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The Recent Monetary Policy and Money Demand in Japan*

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Abstract

After the burst of the bubble, the Japanese economy has experienced a hard recession which Japan has never experienced after the war. The Japanese government conducted the huge public investment without success. The Bank of Japan also performed the low interest policy to boost the economy. However Japanese economy got worse after 1997 when the leading financial institutions suddenly collapsed. The Japanese economy had plunged into the deflationary spiral. The BOJ took the so-called zero interest policy after 1999 to fight against the deflationary pressure. Furthermore it started the qualitative easing policy by increasing the outright purchase of government bond after March 2001.

The policy stands on the idea that money stock has the positive effect on the economy. The money demand has to be stable for the policy to succeed. The bank of Japan (2003) recently reported that the long-run equilibrium relationship between money stock and real economic activity can no longer be detected, though such relationship could be found before 1997. In this paper we quantify that money stock has a positive relationship with real economic activity, and money demand is still stable.

We found one cointegration in the cointegration test between money stock, real GDP, and share price in the period from 1981 through 1997. However the cointegration has broken out when the sample period was extended beyond 1997, as the BOJ (2003) suggests. We performed the cointegration test again by comprising a new variable; financial anxiety and found one cointegration. Dynamic money demand function was estimated with an error correction term. The result was almost statistically satisfactory, suggesting the stability of money demand.

Key words: cointegration, financial anxiety, stability of money demand

JEL Classification: E41, E50, E52

1. Introduction

Money supply is a very important key variable in macroeconomic policy. Many major central banks in Europe and North America treated money supply as intermediate target. However the relationship between money supply and economic activity is not so clear as before. Greenspan confessed in the testimony to the congress in 1993 that money supply is no longer an important target suggesting unclear relationship between money supply and economic activities.

Nevertheless, money supply is still thought to have a certain role in conducting monetary policy because it has important information though the degree of importance attached to money supply is different country by country[1]. The Bank of Japan began publishing forecasts of M2 in July 1978, because the Bank came to understand the importance of money supply through the hard experience of high inflation after the 1st oil shock in 1973. The Bank of Japan has tried to indirectly control money supply by affecting the interest rate in the short-term financial market. Since March 2001, The Bank of Japan started to directly control money supply under the framework of the so-called quantitative easing policy. So the Bank uses high powered money as the monetary policy target now. Money supply can be properly controlled under the assumption of stable relationship between money demand and economic variables such as real GDP and interest rate.

The stability of money demand is a necessary condition to conduct the effective monetary policy. Many studies have been done about the specification of money demand function. The traditional money demand function tries to explain the real money demand by a partial adjustment model with real output and interest rate as dependent variables. The typical model of the money demand function is one constructed by Stephen M. Goldfeld in 1973. He used a real value of narrow money (M1) as a dependent variable and real GNP and a short-term interest rate, as well as the first lag of the dependent variable as explanatory variables. His specification became the standard to estimate the money demand function. Many researchers used this specification to estimate the demand function. However after the mid-1970s, the forecast based on this model caused the overprediction not only in Japan but also in the United States. The overprediction showed by the discrepancy between actual money and estimated money was thought a result of downward shifts of money demand function caused by the financial innovation. Several problems also have been pointed out related to the traditional estimation method. Major problem is that the conventional model is estimated by the level of the variables[2].

Granger and Newbold (1974) indicated that the regression including nonstationary variables might cause the spurious regression phenomenon. A spurious regression shows the statistically high significance, even if there exist no economic relations among variables. Phillips (1986) mathematically proved that the regression estimate in the presence of the nonstationary variables has the biased t-statistics and F-statistics.

We also have to pay an attention to the concept of cointegration first introduced by Engle and Granger (1987) meaning that if a linear relationship among the nonstationary variables is stationary, the variables combined are cointegrated. When the nonstationary

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[1] Milton Friedman recently replies as follows in response to the question by Randall Parker, "Is money stock targeting dead?" ; Money stock target may be dead, but attention to what happens to the money supply is by no means dead. See Randall E. Parker (2002), p.54.

[2] See the survey studies in Judd and Scadding (1982) and Laidler (1985).

variables are cointegrated, those variables have a long-run equilibrium relationship. In that case, the analysis of the short-run dynamics can be explained by the error correction model, which captures the mechanism to prevent the variables from drifting far away. Though several cointegration tests have been proposed in the literature after the two-step method by Engle and Granger (1987), we use here the test procedures of Johansen (1988) and Johansen and Juselius (1990)[3].

