Japan’s Great Recession: What Went Wrong?

by

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Japan’s Great Recession: What Went Wrong? (Summary)

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Japan’s economic growth rate dropped from three percent in the first half of the 1980s to one percent in the 1990s and beyond. It’s not unreasonable, then, to call this Japanese economic situation “the Great Recession.” What went wrong in Japan?

First, we surveyed some proposed explanations, many of which argue that some structural problem caused the Great Recession. Some growth accounting studies, however, found that TFP (Total Factor Productivity) of the Japanese economy didn’t decline in the 1990s compared to the first half of the 1980s. The studies also found that the decline of labor and capital inputs explains the overall growth decline of the 1990s.

Second, we conclude that understanding the reasons why the two inputs decreased is key in solving the puzzle of the Great Recession. A possible answer is deflation caused by strict monetary policy. Deflation may produce real economic stagnation through wage rigidity and deflation expectations.

Third, we construct a VAR (Vector Autoregression) model that includes a real-wage rate and a nonperforming loan variable to the usual VAR model developed by many economists. The results are preliminary, but basically support the above conjectures. Monetary policy variables are important in explaining the Great Recession, and wage rigidity is also important. A non performing loan variable used here was not important, but it is too early to conclude that the impact of the bad loans is small, because the variable used here is proxy one. We still need to explore the real impacts of bad loan on the economy.

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Shigeki Onishi, Risona Bank

The title of this paper was inspired by Kuttner and Posen (2001). The views expressed here do not represent those of the Institute to which I belong. I thank Mr. Yutaka Kosai (Economic and Social research Institute), Professor Shinichi Kitasaka (Doshisha University) and others for their helpful comments. All errors, needless to say, are my own.
Japan’s Great Recession: What Went Wrong?

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“The amplitude of the cycle would be sharply reduced if monetary factors in that comprehensive sense became inoperative.”

Gottfried Haberler, 1958

Japan’s economic growth rate dropped from three percent in the first half of the 1980s to one percent in the 1990s. Even in the 21st century, Japan has not been able to recover from this stagnated situation. If the Japanese economy had grown at three percent instead of the actual one percent in the 1990s, Japanese real GDP would have been worth some 100 trillion yen more than it actually was in 2000. This “lost” GDP throughout the 1990s totals more than 500 trillion yen. And if this stagnation continues, Japan’s lost GDP will approach some two quadrillion yen by 2010. In short, Japan lost one year of GDP in the 1990s, and will lose four years of GDP from 2000 to 2010. Of course, Japan experienced neither severe economic contraction nor a 25 percent unemployment rate. But the impact of the prolonged economic slump is greater than that of the Great Depression in the United States of America, during which, it is said, the U.S. lost about three years of its GDP.1 It’s not unreasonable,

1 Hall and Ferguson(1998)Chap.12. Section3
then, to call this Japanese economic situation throughout the 1990s and beyond “the Great Recession.” What went wrong in Japan?

First, we surveyed some proposed explanations, many of which argue that some structural problem caused the Great Recession. No economist can explain, however, what the structural problems are that caused GDP growth rate to shrink from three percent to one percent. And some growth accounting studies found that TFP (Total Factor Productivity) of the Japanese economy didn’t decline in the 1990s compared to the first half of the 1980s. The studies also found that the decline of labor and capital inputs explains the overall growth decline of the 1990s.

Second, we conclude that understanding the reasons why the two inputs decreased is key in solving the puzzle of the Great Recession. A possible answer is deflation caused by strict monetary policy. Deflation may produce real economic stagnation through wage rigidity and deflation expectations. I then showed that real hourly wages in Japan increased in 1990, and that labor share jumped from some 67 percent to 72 percent, even exceeding that of the United States. Moreover, I also show how Japan’s Phillip’s Curve became almost horizontal. This collective evidence is casual, but strong.

Third, we construct a VAR (Vector Autoregression) model that includes a real-wage rate and a nonperforming loan variable to the usual VAR model developed by many economists. The results are preliminary, but basically support the above conjectures. Monetary policy variables such as call rate, money supply, and exchange rate are important in explaining the Great Recession, and wage rigidity is also important. A non performing loan variable used here was not important, but it is too early to conclude that the impact of the bad loans is small, because the variable used here is proxy one. We still need to explore the real impacts of bad loan on the economy.
1. Possible Explanations

