following a fiscal stimulus. We especially focus on private consumption and the real effective exchange rate. Section 5 concludes the paper.

2. Discussion of the Fiscal Policy Puzzles

In this section, we review two fiscal policy puzzles—the response of private consumption and the response of the real exchange rate.

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[3] There exist few studies on fiscal policy using FAVAR other than those mentioned above. The exception is Gupta, Kabundi and Ziramba (2010) and Lagana and Sgro (2011). But, these do not analyze the public investment.

[4] Although Forni and Gambetti's (2010) work resembles this paper, they do not analyze the response of the real exchange rate or compare results with those of the NOEM model.

2.1. Private Consumption Puzzle

The first puzzle is the disagreement between theory and structural VAR analyses concerning the response of private consumption to a government spending shock (Blanchard and Perotti, 2002; Gali et al., 2007; Mountford and Uhlig (2009).[5] Real business cycle models and DSGE models usually equate a fiscal policy shock with a negative wealth shock that prompts households to decrease consumption and leisure. As noted, however, previous VAR analyses of fiscal policy shocks report a positive consumption response.

Several theoretical attempts have tried to solve these anomalies in a closed economy setting. They have shown that the positive response by private consumption to positive government spending can be generated in a DSGE model by introducing any of the following: (1) non-Ricardian (Rule of Thumb (ROT)) households (Gali et al., 2007); (2) non-separable preferences for consumption and leisure (Linnemann, 2006; Bilbiie, 2009; Bilbiie, 2011); (3) "deep habits" (Ravn et al., 2006); (4) spending reversals (Corsetti et al., 2010); (5) productive public capital (Baxter and King, 1993; Linnemann and Schabert, 2006); (6) a zero lower bound for the nominal interest rate (Eggertsson, 2010; Christiano et al., 2011);[6] and (7) Edgeworth complementarity between public and private consumption (Bouakez and Rebei, 2007).

2.2. Real Exchange Rate Puzzle

The second puzzle is the disagreement between theory and structural VAR analyses concerning the response of the real exchange rate to a government spending shock (Kim and Roubini, 2008; Monacelli and Perotti, 2010). Although empirical results report the real exchange rate *depreciates* following a positive government spending shock, real appreciation is a robust feature of the small open DSGE framework, regardless of investment and/or the assumption of price stickiness.

We suggest a straightforward explanation: the negative wealth effect drives the reduction in private consumption, and the international

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[5] Some VAR analyses find a negative response of private consumption depending on identification and data frequency. For example, Ramey (2011) shows the negative response using narrative approaches.

[6] Although they assume non-separable preferences over consumption and leisure, they assure the complementarity between private consumption and leisure, differed from Linnemann (2006).

risk-sharing condition implies that the real exchange rate must appreciate.[7] This result holds in virtually any model featuring complete asset markets and some ingredient-generating deviations from purchasing power parity.

In addition, depreciation in the real exchange rate following a rise in government spending observed in VAR analyses contrasts starkly with a traditional Mundell-Fleming model. In the Mundell-Fleming model, represented by an open economy extension of the traditional IS-LM apparatus, increased government purchases entail a higher domestic interest rate by boosting domestic aggregate demand. This causes a nominal (and real) appreciation in exchange rates following covered and uncovered interest rate parity.

3. The FAVAR Model

This section explains the econometric framework for the FAVAR model.[8] Let Y_t be an $M \times 1$ vector of observable economic variables, where M is small. Although Y_t is used in a standard VAR, Y_t alone does not easily add economic information. We therefore assume that a $K \times 1$ vector of unobserved factors, where K is small, summarizes this additional information. The joint dynamics of (F_t, Y_t) are given by

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + u_t, \qquad (1)$$

where $\Phi(L)$ is a matrix of polynomials of finite order d and the error term u_t is the mean 0 with covariance matrix Σ.

There is apparently little difference between a standard VAR and the FAVAR. Yet Equation (1), which is a FAVAR, cannot be estimated because the factors are unobservable. We must therefore assume that the factors

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[7] Following Monacelli and Perotti (2010), the log-linearized international risk sharing condition is shown as: $c_t = c_t^* + \sigma^{-1} q_t$, where c_t is private consumption in the home country (in log terms), c_t^* is world private consumption (in log terms) and is equal to world output y_t^*, q_t is the (foreign currency-based) real exchange rate (in log terms), and σ is the intertemporal elasticity of substitution in private consumption. Therefore, when private consumption in the home country declines following the positive government spending shock, the real exchange rate appreciates (i.e., q_t decreases).