The paper is organized as follows. We describe the data associated with the outcome of preliminary unit root test in section 2. Section 3 presents the empirical evidence of the long run relationship between real money balance and other variables. The evidence suggests that over the time periods I study there exists a cointegration between real M2 and other variables. In section 4, we estimate the short-run demand function with error correction model. The simulation test is performed in section 5. Conclusion is presented in section 6.

2. Data Description

The data used in this study consist of seasonally adjusted, quarterly observations of real money stock, real GDP, interest rate, and share price. For a measurement of money stock, we use M2+CD, which is the major indicator of broad monetary aggregate in Japan. Interest rate as the opportunity cost of holding money must be the spread between own rates on money itself and rates on rival assets. We select CD rate for own rate and yield on 10 years government bond for rival rate. Share price is chosen as a proxy for the asset variable to capture the asset effect on the money demand. Share price is measured by Tokyo Stock Market Price Index (TOPIX). All the variables except for interest variable are expressed as natural logarithms.

Sample period is from 1981/Q1 through 2000/Q4. Since the cointegration test requires that the each economic series are integrated of order one, we determine the order of integration of each variables by implementing the unit root test. We performed the following two unit root tests; Elliot-Rothenberg-Stock (ERS) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The null hypothesis of the former test is that a variable has a unit root while that of the later test is that a variable is stationary. The results are shown Table.1. We performed the same tests on the first differenced variables and found that all variables are I (1).

[3] Studies of money demand using the error correction model are well surveyed in Sriram (2001).

Table 1. Unit Root Test

variables		ERS	KPSS
real money stock	trend	-1.712322	0.23798***
real GDP	const	-0.099681	1.085004***
interest spread	const	-0.767372	0.5205**
share price	const	-0.637521	0.474684***
DV	trend	-2.743211	0.126754*

Notes:

1.Rejections of the null hypothesis at 1, 5, and 10% are denoted by ***, ** and * respectively. See MacKinnon (1996) and Kwiatkowski, Phillips, Schmidt, and Shin (1996, Table 1).

2.DV is the variable of financial anxieties which we will refer to later.

3. Cointegration Test Results

At first we check the relationship between real money stock and real GDP by watching the scatter diagram at Figures 1a and 1b before the formal cointegration tests are conducted. We surely confirm the stable relationship between them before 1997. However two variables seem to be diverged year by year since 1997.