The Bubble and Its Subsequent Burst

Many Japanese economists attribute Japan’s stagnation to the “bubble” and its burst, but many countries have experienced bubbles and bubble bursts. But no country has experienced such a prolonged stagnation. For example, the Scandinavian countries experienced bubbles and bursts at the end of the 1980s, but all those countries recovered in several years. Chapter 2 of Harada (2003) extensively surveys bubbles and bubble bursts in all the advanced countries using International Monetary Fund, *International Financial Statistics* data, and found that 11 countries experienced bubbles and bubble bursts in the 1980s. Moreover, it was found, the scale of stagnation of these countries, defined as the accumulated differences of trend GDP after bubble burst divided by GDP, was only 6.8 percent on average, while the scale of Japan is 24.1 percent as shown in Table 1. This figure also shows that the average scale of bubbles of these 11 countries, defined as the accumulated differences of trend GDP throughout 1970 to 2000 divided by GDP, was 6.0 percent, and the figure for Japan was 7.8 percent. That is, Japan’s stagnation after the bubble is much greater than the average, while Japan’s bubble is only slightly larger than the average. This fact suggests that Japanese sluggish post-bubble economy cannot be explained by scale of the bubble. It also suggests that it should be explained by the phenomena that

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2 There seems to be a correlation between scale of the bubble and decrease rate of stock price index defined as rate of the lowest level of stock price index after bubble to the highest level of stock price index in the bubble period. The decrease rate of stock price index, however, is reflecting the Japan’s stagnation after the bubble, and this rate is not a good indicator of the magnitude of the bubble. There is no correlation between scale of the bubble and increase rate of stock price index defined as the rate of the highest level of stock price in the bubble period to the lowest level of stock price in bubble period (Actually, the rate of the highest level of stock price in the bubble period to the stock in 5 years before, since it is difficult to judge
happened after the bubble burst, not by the magnitude of the bubble itself.

Structural and Supply Side Problems

Many economists also argue that Japan’s low growth rate is best explained by examining the supply side of its economy (Hayashi (2003) and Miyagawa (2003) are two examples). That is, they assert that the Japanese economy has structural problems, and that its potential GDP growth rate declined. But, no economist can explain what the structural problems are that caused GDP growth to shrink from three percent to one percent.

If we look at real GDP per working hours instead of ordinary real GDP, we see a different picture. Chart 2 shows real GDP per working hours and real GDP (both are indexed at 1990 = 100). Real GDP growth has declined sharply since the 1990s, but real GDP per working hours has not significantly declined. More careful growth accounting studies considering the capital utilization rate also support the contention that GDP per working hours did not decrease. Nakajima et al. (2001), Motohashi (2001), Miyagawa (2002) show that TFP has not significantly declined. Nakajima and Motohashi show TFP increased, and Miyagawa shows TFP declined only slightly in 1990s. If TFP did not decline, then labor productivity, i.e. GDP per working hours, does not decline much, either. Table 3 shows the results of Motohashi’s estimates. The growth rate of output declined from 3.25 percent in 1980-85 to 1.45 percent in 1995-2000 by 1.80 percentage points—but TFP increased when the lowest level of stock price is).

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3 The same fact is pointed out by Dr. Barry Bosworth of Brookings Institution and Professor Dale W. Jorgenson at International Forum by Economic and Social research Institute, Japan on February 17-19, 2003.
from 0.60 percent in 1980-85 to 0.74 percent in 1995-2000 by 0.14 percentage-points.
What factors, then, declined? Labor input declined sharply, from 1.1 percent in 1980-85 to minus 0.14 percent in 1990-2000 by 1.28 percentage-points decline—and capital input declined from 1.50 percent in 1980-85 to 0.85 percent in 1995-2000, or by 0.65 percentage-points.

Structural Problems of the 1990s: Still There Was in the 80s

We don’t intend to assert that the Japanese economy doesn’t have structural problems; it certainly does. Japan’s economy is a dual economy. The export manufacturing sector, which claims only about 20 percent of GDP, has high productivity, but other sectors have low productivity. Our point is that Japan had structural problem not only in 1980s but also in 1990s.

Additionally, Japan has already made great structural reform till 1990s. Public corporations, Japan Rail Road Corporation and Japan Telephone and Telegram Corporation were privatized in 1987 and 1989 respectively. And, income and corporate tax was reduced drastically before early 1990s, while consumption tax was introduced and increased in 1989 and 1997. Ratio of income tax and corporate tax revenue to GDP was 21.9% in 1990, but 17.3% in 2000. Social security tax was increased, but still tax was reduced in 1990s. Ratio of income tax + corporate tax + social security tax to GDP was 30.8% in 1990, but 27.7% in 2000(National Accounts, Economic and Social Research Institute, Cabinet Office). If structural reform was important, this is the structural reform. Huge tax reduction including marginal tax rate cut – maximum income tax rate was reduced 80% (includes local tax) from 1987

4 See Table 1, table 2, and Table 3 of Baily and Solow(2001).
throughout to 50% in 1997, while consumption tax became 5% in 1997 — should have
great positive impact on Japanese economy, but still we cannot see the impact.