[8] This section conforms to Bernanke et al. (2005), Shibamoto (2007), and Vargas-Silva (2008). For details, see Bernanke et al. (2005).

affect a large number of variables estimate Equation (1). This assumption allows us to infer the unobservable factors from these economic time series variables. Let X_t be an $N\times 1$ vector of informational economic variables, where N is large, such that $K+M << N$.[9] Also, assume that X_t is related to both the unobservable factors vector F_t and the observable factors vector Y_t, given as follows:

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t, \qquad (2)$$

where Λ^f, Λ^y are the $N\times K$, $N\times M$ matrix of factor loadings, respectively, and e_t is an $N\times 1$ vector of error terms, which is weakly correlated with the mean 0.

For the estimation we follow the two-step approach proposed by Bernanke et al. (2005).[10] This means we identify F_t in the first step and estimate Equation (1) in the second. Specifically, we perform the following procedures in the first step. Initially, the common components, C_t, are estimated using the first $K+M$ principal components of X_t. Second, following Bernanke et al. (2005), variables are classified as slow moving and fast moving. Slow-moving variables are those predetermined in the current period, such as output and employment. Fast-moving variables are those sensitive to contemporaneous economic news or shocks, such as asset prices. Next, a principal component analysis is applied to the slow-moving variables to derive a vector of slow-moving factors, F_t^S. Finally, the following regression is estimated:

$$\hat{C}_t = b_{F^S}\hat{F}_t^S + b_Y Y_t + e_t, \qquad (3)$$

where the estimated factors, $\hat{F}_t$, are obtained from $\hat{C}_t - b_Y Y_t$. In the second stage we estimate the VAR in $\hat{F}_t$ and Y_t, and compute the impulse response function using a Choleski decomposition.

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[9] As Bernanke et al. (2005) point out, it is acceptable for N to be greater than T.

[10] Although Bernanke et al. (2005) estimate the FAVAR by the two-step approach and a Bayesian method based on Gibbs sampling, they suggest that the two-step approach tends to produce more plausible responses.

4. Empirical Analyses

4.1. Explaining the Dataset

To analyze the dynamic effects of various macroeconomic variables (including private consumption and the real effective exchange rate), we estimate factors from a dataset containing 137 quarterly macroeconomic time series for 1983Q2 to 2008Q1 (T = 100). This dataset is similar to that in Fujii et al. (2012). The selected series basically follow those in Shibamoto (2007). They are transformed to induce stationarity, and seasonality is removed by Census X-12-ARIMA for all parameters except the interest rate. As the real exchange rate we extract foreign currency-based index data (2005 = 100) prepared by the Bank of Japan.[11] Data are from the Nikkei NEEDS database. Public investment is assumed to be the only variable included in the scalar of observable variable Y_t, and the other variables are included in the vector of informational economic variables X_t. The VAR includes four lags of each variable, and the estimation is conducted using three factors.[12] Table 1 identifies all data series included in the dataset and the classification into slow-moving and fast-moving variables.

4.2. Impulse Responses

The FAVAR approach makes it possible to construct impulse response functions to the government spending shock for any element of X_t. Figure 1 shows the selection of key macroeconomic variables relevant to an increase in public investment for the FAVAR model up to 20 quarterly periods. The green solid line indicates the estimated median response. Blue and red lines depict confidential intervals. Here, the public investment shock implies a growth disturbance of 1%.

Figure 1 shows the response of main macroeconomic and financial variables to the positive public spending shock. The result is consistent with VAR analyses of fiscal policy such as Blanchard and Perotti (2002). On the other hand, the real exchange rate appreciates, a result which inconsistent with previous empirical literature such as Monacelli and Perotti (2010). We can explain these outcomes using the NOEM model with ROT consumers (or

[11] The real exchange rate appreciates (depreciates) if the value increases (decreases).
[12] We set the number of factors similar to Bernanke et al. (2005). Although Bai and Ng's (2002) criterion determines the number of factors in the dataset, it does not determine how many factors should be included in the VAR, as Bernanke et al. (2005) pointed out.

incomplete asset markets) introduced by Gali et al. (2007).[13] Gali et al. (2007) introduce ROT consumers who neither save nor purchase the Arrow-Debreu security and show that aggregate consumption increases if the ratio of ROT consumers (per population) is sufficiently large. On the other hand, since optimizing consumers, who reduce private consumption following an increase in government spending, partake in international risk-sharing, the real exchange rate appreciates because private consumption declines.