Figure 1a　Money Stock and Real GDP

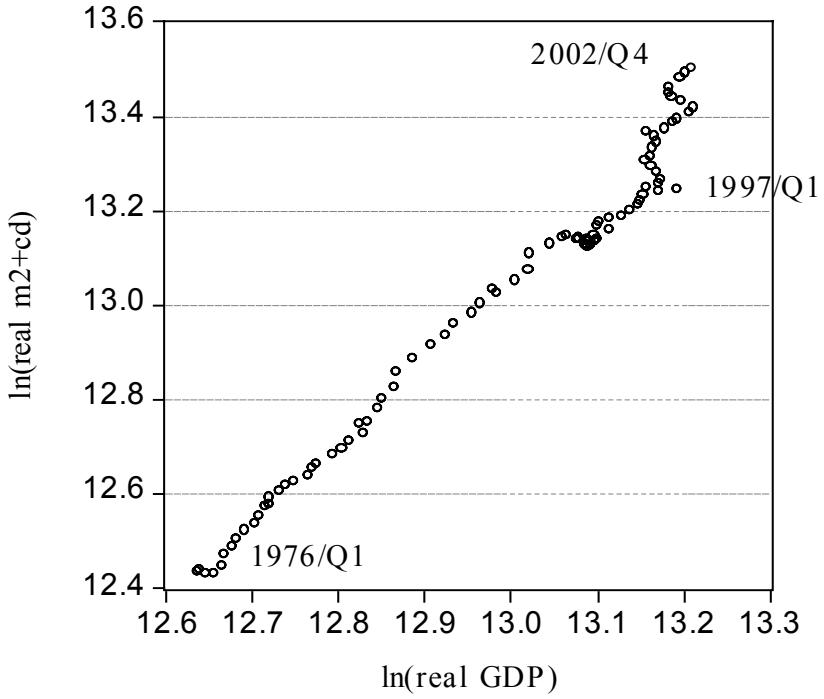
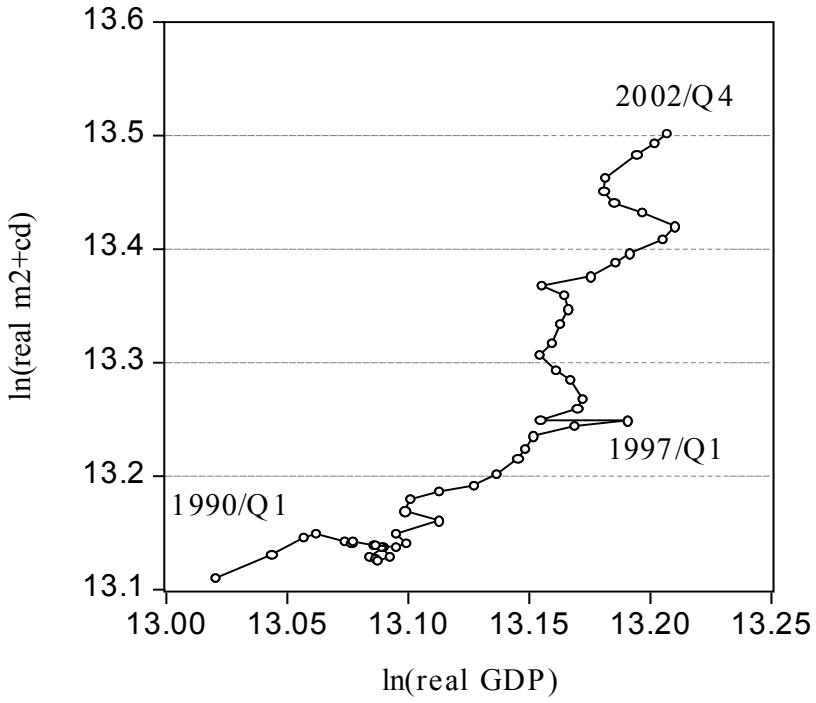


Figure 1b　Money Stock and Real GDP



Engle and Granger (1987) proposed two-step procedure to evaluate the cointegration. Their method was technically so simple that it had been very commonly used especially in 1980s. However their method evaluate the bivariate cointegrating relationship between nonstationary variables, neglecting the presence of multivariate cointegrating vectors. Johansen (1988) and Johansen and Juselius (1990) developed the procedure to evaluate the presence of multiple cointegrating vectors. We employ the more general method of Johansen than Engle and Granger's, to evaluate the cointegrating system among money and other variables.

We pay a close attention to the effect of assets on money stock. We conduct the cointegration test among real money stock, real GDP and share price. Share price is a proxy for asset transaction demand for money.

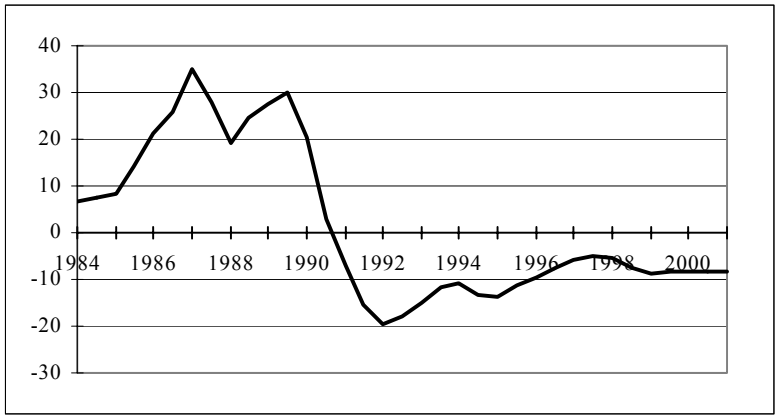
The test results are shown in Table 2. First we analyze the cointegration among real money stock, real GDP and real share price in the period from 1981/Q1 through 1997/Q4. The result shows that there exists a long –run equilibrium relationship between three variables: real money stock, real GDP and share price. However we could no longer find the long-run relationship between these variables when we extend the sample period to include the data from 1998 henceforward. Why does the stable relationship between the money stock and the other variables disappear after 1997? The reason seems to be related with the rise of the financial anxieties. Then we consider the financial anxieties which occurred after the collapse of the bubble economy[4].