2. Setting of the Problems

I will now focus on the puzzle of the Great Recession. I can conclude that TFP
did not decline, and that it is the labor and capital inputs that declined in the 1990s.
Because TFP did not decrease, structural problems cannot explain the Great Recession.
So why did labor and capital inputs decline? The reason is simple. Deflation caused
by strict monetary policy after the burst of the bubble increased real interest rates, real
debts, real wages, and squeezed profits. All these factors decreased labor and capital
demands in Japan’s economy.

Monetary Policy

Chart 4 shows the growth rates of real GDP, money supply, (M2+CD) and real
gross capital formation by the government. The figure suggests there is a strong
correlation between real GDP and money supply, but no correlation between GDP and
government capital spending. Chart 5 shows the growth rates of real GDP, real
exports, and exchange rates. The increase of the exchange rate means depreciation,
and the decrease means appreciation of the yen, as the exchange rate is expressed as
yen per dollar in this chart. The chart suggests that yen depreciation causes an
increase in exports, and exports increase real GDP. That is, it is suggested that money
and exchange rates (this is also monetary variable) cause fluctuations in real GDP.

Other careful studies, such as Bayoumi (2000), Hori and Ito (2002), Miyao (2002),
Tanaka, Kitano (2002) and Nakazawa, Onishi and Harada (2002) (hereafter NOH) using VAR (Vector Autoregression) models, suggest that monetary shock might be an important factor to explain the fluctuation in the 1980s and 90s. These studies are very much different in which points they emphasize. Bayoumi stresses various factors such as fiscal policy, monetary policy over investment during the bubble and decline in the financial intermediation function. He thinks that major factor is disruption in financial intermediation, largely operating through the impact of changes in domestic asset prices on bank lending. Miyao, Tanaka and Kitano, and NOH stress the importance of monetary policy. NOH argue that the decline in the financial intermediation function is also caused by a deflationary monetary policy, which resulted in asset price decline.

Of course, correlation does not necessarily mean causation. Monetary fluctuation might be a result of real economic fluctuation, but, at least in the middle of the 1980s, monetary policy was intently expansionary. At the end of the 1980s to early 1990s, the policy was also intentionally shrinking in order to burst the bubble.

Effects of Monetary Policy: Temporal or Persistent?

It might be agreed to some extent among Japanese economists (Kosai, Ito, Arioka (2000) and Miyao (2002), for example) that monetary policy caused the fluctuations at the end of the 1980s and early 1990s. This fluctuation is explained by the widely accepted theory of unexpected money (Barro (1977)). Studies on the Japanese economy using data before the early 1990s, such as that from Horiuchi (1991) and McCallum (1993), usually show that the effects of unexpected money are weak in Japan. On the contrary, NOH (2002) show that unexpected money significantly explains real GDP fluctuations. Additionally, Miyao (2002) shows that call rate fluctuation persistently affects real production during the bubble and bubble burst.
periods. The difference between Horiuchi, McCallum and NOH can be explained by
the fact that Horiuchi and McCallum do not necessarily include data of unexpected
money because the money supply was very stable before the end of the 1980s, while
NOH uses very unstable money data at the end of the 1980s to early 1990s5.

I can thus conclude that unstable monetary policy explains Japanese economic
fluctuations from the end of 1980s to early 1990s, but I cannot yet explain the
persistent economic stagnation after the middle of the 1990s.

3. Factors Providing Monetary Policy with Persistent Impacts

To fully explain Japan’s Great Recession, it is necessary to explain why
monetary policy affects persistent impacts. To do that, I will propose two factors:
wage rigidity and debt deflation caused by the past nominal debt contracts, which
provide monetary policy with persistent power.

Wage Rigidity

Chart 6 shows real hourly wage, production, unemployment rate, and consumer
price index in Japan and the United States. Because there is no official hourly wage
data in Japan, we calculated hourly wages by dividing contractual earnings (including

5 Seo and Takahashi(1982) using the data from 1965 to 1980 shows that unexpected money
stably and significantly explains changes of real GDP. Monetary data in 1965-85 includes
fluctuated data in the early 1970s. This probably means that impact of unexpected money is
statistically easy to identify in the period of unstable money supply, because unexpected
money is large in the period.
overtime pay) by contractual labor hours (including overtime hours). Real wages in Japan increased even in the 1990s, and decreased after 1998. On the contrary, U.S. real wages decreased even until 1996, and started to increase in 1997, while U.S. economy was in good shape. It is natural that Japan’s unemployment rate increased and U.S. unemployment rate decreased in the 1990s, because Japanese real wages increased in recession and U.S. real wages decreased in prosperity. As the result, employment in the United States increased sharply, consumption increased rapidly, profits soared, and investment expanded drastically. But in Japan in the 1990s, the opposite occurred. Japan’s labor share increased from about 67 percent in 1975-1990 to about 72 percent in 1990s, and exceeded that in U.S. In Japan profits were squeezed, investment shrunk, total demand declined, and employment decreased. This is a vicious circle.