4.3. Additional Analyses

In addition to primary results shown in the previous subsection, other results and extensions merit discussion. They include the response of stock prices and the division of the sample into the period before and after Japan's bubble (post-1991).

4.3.1. Response of Stock Prices

Fukuda and Yamada (2011) explain Japan's dramatic fiscal deficit increase during the 1990s and 2000s by focusing on stock price targeting by the Japanese government. They show that Japanese government reacted to stock prices and reduced fiscal stimulus from 1992 to 2000, which would have been lower by ¥2.5 trillion on average of their calculus, without its targeting. We evaluate quantitative and qualitative effects of its targeting via public investment. Figure 1 also shows that the Nikkei 225, Nikkei 500, and TOPIX barely reacted, or reacted negatively in the short-run. These results confirm those from the standard DSGE model with capital. Expansionary government spending reduces the markups of firms in monopolistically competitive markets, reduces their stock prices, and reduces Tobin's q. A reduction in Tobin's q means a reduction in capital investment (which equals private investment in the DSGE model). Therefore, we conclude that stock price targeting by the Japanese government did not serve stock prices well.

4.3.2. Sub-Sample Analysis: Post-Bubble (1991:Q1)

[13] For a detailed introduction to ROT consumers, see section 7.1 in Monacelli and Perotti (2010). Moreover, Erceg et al. (2005) show qualitative results identical to ours with respect to private consumption and the real exchange rate using the NOEM model with ROT consumers.

Discussions of Japanese fiscal policy have established that its quantitative effects diminished following the burst of Japan's economic bubble. For example, Ihori et al. (2003) empirically show that the quantitative effects of government spending have diminished since 1990. Therefore, we ask whether the finding is satisfied in a data-rich environment. Figure 2 shows a response similar to Figure 1, except for the sample period from 1991:Q1. Although most responses are qualitatively unchanged, GDP declined dramatically following an increase in public investment. This result is surprising, and little theoretical evidence explains it. In summary, the effect of public investment on GDP has diminished since 1991. However, the response of private consumption is unchanged in our result.

5. Conclusion

This paper has studied the effects of public investment shocks on private consumption and the real exchange rate in Japan using numerous macroeconomic, sectoral, and financial variables. We found three results: First, private consumption responds positively, and the real exchange rate appreciates. These responses are consistent with results of the NOEM model featuring ROT consumers. Second, the impulse responses to public investment shock of stock prices are negative. That is, stock price targeting did not work improve stock price and we can evaluate it ineffectively. Third, after 1991 the response of GDP changes only qualitatively compared with its response in the full sample, but no previous theory explains this outcome. Solving that puzzle remains for future work.