[4] The Bank of Japan (1997) analyzed the long-run relationship between real M2+CD and real GDP using the Japanese quarterly data from 1968/Q1 through 1996/Q3, and found the existence

Financial Anxieties

The bursting of the bubble caused the rapid decline of asset price, especially land price as figure 2 shows. The continuous drop of land price decreases the collateral value of land and accumulates the non-performing loan the banking sector has. The firms which rapidly increased their liability under their bullish expenditure in the latter half of 1980's had got into the financially difficult situations. The figure 4 shows corporate bankruptcies during the emergence and burning of the bubble. It shows that the amount of bankruptcies in 1991 had risen more than 300 percent from the previous year. The banking sector has become increasingly vulnerable due to the non-performing loan problems.

Figure 2　Land Price in 6 large urban areas
(Percentage changes from the previous year)



(Source) Japan Real Estate Institute　　(end of fiscal half)

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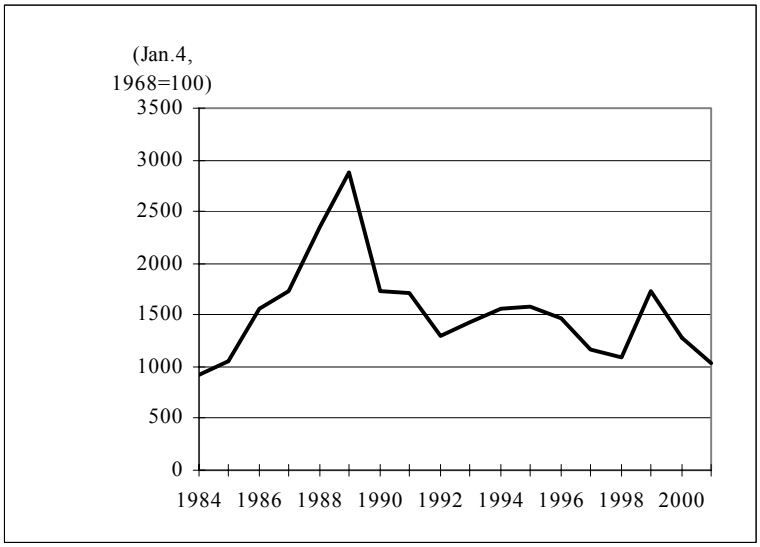
of cointegration among them. They used the two-step method by Engle and Granger and add the dummy variable after 1986/Q1 to take into consideration the structural shock caused by the financial liberalization in the latter half of 1980's.

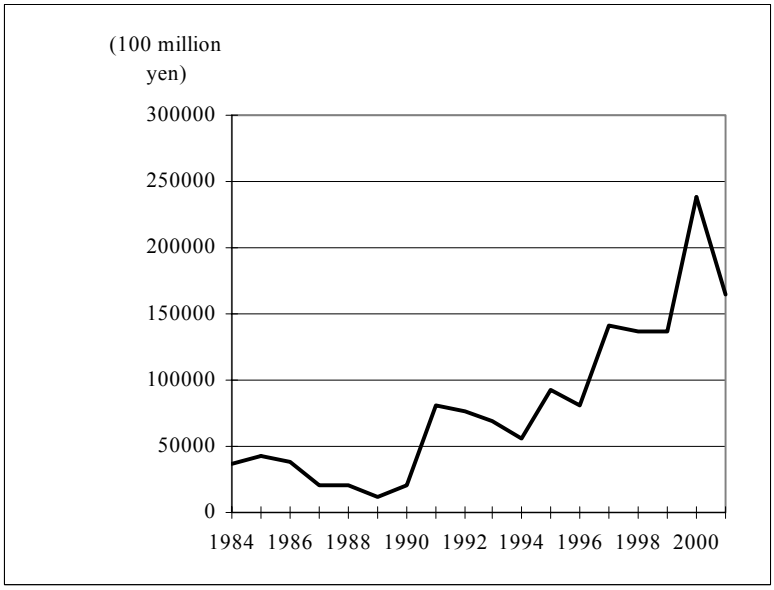
Based on this preceding research, the Bank of Japan (2003) repeated the same estimation by extending the sample period and concluded as follows. A long-run equilibrium relationship between real M2+CD, real GDP, and the opportunity cost can be found in the sample period before 1997. However this relationship cannot be detected any more when the sample is extended beyond 1997, when anxieties over the financial system emerged. They used a three-variable error correction model (VECM) to find a long-run equilibrium relationship.