Phillip’s Curve

The same story can be explained by the Phillip’s Curve. Figure 7 shows Japan’s Phillips Curve in 1980-92 and 1993-2002. The Phillip’s Curve in 1980-92 has steep slope, and the curve might be vertical, but the slope in 1992-2002 is soft and might be horizontal. The shape of the curve suggests that deflation in 1990 contradicts the wage rigidity and increased the unemployment rate sharply.

The Phillip’s Curve also shows that there was not structural shift in the labor market. If there was, the curve must not be a stable right- declining slope, and we see a right-increasing slope, as we saw in the 1970s. Japan’s Phillips Curve in the 1990s is consistent with the argument of Akerlof, Dickens, Perry (1996), who wrote that deflation persistently increases unemployment under the downward rigidity of

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6 The data ignore bonus. Harada and Egawa (2002) estimated hourly wages considering bonus. We used simple data as the Harada and Egawa data has large fluctuations.
wages.

Nominal Debt Contracts

Concerning the nominal debt contract, I cannot express the impact drastically in charts, but the variable is also important considering that the decline in wages after 1998 did not produce a recovery. It seems that problems of nonperforming loans became severe after 1998, when deflation became serious.

4. VAR Model

This collective evidence in Section 3 is casual, but strong. We will now construct a VAR (Vector Autoregression) model that considers the factors that provide monetary policy with prolonged impacts on the economy. We added the difference between a real-wage rate and marginal productivity of labor, and non performing loans to the usual VAR model developed by NOH (2002). NOH use gross capital formation by the government as a fiscal variable, call rate, money supply (M2+CD), and exchange rate as monetary variables, and GDP deflator, real exports in SNA data, real GDP, consumption tax dummies, and seasonal dummies.

For the difference between real wage and marginal productivity of labor, we estimated marginal productivity of labor (See appendix on the method of estimation). And we use excess debt\(^7\), defined as debt minus cash flow times five years (20 quarters) calculated in Onishi, Nakazawa, Harada (2002) as proxy variable for non-performing loans.

\(^7\) These GDP deflators and excess debt are seasonally adjusted, because of technical reasons for calculating the variables. But, other variables are not seasonally adjusted.
These variables are compiled by us, not widely used, and not officially published. Then we will show these variables - the difference between real wage and marginal productivity of labor, and excess debt in Chart 8. Real wage rate, marginal productivity of labor, and the difference are expressed in logarithm. Excess debt is stood for trillion yen. Real wage was larger than marginal productivity of labor in the latter half of 1980s, but was smaller in 1990s. That is, real wage was too high throughout 1990s. Excess debt jumped in early 1990s, and gradually declined in 1990s.

Procedures for constructing the VAR model

GDP data has been revised since 1980, and we use 1980 to 2002 as the estimation period. All the data are quarterly data. The logarithms of all data have been taken, with the exception of the call rate. For excess debt, the value is minus in 1980, we used the data after 1981. The results of unit root tests using augmented Dickey-Fuller test are given in Table 9. The table shows that all the variables are generally denied unit roots by taking the first differences of the variables. We then use these first differences of the variables.

The data used here are gross nominal capital formation by the government, the call rate, money supply (M2+CD), exchange rate, GDP deflator, real wage minus marginal productivity of labor, real exports, excess debt, real GDP, seasonal dummies, and consumption tax dummies. The definition and the source of the data are summarized in Table 10.

We then estimate the VAR model using all the data. To select rag order, for first 

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*NOH use real gross nominal capital formation by the government. But we use nominal variable, because it can be considered to be more policy variable than real variable.
to sixth orders, Schwarz Criteria and AIC (Akaike Information Criteria) are calculated. For Schwarz Criteria, first order was selected, and for AIC sixth order was selected. Here we chose first order lag.

Granger Causalities

The results of Granger causalities are as shown in Chart 11. Monetary variables (call rate or money supply) cause GDP deflator. GDP deflator causes real GDP, real export and nominal public investment. Real export causes real GDP, GDP deflator and public investment. Excess debt causes GDP. GDP causes export, GDP deflator and public investment, but public investment does not cause GDP. Public investment causes export and GDP deflator. We don’t know why GDP, GDP deflator and export cause public investment. It might be explained by the fact that stagnant GDP growth, deflation and decline of export become a pressure to expand public spending.

Impulse response functions

The analysis here depends on Cholesky decomposition, assuming that the interdependence of the variables is recursive. In this case, the result of the impulse response function is changeable according to the order of explanatory variables. In principle, variables are arranged in the order of policy variables, market variables, and economic variables. Concretely, the order of the variables are gross nominal capital formation by the government, the call rate, money supply (M2+CD), exchange rate, deflation deflator, inflation deflator, real wage over productivity, real exports, excess debt, real GDP. The order of monetary variables and deflators are basically consistent to the results of Granger causality.