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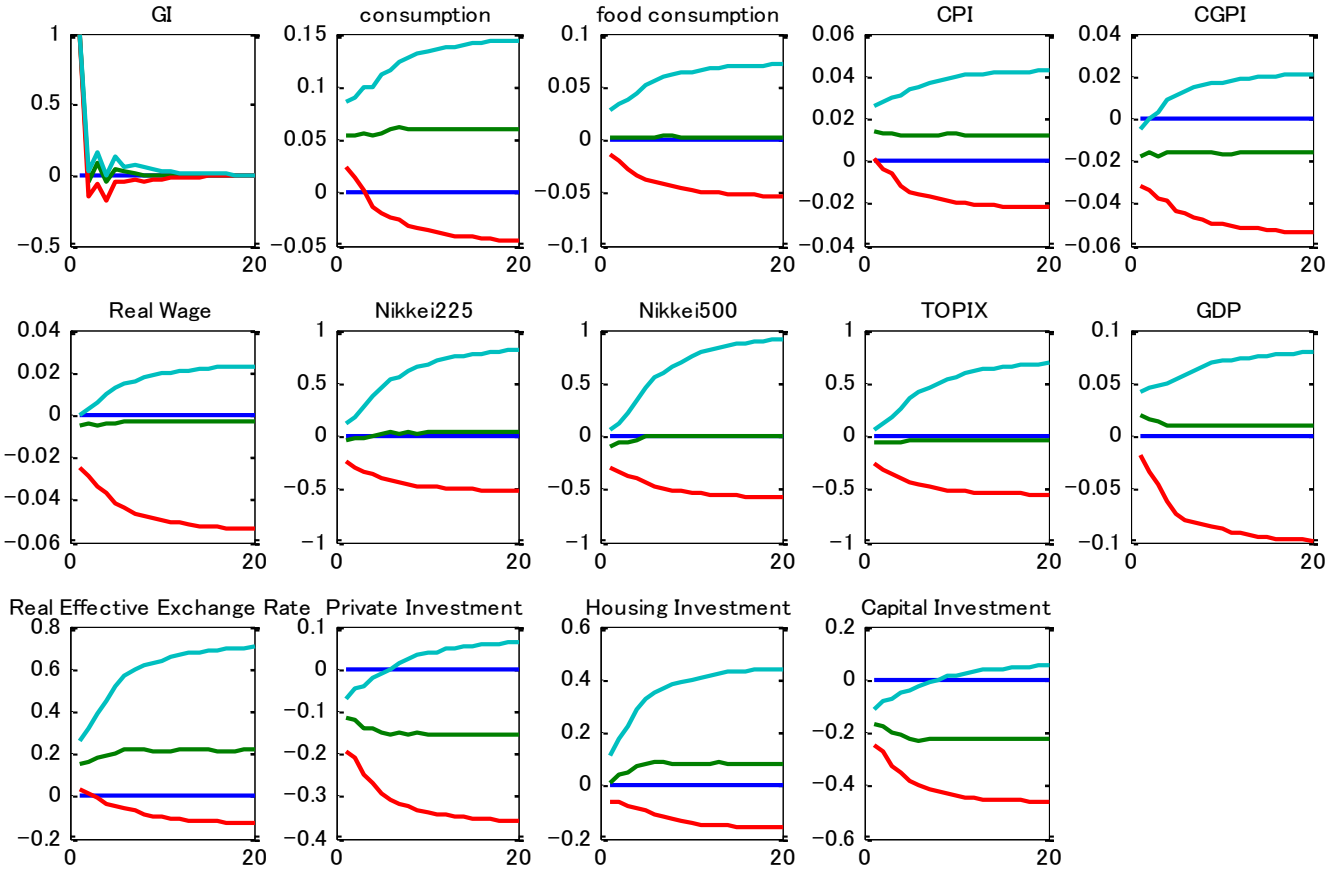