Figure 3　Stock Prices, TOPIX



(Source) Tokyo Stock Exchange

Figure 4　Corporate Bankruptcies ; Amount of Liabilities



(Source) Tokyo Stock Research Ltd.

It was the year of 1997 when serious financial problems had come out in the Japanese economy. Several big banks and security companies had failed, including Hokkaido

Takushoku Bank and Yamaichi Securities. The Hokkaido Takushoku Bank, well known as TAKUGIN was the largest regional bank in Hokkaido and Yamaichi Securities Company was fourth largest bank of the Big Four securities firms in Japan. Though several financial institutions had been failing after the burst of the bubble economy in 1990, they were the small sized institutes and tactically dealt by insurance deposit[5]. However the failure of two big financial institutions was quite deferent from the former bank failures when the significance of their role in the Japanese economy was put into consideration. People's anxieties over the financial system rapidly increased. Further their failure triggered the rapid decline in the share prices of many financial institutions. ` Japan premium` was also imposed in the international market at the same time. As a result both firms and household seem to try to increase the money demand by their precautionary motivation. Therefore the rise of this motivation seems to break down the cointegration between real money, real GDP and share price which existed in the pre-1997.

Qualification of Financial Anxieties

We need to comprise another variable to capture the rise of precautionary demand for money after 1997. Kimura and Fujita (1999) proposed a new variable to capture the psychological change of people due to the financial anxieties. They used the Corporate Financial Position Diffusion Index issued quarterly by Bank of Japan known as TANKAN in order to qualify the unobservable variable.

Following Kimura and Fujita's, we formulate the model as follows.

$$DI_t = \beta_0 + \beta_1 rate_t - \beta_2 rate_{t-1} + \varepsilon_t$$

where DI is the diffusion index for the financial position, rate is the interest rates on loans and ε_t is an error term, which shows the influence of irregular or unexpected factors other than interest rates on loan. The financial anxieties can be captured as the variance of this error term[6].

We here introduce TARCH (Threshold Autoregressive conditional Heteroscedasticity) or Threshold ARCH model for the error term ε_t with asymmetric variance property.

$$\varepsilon_t \mid I_{t-1} \sim N(0, h_t^2)$$

$$h_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 d_{t-1} + \alpha_3 h_{t-1}^2$$

where I_{t-1} is an information set generated by $\{\varepsilon_0, \varepsilon_1, \cdots, \varepsilon_{t-1}\}$ and where

$$d_{t-1} = \begin{cases} 1, & \text{if } \varepsilon_{t-1} < 0 \\ 0, & \text{if } \varepsilon_{t-1} \geq 0. \end{cases}$$

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[5] It is after 1987 when asset inflation turned to be speculative bubble. Share price, Nikkei Heikin had reached 38,915 yen, the highest level in the end of 1989. Share price started to collapse after 1990 when Bank of Japan began to take a tight monetary policy. It had been 7,600, the lowest level in March 2000. Land price started to decline after 1991 and still continue to decline now.

[6] The sample in TANKAN is taken from about 700 companies listed in stock exchange. The diffusion indexes for the financial position are made as follows, for example. Companies are asked to choose one out of three answers, 1 tight, 2 not so tight, 3 easy. The percentage share of those which answered 3 is subtracted from those which answered 1.

In this model, the conditional variance h_t^2 is subject to an impact α_1 from good news ($\varepsilon_{t-1} \geq 0$), while an impact ($\alpha_1 + \alpha_2$) from bad news ($\varepsilon_{t-1} < 0$). This kind of asymmetric property corresponds to the situation such that the psychological change of people due to the financial anxieties increases the precautionary demand and that an easy financial position does not rise the precautionary demand[7].