The results are shown in Chart 12. Dotted line means 5% level of significance.
The impacts of various variables to real GDP are as follows. Public investment significantly increases real GDP. The increase of the call rate reduces real GDP, but the effect is statistically insignificant. Money supply significantly increases real GDP. Exchange rate depreciation (exchange rate is expressed as yen per dollar) increases real GDP, but the effect is statistically insignificant. GDP deflator significantly increases real GDP. The increase of real wage compared to marginal productivity of labor significantly reduces real GDP. Real export also significantly increases real GDP. The impact of excess debt is not significant.

We estimated the VAR model in the opposite order of the variables. The significance of public expenditure, money supply, and exchange rate became weak, but the essential nature of the result doesn’t change.

Chart 12 shows the response to one standard error shock of various variables, but to reach any policy implications, the response to one percent shock is convenient. Table 13 shows the accumulated response of 10 quarters (2.5 years) of one percent shock. The table shows what variables are numerically important. A one percent increase of public investment increases real GDP by 0.14 percent over two and a half years. This figure is translated into a Keynesian multiplier by dividing the ratio of nominal public investment to nominal GDP (about 8 percent). The figure is about 1.7, and slightly larger than the multiplier compiled by complicated macro econometric model such as Hori et al. (2003). A one percent increase of the call rate reduces real GDP by 0.45 percent. A one percent increase of money supply increases real GDP by 1.37 percent. This is a very large number, but similar research basically produces same number. NOH (2002) estimate the number 1.64 for two years. A one percent depreciation of the yen increases real GDP by 0.05 percent. A one percent increase of GDP deflator increase real GDP by 0.05 percent. A one percent increase of real wage
compare to marginal productivity of labor reduces real GDP by 0.28 percent. Real wage minus marginal productivity of labor increased 10 percent since the bubble period to the middle of the 1990s (See Chart 8(1)). It is possible to say that this factor caused three percent decline of real GDP in the middle of 1990. A one percent increase of real export increases real GDP by 0.28 percent. This number seems too large, considering that the weight of export to GDP is about 10%. Excess debt does not affect real GDP. This seems to be an unexpected result for many people, so we put excess debt in the first order of the variables in Cholesky decomposition. The result of the accumulated response of 10 quarters (2.5 years) of one percent shock is shown in Table 14. But still excess debt does not affect real GDP, either.

Points of Estimation Results

The results basically support the conjectures in Section 2 and 3 of this paper. Monetary policy variables such as money supply, call rate, and exchange rate are important in explaining the Great Recession, and wage rigidity is also significant. Excess-debt variable used here is not important. This does not mean that non-performing loan is not important. The variable as bad loans used here are not exact. No one knows the true value of the bad loans. If I can find more accurate and theoretically persuasive variables for bad loans, then I might be able to find the result that deflation itself and the bad loan are much more important. Still, I need to explore the real impacts of excess debt. And we cannot explain how monetary variable effect real economic activity by adding real wage compared to marginal productivity of labor and excess debt. Monetary impact is very large, but we cannot understand why the impact is so large and persistent.

Instead of pursuing the reason why monetary impact is persistent, it might be
reasonable to think that successive monetary shocks affected real economy throughout 1990s and beyond. We can think of these shocks such as yen appreciation in 1995, inadequate monetary expansion for financial systemic risk in 1998, and break of monetary expansion in 2000. These successive monetary shocks might affect real economy persistently.

Monetary Policy Making in a Country Captured by Divided Vested Interests

Japan's Great Recession was caused by strict monetary policy. A natural question thus arises: Why didn't Japan increase the money supply? The reason is simple. Japanese banks held a great amount of government bonds. Table 15 shows the extent to which banks held them. The vertical line shows the ratio of government bonds to total assets of each bank in March 1998, and the horizontal line shows the ratio in March 2003. This figure shows that Japanese banks increased their government bond holdings from 1998 to 2003. In this situation, if the Bank of Japan increased the money supply, then nominal interest rates would increase through economic recovery and price expectation effect (Fisher effect), and bond prices would fall. Of course, the main assets of ordinary banks are loans, so the balance sheets of ordinary banks will be improved by economic recovery even though bond prices fall. But there might be unusual banks, and the Japanese monetary authority must be concerned about that. This might be a reason why the Japanese monetary authority cannot use the power of monetary policy.

\[\text{This is inspired by an excellent book by Mallon(1975)}\]
5. Conclusions

Japan’s Great Recession is basically explained by monetary factors. The persistence of the monetary impacts is partly explained by wage rigidity. And we can also think that successive monetary shocks affected real economy throughout 1990s and beyond. The impact of excess debt in this estimation was not significant, but it is too early to conclude that the impact of the bad loan was small, because variable used here is just excess debt, not bad loan.

If the Bank of Japan increases the money supply, then some banks might be in a difficult situation. But, if deflation continues, much more banks will go in a more serious situation, and much more enterprises will also go bankrupt.