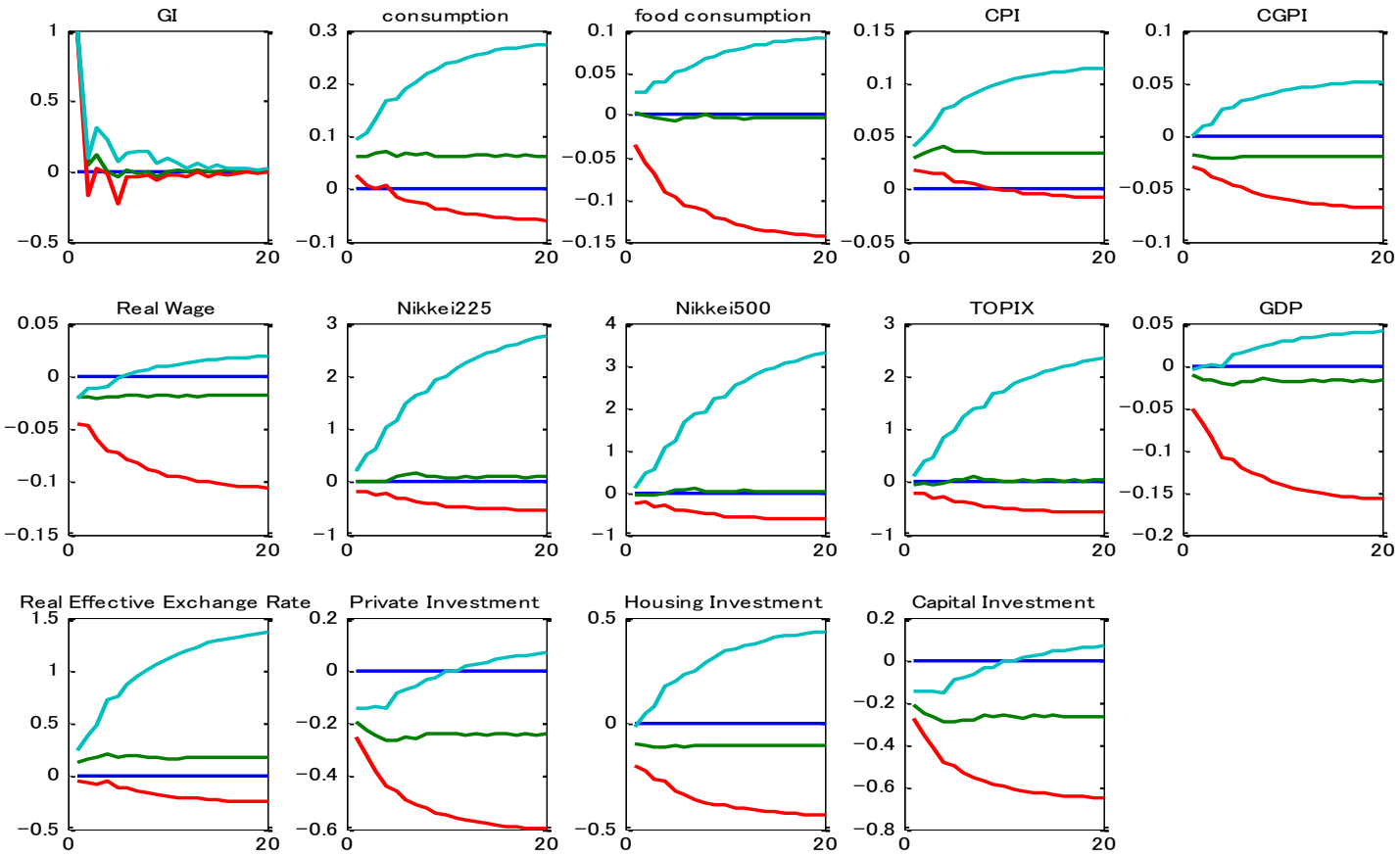
Figure 1: Impulse responses to an increase in public spending, 1983:Q2–2008:Q1