Estimation results are shown in Table 2. Every parameter except α_2 is in significant level. The sign of parameter seems to be reasonable in economic sense. Since a rise of DI_t implies easy financial position and a rise of $rate_t$ means that of interest rate, $\beta_1 + \beta_2$ should take a negative value. The parameter α_2 of $\varepsilon_{t-1}^2 d_{t-1}$ takes a positive value and hence the conditional variance is shown to exhibit asymmetric property, though the significance level is not sufficient. Figure 5 depicts the behavior of h_t^2.

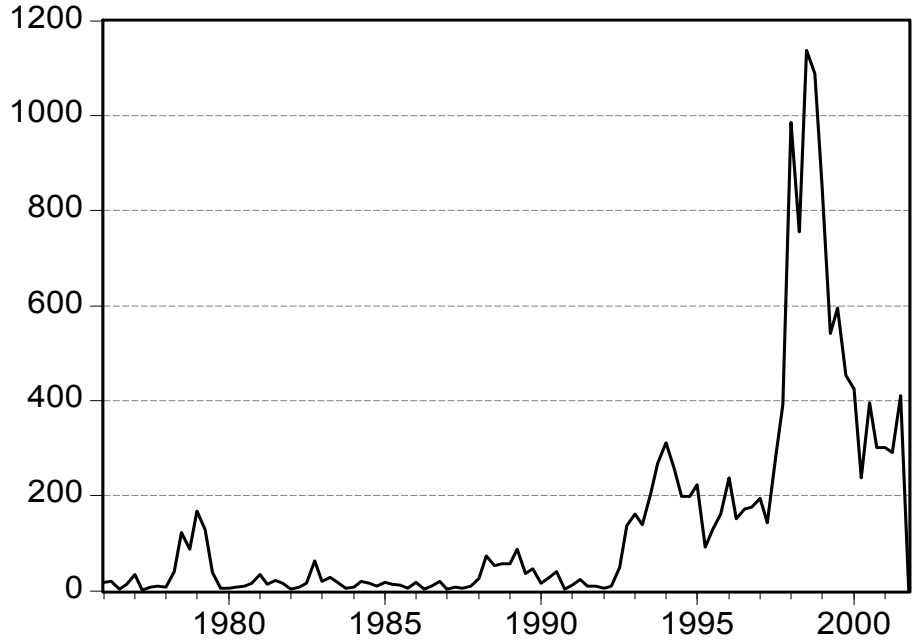
Table 2 Estimation of TARCH model (1976/Q1-20001/Q4)

	Coefficient	Std. Error	z-Statistic	Prob.
β_0	-11.18269	0.4268202	-26.2	2.66E-151
β_1	0.0360931	0.0041378	8.7228371	2.71E-18
β_2	-0.052555	0.0040392	-13.01121	1.06E-38
α_0	7.2321225	2.1308525	3.3940043	0.0006888
α_1	1.0383733	0.1966078	5.2814447	1.28E-07
α_2	0.3026657	0.2505732	1.2078932	0.2270883
α_3	-0.284238	0.0664223	-4.27925	1.88E-05

Anxieties variable denoted by DV is seen to increase rapidly after 1997 when people strongly feel anxiety over the financial system because of the failure of several big financial institutes in Japan. Then DV rapidly decrease after 1999. The decline can be seen as follows. The Bank of Japan had adopted an aggressive monetary easing policy to reduce the inter-bank money rate to a low level in February 1999. Thanks to this so-called zero interest policy, the uncollateralized overnight call rate was lowered to 0.01 percent and further declined to 0.001 percent when the BOJ had took the so-called quantitative easy policy in March 2001. The Japanese government also decided to inject the public fund to the banking sector; the amounts are 1.8 trillion yen in 1998, 7.8 trillion yen in 1999. Both

[7] In estimating TARCH model, the shock ε_t influences h_{t+1}^2 in the next quarter. However, real firms feel and react to financial anxieties within the t-th period when the shock happens in the t-th period. Hence, we assume the time shift of conditional variance h_t^2 and the financial anxieties is newly defined by a variable $DV_t \equiv h_{t+1}^2 / 1000$.

Figure 5　Anxieties over the financial system (DV, conditional variance)



efforts of the BOJ and the government had succeeded in dispelling the financial anxiety. Thus, DV rapidly decrease after 1999 when the BOJ began to take an aggressive policy and the government decided to inject public fund to stabilize the financial system.