Appendix

Estimating Procedure of Marginal Productivity of Labor

Marginal productivity of labor is calculated by using Cobb-Daggles Function. Capital and utilization index are estimated as follows.

1. Estimation of Capital Stock

1990 base data and 1995 base data of Private Capital Formation in SNA Data were connected. Capital stock of JT is subtracted from manufacturing capital stock. Capital stock of JT, NTT, Electric Power Development Co. Ltd. JR, Privatized Bullet Train is subtracted from capital stock in all the industries. Capital stock in non-manufacturing sector is capital stock in all the industry minus manufacturing sector.

2. Estimation of Utilization Rate in Non-Manufacturing Sector

Indices of Tertiary Industry Activity in 1990 base data and 1995 base data were connected in average of 1995. After taking seasonal adjusted method, we estimate the
following equation.

\[ \log\left(\frac{\text{Indices of Tertiary Industry Activity}}{\text{Capital stock in non-manufacturing sector}}\right) = c + a \times \text{TREND} \]

And we put the error of the above equation in the following equation.

\[ (\text{Error} + 1) \times 100 \]

We can make an indicator from the above equation by making the indicator 100 for year 2000.

3. Employment Earnings

Until 1989 data in 68SNA and after 1990 data in 1993SNA were used.

4. Seasonal Adjusted Data

All the data except capital stock is seasonal adjusted by X-11.

5. Labor share

Labor share \( a = \frac{\text{employment earnings}}{\text{nominal GDP}} = 0.536882614 \)

This is average of data since 1980 to 2002

6. Estimation

We estimated \( A \) and \( \lambda \) in the following equation.

\[ \ln(\text{GDPs}) = \ln(A) + 0.536882614 \times \ln(\text{LEYEDs} \times \text{HPAs}) + 0.463117386 \times \ln(\text{km} \times \text{kadou} + \text{kn} \times \text{kadou}_n) + \lambda \times \text{TREND} \]

7. Marginal Productivity of Labor

Marginal productivity of labor is calculated by differentiating the equation in 6.

\[ w^* = a \times A \times e^{\lambda T} \times \left( \frac{\text{km} \times \text{kadou} + \text{kn} \times \text{kadou}_n}{\text{leyed} \times \text{hpa}} \right)^{1-\alpha} \]

8. Real Wage

Employment Earnings

Until 1989 data in 68SNA and after 1990 data in 1993SNA were used.
The data is seasonal adjusted by X-11.

Wage Rate = Employment Earnings / (No. of Employee × Working Hours)

Real Wage = Wage Rate / GDP deflator.

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Table 1 Magnitudes of Bubbles and Stagnations in Advanced Countries in 1980s

<table>
<thead>
<tr>
<th></th>
<th>Period of Bubble</th>
<th>Magnitudes of Bubbles</th>
<th>Magnitudes of Stagnations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>1987 - 1991</td>
<td>7.8</td>
<td>-24.1</td>
</tr>
<tr>
<td>Australia</td>
<td>1984 - 1989</td>
<td>7.2</td>
<td>0.9</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1983 - 1987</td>
<td>9.8</td>
<td>-4.6</td>
</tr>
<tr>
<td>Austria</td>
<td>1988 - 1991</td>
<td>4.4</td>
<td>-6.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>1987 - 1990</td>
<td>4.1</td>
<td>-3.8</td>
</tr>
<tr>
<td>Denmark</td>
<td>1982 - 1986</td>
<td>5.8</td>
<td>-1.7</td>
</tr>
<tr>
<td>Finland</td>
<td>1987 - 1989</td>
<td>5.2</td>
<td>-9.9</td>
</tr>
<tr>
<td>France</td>
<td>1986 - 1989</td>
<td>3.6</td>
<td>-7.0</td>
</tr>
<tr>
<td>Italy</td>
<td>1984 - 1989</td>
<td>3.2</td>
<td>-9.4</td>
</tr>
<tr>
<td>Sweden</td>
<td>1984 - 1989</td>
<td>4.9</td>
<td>-3.3</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1984 - 1990</td>
<td>9.9</td>
<td>-5.9</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>6.0</td>
<td>-6.8</td>
</tr>
</tbody>
</table>

(Source) Harada(2003)Chapter2, Table2-1, Original data are from International Monetary Fund, International Financial Statistics

(Note)
1. 11 countries which experienced bubbles are selected from advanced 23 countries in IMF, IFS data according to the following procedures.
   (1) Real GDP growth rate continuously exceeded trend growth rate (1970-2000 average) by 3 years in middle of 1980s to early 1990s, and real GDP growth rate continuously declined by the trend growth rate for more than 3 years.
   (2) Stock price increased by 100% in bubble age.
   (3) Per capita GDP exceed 5000 $ in 1985.
2. Magnitude of Bubbles is accumulated difference of trend GDP.
3. Magnitude of stagnation is accumulated difference of trend GDP.
Chart 2  Real GDP and Real GDP per Working Hour