Note: GI = public investment; CPI = Consumer Price Index; CGPI = Corporate Goods Price Index

Figure 2: Impulse responses to an increase in public spending, 1991:Q1–2008:Q1



Note: GI = Public investment; CPI = Consumer Price Index; CGPI = Corporate Goods Price Index

Table 1: Data description

Number	Data Name	Period	Code
Slow moving variables			
1	Industrial Production Index(Mining and Manufacturing,2005=100)	1983Q2-2008Q1	5
2	Industrial Production Index(Construction Goods,2005=100)	1983Q2-2008Q1	5
3	Industrial Production Index(Capital Goods,2005=100)	1983Q2-2008Q1	5
4	Industrial Production Index(Durable Consumer Goods,2005=100)	1983Q2-2008Q1	5
5	Industrial Production Index(Nondurable Consumer Goods,2005=100)	1983Q2-2008Q1	5
6	Industrial Production Index(Consumer Goods,2005=100)	1983Q2-2008Q1	5
7	Industrial Production Index(Final Demand Goods,2005=100)	1983Q2-2008Q1	5
8	Industrial Production Index(Investment Goods,2005=100)	1983Q2-2008Q1	5
9	Industrial Production Index(Producer Goods,2005=100)	1983Q2-2008Q1	5
10	Producer's Shipment Index(Mining and Manufacturing,2005=100)	1983Q2-2008Q1	5
11	Producer's Shipment Index(Construction Goods,2005=100)	1983Q2-2008Q1	5
12	Producer's Shipment Index(Capital Goods,2005=100)	1983Q2-2008Q1	5
13	Producer's Shipment Index(Durable Consumer Goods,2005=100)	1983Q2-2008Q1	5
14	Producer's Shipment Index(Nondurable Consumer Goods,2005=100)	1983Q2-2008Q1	5
15	Producer's Shipment Index(Consumer Goods,2005=100)	1983Q2-2008Q1	5
16	Producer's Shipment Index(Final Demand Goods,2005=100)	1983Q2-2008Q1	5
17	Producer's Shipment Index(Investment Goods,2005=100)	1983Q2-2008Q1	5
18	Producer's Shipment Index(Producer Goods,2005=100)	1983Q2-2008Q1	5
19	Capacity Utilization Index(Machinery,2005=100)	1983Q2-2008Q1	5
20	Capacity Utilization Index(Chemicals,2005=100)	1983Q2-2008Q1	5
21	Capacity Utilization Index(Ceramics, Clay and Stone Products,2005=100)	1983Q2-2008Q1	5
22	Capacity Utilization Index(Electrical Machinery,2005=100)	1983Q2-2008Q1	5
23	Capacity Utilization Index(Fabricated Metals,2005=100)	1983Q2-2008Q1	5
24	Capacity Utilization Index(General Machinery,2005=100)	1983Q2-2008Q1	5
25	Capacity Utilization Index(Manufacturing,2005=100)	1983Q2-2008Q1	5
26	Capacity Utilization Index(Nonferrous Metals,2005=100)	1983Q2-2008Q1	5
27	Capacity Utilization Index(Pulp, Paper and Paper Products,2005=100)	1983Q2-2008Q1	5
28	Capacity Utilization Index(Transport Equipment,2005=100)	1983Q2-2008Q1	5
29	Capacity Utilization Index(Textiles,2005=100)	1983Q2-2008Q1	5
30	Department Store Sales(per Square Meter,10,000 yen)	1983Q2-2008Q1	5
31	Department Store Sales(per Worker,10,000 yen)	1983Q2-2008Q1	5
32	Large-Scale Retail Store Sales (million yen)	1983Q2-2008Q1	5
33	Index of Wholesale Price in Small and Medium Sized Enterprises(2005=100)	1983Q2-2008Q1	5
34	Index of Sales in Small and Medium Sized Enterprises (Manufacturing,2005=100)	1983Q2-2008Q1	5
35	Index of Shipment in Small and Medium Sized Enterprises(2005=100)	1983Q2-2008Q1	5
36	Index of Total Worked Hours(All Industries, 30 or More Persons,2005=100)	1983Q2-2008Q1	5
37	Household Disposable Income(yen)	1983Q2-2008Q1	5
38	Electric Power Consumption of Large Users(million KWH)	1983Q2-2008Q1	5
39	New Job Offers(person)	1983Q2-2008Q1	5
40	New Job Offers(Part-Time,person)	1983Q2-2008Q1	5
41	Consumption Expenditure(yen)	1983Q2-2008Q1	5
42	Consumption Expenditure(Food,yen)	1983Q2-2008Q1	5
43	Employment Index of Regular Workers (All Industries, 30 Employees or more,2005=100)	1983Q2-2008Q1	5

The selected series basically follow those in Shibamoto (2007). The last column represents the transformation code following Bernanke et al. (2005). Variables 121–129 include construction in progress at market prices in calendar year 2000.

Table 1: Data description

Number	Data Name	Period	Code
44	Unemployment Rate(%)	1983Q2-2008Q1	5
45	Consumer Price Index(Clothes and Footwear)	1983Q2-2008Q1	5
46	Consumer Price Index(Food)	1983Q2-2008Q1	5
47	Consumer Price Index(Fuel Light and Water Charges)	1983Q2-2008Q1	5
48	Consumer Price Index(General)	1983Q2-2008Q1	5
49	Consumer Price Index(General, Exclude Fresh Food)	1983Q2-2008Q1	5
50	Consumer Price Index(General, Exclude Imputed Rent)	1983Q2-2008Q1	5
51	Consumer Price Index(Furniture and Household Utensils)	1983Q2-2008Q1	5
52	Consumer Price Index(Miscellaneous)	1983Q2-2008Q1	5
53	Consumer Price Index(Reading and Recreation)	1983Q2-2008Q1	5
54	Consumer Price Index(Transportation and Communication)	1983Q2-2008Q1	5
55	Corporate Goods Price Index(Manufacturing Industry Products)	1983Q2-2008Q1	5
56	Corporate Goods Price Index(Mineral Produce)	1983Q2-2008Q1	5
57	Corporate Goods Price Index(All Commodities)	1983Q2-2008Q1	5
58	Real Wage Index(Contractual Cash Earnings in All Industries),2005=100)	1983Q2-2008Q1	5
59	Real Wage Index(Contractual Cash Earnings in Manufacturing,2005=100)	1983Q2-2008Q1	5
60	Wage Index(Contractual Cash Earnings in Manufacturing,2005=100)	1983Q2-2008Q1	5
61	Wage Index(Contractual Cash Earnings in All Industries,2005=100)	1983Q2-2008Q1	5
62	Import Volume Index(Total)	1983Q2-2008Q1	5
63	Export Volume Index(Total)	1983Q2-2008Q1	5
64	Value of Exports, Customs Clearance Basis(million)	1983Q2-2008Q1	5
Fast moving variables			
65	Total Floor Area of Building Construction Started(Grand Total,1,000m^2)	1983Q2-2008Q1	5
66	Total Floor Area of New Housing Construction Started(Built for Sale,1,000m^2)	1983Q2-2008Q1	5
67	Total Floor Area of New Housing Construction Started(Owned,1,000m^2)	1983Q2-2008Q1	5
68	Total Floor Area of New Housing Construction Started(Total,1,000m^2)	1983Q2-2008Q1	5
69	Total Number of New Housing Constuction Started(Built for sale)	1983Q2-2008Q1	5
70	Total Number of New Housing Constuction Started(Owned)	1983Q2-2008Q1	5
71	Total Number of New Housing Constuction Started(Rented)	1983Q2-2008Q1	5
72	Total Number of New Housing Constuction Started(Total)	1983Q2-2008Q1	5
73	Amount of Clearing(Value: million yen)	1983Q2-2008Q1	5
74	Amount of Clearing(Number: thousand bills)	1983Q2-2008Q1	5
75	Nikkei Stock Average 225 Selecteed Stocks(Average of Month,yen)	1983Q2-2008Q1	5
76	Nikkei Stock Average 500 Selecteed Stocks(Average of Month,yen)	1983Q2-2008Q1	5
77	Arithmetic Stock Price Average(First Section of the Tokyo Stock Exchange)	1983Q2-2008Q1	5
78	Tokyo Stock Price Index(TOPIX)	1983Q2-2008Q1	5
79	Foreign Exchange Rate(Yen per US Dollar)	1983Q2-2008Q1	5
80	Foreign Effective Exchange Rate(Nominal,2005=100)	1983Q2-2008Q1	5
81	Money Stock(M1,Average,100 million yen)	1983Q2-2008Q1	5
82	Money Stock(M2,Average,100 million yen)	1983Q2-2008Q1	5
83	Monetary Base(Average,100 million yen)	1983Q2-2008Q1	5
84	Bank of Japan Accounts, Assets, Loans(100 million yen)	1983Q2-2008Q1	5
85	Banking Accounts, City Banks, Assets, Cash and Due from Banks(100 million yen)	1983Q2-2008Q1	5
86	Banking Accounts, Regional Banks, Assets, Cash and Due from Banks (100 million yen)	1983Q2-2008Q1	5
87	Banking Accounts, City Banks, Assets, Call Loans(100 million yen)	1983Q2-2008Q1	5

The selected series basically follow Shibamoto (2007). The last column represents the transformation code following Bernanke et al. (2005). Variables 121–129 include construction in progress at market prices in calendar year 2000.