(Note) 1. Real GDP per Working Hours = Real GDP / (Workers by Industry x Working Hours by Industry)
2. SNA and Monthly Labor Survey are used before 1989. 93SNA is used after 1990.
<table>
<thead>
<tr>
<th></th>
<th>1980-85</th>
<th>1985-90</th>
<th>1990-95</th>
<th>1995-00</th>
<th>Change 80-85 to 95-00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>3.25</td>
<td>5.14</td>
<td>1.69</td>
<td>1.45</td>
<td>-1.80</td>
</tr>
<tr>
<td>Labor</td>
<td>1.14</td>
<td>1.33</td>
<td>-0.04</td>
<td>-0.14</td>
<td>-1.28</td>
</tr>
<tr>
<td>Capital</td>
<td>1.50</td>
<td>2.30</td>
<td>1.16</td>
<td>0.85</td>
<td>-0.65</td>
</tr>
<tr>
<td>Information Capital</td>
<td>0.31</td>
<td>0.41</td>
<td>0.15</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Other Capital</td>
<td>1.19</td>
<td>1.89</td>
<td>1.01</td>
<td>0.34</td>
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<tr>
<td>TFP</td>
<td>0.60</td>
<td>1.52</td>
<td>0.57</td>
<td>0.74</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Chart 4 Real GDP, Money Supply and Government Investment

(Source) Cabinet Office "SNA," Bank of Japan "Financial and economic Statistics"
(Note) GDP growth rate in 1980 is calculated by 68SNA.

Chart 5 Real GDP, Exchange Rate and Real Exports

(Note) GDP growth rate in 1980 is calculated by 68SNA.
Chart 6  Production, Real Wage and Unemployment Rate in Japan and the U.S.A

(1) Japan

(2) U.S.A.

(Source) Japan: Ministry of General Affairs, Ministry of Welfare and Labor
U.S.: Department of Commerce, Department of Labor
Chart 7 Phillips Curve

CPI increase rate to the same month of the previous year (%)

Unemployment rate (%)

1980-92
y = -4.0841x + 12.24
R² = 0.3636

1993-2002
y = -0.6237x + 2.5134
R² = 0.7763

(Note) Effects of Consumption tax on CPI are excluded.

Estimated Equation:
CPI (increase rate to the same month of the previous year, %) = unemployment Rate, % + β
Chart 8 Newly Introduced Variables
(1) Real Wage and Marginal Productivity of Labor

(1) Excess Debt (All Industries)
<table>
<thead>
<tr>
<th>Variables</th>
<th>Trend + Constant</th>
<th>Constant</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Lags</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>NIPUB</td>
<td>-8.89 ***</td>
<td>-2.02</td>
<td>1.16</td>
</tr>
<tr>
<td>CALL</td>
<td>-3.97 ***</td>
<td>-2.69</td>
<td>-2.61</td>
</tr>
<tr>
<td>M2CD</td>
<td>-0.62</td>
<td>-1.13</td>
<td>-1.32</td>
</tr>
<tr>
<td>EXCHANGE</td>
<td>-1.54</td>
<td>-1.20</td>
<td>-1.89</td>
</tr>
<tr>
<td>PGDP</td>
<td>-0.98</td>
<td>-0.49</td>
<td>1.56</td>
</tr>
<tr>
<td>RW-MPL</td>
<td>-1.55</td>
<td>-1.46</td>
<td>-1.45</td>
</tr>
<tr>
<td>EXPORT</td>
<td>-4.04 ***</td>
<td>-4.01 **</td>
<td>-2.88</td>
</tr>
<tr>
<td>GDP</td>
<td>-5.45 ***</td>
<td>-2.03</td>
<td>1.11</td>
</tr>
<tr>
<td>DEBTS</td>
<td>-2.99</td>
<td>-2.32</td>
<td>-2.51</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Trend + Constant</th>
<th>Constant</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Lags</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CALL</td>
<td>-6.36 ***</td>
<td>-4.66 **</td>
<td>-4.41 **</td>
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<tr>
<td>M2CD</td>
<td>-3.94 **</td>
<td>-3.18 **</td>
<td>-2.12 **</td>
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<tr>
<td>GDP</td>
<td>-17.94 ***</td>
<td>-37.98 **</td>
<td>-3.79 **</td>
</tr>
<tr>
<td>DEBTS</td>
<td>-10.15 ***</td>
<td>-5.69 **</td>
<td>-7.04 **</td>
</tr>
</tbody>
</table>