Table 1: Data description

Number	Data Name	Period	Code
88	Banking Accounts, Regional Banks, Assets, Call Loans(100 million yen)	1983Q2-2008Q1	5
89	Banking Accounts, City Banks, Assets, Loans and Bills Discounted(100 million yen)	1983Q2-2008Q1	5
90	Banking Accounts, Regional Banks, Assets, Loans and Bills Discounted (100 million yen)	1983Q2-2008Q1	5
91	Banking Accounts, City Banks, Assets, Investment Securities(100 million yen)	1983Q2-2008Q1	5
92	Banking Accounts, Regional Banks, Assets, Investment Securities(100 million yen)	1983Q2-2008Q1	5
93	Banking Accounts, City Banks, Liabilities, Borrowed Money(100 million yen)	1983Q2-2008Q1	5
94	Banking Accounts, Regional Banks, Liabilities, Borrowed Money(100 million yen)	1983Q2-2008Q1	5
95	Banking Accounts, City Banks, Liabilities, Call Money(100 million yen)	1983Q2-2008Q1	5
96	Banking Accounts, City Banks, Liabilities, Deposits(100 million yen)	1983Q2-2008Q1	5
97	Banking Accounts, City Banks, Liabilities, Negotiable Certificates of Deposits (100 million yen)	1983Q2-2008Q1	5
98	Banking Accounts, Regional Banks, Liabilities, Negotiable Certificates of Deposits (100 million yen)	1983Q2-2008Q1	5
99	Banking Accounts, Regional Banks, Liabilities, Deposits(100 million yen)	1983Q2-2008Q1	5
100	Index of Industrial Inventories(Mining and Manufacturing,2005=100)	1983Q2-2008Q1	5
101	Index of Industrial Inventories(Construction Goods,2005=100)	1983Q2-2008Q1	5
102	Index of Industrial Inventories(Capital Goods,2005=100)	1983Q2-2008Q1	5
103	Index of Industrial Inventories(Durable Consumer Goods,2005=100)	1983Q2-2008Q1	5
104	Index of Industrial Inventories(Nondurable Consumer Goods,2005=100)	1983Q2-2008Q1	5
105	Index of Industrial Inventories(Consumer Goods,2005=100)	1983Q2-2008Q1	5
106	Index of Industrial Inventories(Final Demand Goods,2005=100)	1983Q2-2008Q1	5
107	Index of Industrial Inventories(Investment Goods,2005=100)	1983Q2-2008Q1	5
108	Index of Industrial Inventories(Producer Goods,2005=100)	1983Q2-2008Q1	5
109	The Basic Discount Rate and Basic Loan Rate(%)	1983Q2-2008Q1	5
110	Yield of Interest-Bearing Government Bonds(10 years,%)	1983Q2-2008Q1	1
111	Yield of Government Guaranteed Bonds(10 years,%)	1983Q2-2008Q1	1
112	Yield of Local Government Bonds(10 years,%)	1983Q2-2008Q1	1
113	Yield of Interest-Bearing Bank Debentures(5 years,%)	1983Q2-2008Q1	1
114	Yield of Government Bonds(10 years,%)	1983Q2-2008Q1	1
115	Tokyo Interbank Offered Rate(TIBOR)(3 months,%)	1983Q2-2008Q1	1
116	Deposit Rates of Postal Savings, Ordinary Savings(%)	1983Q2-2008Q1	1
117	Spread between Long and short term interest rates(%)	1983Q2-2008Q1	1
118	Call Rate(Collateralized Overnight, Month Average,%)	1983Q2-2008Q1	1
119	Government Fixed Capital Formation(billion yen)	1983Q2-2008Q1	5
120	GDP(billion yen)	1983Q2-2008Q1	5
121	Real New Investment,Agriculture, Forestry and Fisheries(billion yen)	1983Q2-2008Q1	5
122	Real New Investment,Mining(billion yen)	1983Q2-2008Q1	5
123	Real New Investment,Construction(billion yen)	1983Q2-2008Q1	5
124	Real New Investment,Manufacturing(billion yen)	1983Q2-2008Q1	5
125	Real New Investment,Wholesale and Retail Trade(billion yen)	1983Q2-2008Q1	5
126	Real New Investment,Real Estate(billion yen)	1983Q2-2008Q1	5
127	Real New Investment,Transport and Communications(billion yen)	1983Q2-2008Q1	5
128	Real New Investment,Electricity, Gas and Water Supply(billion yen)	1983Q2-2008Q1	5
129	Real New Investment,Service activities(billion yen)	1983Q2-2008Q1	5
130	Real Tax and Stamp Revenue(billion yen)	1983Q2-2008Q1	5

The selected series basically follow Shibamoto (2007). The last column represents the transformation code following Bernanke et al. (2005). Variables 121–129 include construction in progress at market prices in calendar year 2000.

Table 1: Data description

Number	Data Name	Period	Code
131	Real Effective Exchange Rate Index(2005=100)	1983Q2-2008Q1	5
132	Real Long-term Interest Rates	1983Q2-2008Q1	1
133	Real Short-term Interest Rates	1983Q2-2008Q1	1
134	Public Debt	1983Q2-2008Q1	5
135	Gross Private Fixed Capital Formation	1983Q2-2008Q1	5
136	Gross Private Fixed Capital Formation(Housing)	1983Q2-2008Q1	5
137	Gross Private Fixed Capital Formation(Facilities)	1983Q2-2008Q1	5

The selected series basically follow Shibamoto (2007). The last column represents the transformation code following Bernanke et al. (2005). Variables 121–129 include construction in progress at market prices in calendar year 2000.