(Note) *** stands for 1%, ** 5%, *10% level of significance.
<table>
<thead>
<tr>
<th>Names of</th>
<th>Definitions</th>
<th>Sources</th>
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</thead>
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<tr>
<td>NIPUB</td>
<td>GROSS DOMESTIC FIXED CAPITAL FORMATION-PUBLIC SECTORS</td>
<td>ANNUAL REPORT ON NATIONAL ACCOUNTS</td>
</tr>
<tr>
<td>CALL</td>
<td>CALL RATES-COLLATERALIZED OVERNIGHT,CALL RATES-UNCOLLATERALIZED</td>
<td>FINANCE AND ECONOMIC STATISTICS MONTHLY</td>
</tr>
<tr>
<td>M2CD</td>
<td>MONEY SUPPLY AVERAGE OUTSTANDING-M2+CD</td>
<td>FINANCE AND ECONOMIC STATISTICS MONTHLY</td>
</tr>
<tr>
<td>EXCHANGE</td>
<td>EXCHANGE RATES-YEN PER US DOLLAR(SPOT,MIDDLE,MONTHLY AVERAGE)</td>
<td>FINANCE AND ECONOMIC STATISTICS MONTHLY</td>
</tr>
<tr>
<td>PGDP</td>
<td>GROSS DOMESTIC PRODUCT(OR GROSS DOMESTIC EXPENDITURE)(DEFRACTOR)1995</td>
<td>ANNUAL REPORT ON NATIONAL ACCOUNTS</td>
</tr>
<tr>
<td>Real Wage - Marginal Productivity of Labor</td>
<td>See Appendix</td>
<td></td>
</tr>
<tr>
<td>EXPORT</td>
<td>EXPORTS OF GOODS &amp; SERVICES(AT CONSTANT PRICES)</td>
<td>ANNUAL REPORT ON NATIONAL ACCOUNTS</td>
</tr>
<tr>
<td>EXCESS DEBT</td>
<td>(1)-( (2)+(3)-(4) )+(5)+(6)-( (7)×0.5+(6) )×20 Data is seasonally adjusted. (1)CORPORATE CURRENT LIABILITIES-SHORT.TERM DEBT (2)CORPORATE CURRENT ASSETS-NOTES RECEIVABLE, ACCOUNTS RECEIVABLE (3)CORPORATE CURRENT INVENTORIES (4)CORPORATE CURRENT LIABILITIES-NOTES PAYABLE, ACCOUNTS PAYABLE (5)CORPORATE FIXED LIABILITIES-LONG.TERM DEBT-ALL INDUSTRIES (6)CORPORATE FIXED LIABILITIES-CORPORATE BONDS-ALL INDUSTRIES (7)CORPORATE CURRENT PROFIT-ALL INDUSTRIES (8)DEPRECIATION EXPENSES</td>
<td>QUARTERLY REPORTS OF INCORPORATED ENTERPRISES</td>
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<tr>
<td>GDP</td>
<td>GROSS DOMESTIC PRODUCT(OR GROSS DOMESTIC EXPENDITURE)(AT CONSTANT)</td>
<td>ANNUAL REPORT ON NATIONAL ACCOUNTS</td>
</tr>
</tbody>
</table>
Chart 11 Granger Causality

N_IPUB ←→ R_GDP
CALL ←→ M2+CD
EXCHANGE ←→ N_IPUB
EXCESS DEBT ←→ PGDP
EXPORT ←→ R_WAGE-MPL
PGDP ←→ R_GDP

→ 1%
→→ 5%
### Table 13 Accumulated Response of Real GDP to One Percent Shock of Each Variable

<table>
<thead>
<tr>
<th>NIPUB</th>
<th>CALL</th>
<th>M2CD</th>
<th>EXCHANGE</th>
<th>GDP Deflator</th>
<th>RW-MPL</th>
<th>EXPORT</th>
<th>EXCESS DEBTS</th>
<th>Real GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14</td>
<td>-0.46</td>
<td>1.37</td>
<td>0.06</td>
<td>0.05</td>
<td>-0.28</td>
<td>0.28</td>
<td>0.00</td>
<td>0.49</td>
</tr>
</tbody>
</table>

### Table 14 Accumulated Response of Real GDP to One Percent Shock of Each Variable  
- In Case of Placing Excess Debt in First Order -

<table>
<thead>
<tr>
<th>EXCESS DEBTS</th>
<th>NIPUB</th>
<th>CALL</th>
<th>M2CD</th>
<th>EXCHANGE</th>
<th>GDP Deflator</th>
<th>RW-MPL</th>
<th>EXPORT</th>
<th>Real GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.14</td>
<td>-0.35</td>
<td>1.36</td>
<td>0.06</td>
<td>0.01</td>
<td>-0.26</td>
<td>0.28</td>
<td>0.49</td>
</tr>
</tbody>
</table>
Chart 15  Change of the Rate of JGB to Total Asset of Japanese Banks 1997 - 2001

(Source) National Bankers Association
(Note) Data of major marged banks are averages of the former banks.