The result of the cointegration test taking the financial anxiety into consideration is also shown in Table 3. We tested the cointegration rank by both maximal eigenvalue and trace test. Number of lags was determined by the likelihood ratio test. It suggests that there still exists a long-run equilibrium relationship among real money stock, real GDP, share price, and financial anxiety, though the equilibrium relationship has been broken down in the model ignoring the financial anxiety.

Table 3　Cointegration test

	Sample period	Cointegration rank	Cointegration vector		
			α_Y	α_R	α_{DV}
1	1981/Q1-1997/Q4	1	1.37375 (0.03249)	0.06772 (0.00998)	
2	1981/Q1-2000/Q4	0			
3	1981/Q1-1997/Q4	1	0.95367 (0.101787)	0.15929 (0.023843)	0.4262 (0.102746)
4	1981/Q1-2000/Q4	1	1.0448 (0.090963)	0.13066 (0.024302)	0.34333 (0.046763)

notes. 1.Values in parenthesis below the coefficients of the cointegrating vector are standard deviation

2. The rank of cointegration was tested by both maximal eigenvalues and trace test.

3. $EC_t = M_t - \alpha_Y Y_t - \alpha_R S_t - (\alpha_{DV} DV_t)$

4. One cointegration rank means that there is one long-term equilibrium relationship among the variables we used, while zero cointegration rank means that there is no long-term equilibrium relationship.

4. Estimating short-run money demand regression

The cointegration result above shows that there exists one cointegration relationship between real money stock, real GDP, share price, and financial anxiety. We try to estimate the following short-run money demand function.

Model 1

$$\Delta M_t = \beta_0 + \beta_1 EC_{t-1} + \sum_{i=0}^{l} \beta_{2i} \Delta Y_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta R_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta S_{t-i} + \delta_t$$

Model 2

$$\Delta M_t = \gamma_0 + \gamma_1 EC_{t-1} + \sum_{j=0}^{l} \gamma_{2j} \Delta Y_{t-j} + \sum_{j=0}^{m} \gamma_{3j} \Delta R_{t-j} + \sum_{j=0}^{n} \gamma_{4j} \Delta S_{t-j} + \sum_{j=0}^{p} \gamma_{5j} \Delta DV_{t-j} + \varepsilon_t$$

The both models include real GDP as the scale variable, the interest rate spread between government 10 year bond yield and 3-month CD rate as the opportunity cost, and share price as the asset variable. Real money stock, real GDP, interest rate spread and share price are denoted by M, Y, R, and S respectively. Model 2 has an additional variable DV as financial anxiety, which is the conditional variance indicating the degree of people's anxiety shown in Figure 5. Δ is the first difference operator. δ_t and ε_t are the short-run random disturbance term. EC is the error correction term representing the deviation from the long-run equilibrium. It means that actual money stock do not always equal what firms and household are willing to hold on the basis of the long-run aquarium relationship. The coefficient of the error correction suggests that they try to correct any disequilibrium from the long-run equilibrium money stock. The negative value of the error correction coefficient means to correct the disequilibrium.

We estimated the model over the period from 1981/Q1 through 2000/Q4. The estimation results are shown in Table 4 and 5. The lag length for each variable has been determined by checking the significance of them by p-value. The growth rate of real GDP in the period t and t-1 have the significant impact on money demand in both models, suggesting that the rise of income increase the transaction demand for money. The error correction term take the negative in the period t-1 in both models, though it is not statistically significant in model 1. It means that even if the relationship among the real money stock and other variables diverges from the long-run equilibrium path, those variables will begin to move in

such a way to converge into the long-run equilibrium soon. The coefficient of R, the interest rate spread take the negative, suggesting the increase in the opportunity cost decrease money demand, though the coefficient is not statistically significant in both model. Share price denoted by S is expected to have a positive impact on the money demand especially in the process of the burst and collapse of the bubble. Our result shows that the change of share price has a positive impact on the money demand in the period t and t-1 in both models. It means that the money demand is thought to move in the same direction with share price. That is, money demand increase in line with rise of stock price, while money demand decrease in line with fall of share price.

The coefficient of DV_t is expected to take the positive sign, because the rise of financial anxieties is supposed to increase the precautionary demand. The estimated coefficient of DV shown in table 5 takes positive value as expected. Overall our result indicates that the sighs of almost all estimated coefficients seem to satisfy the suggestion of economic theory, though the coefficients of interest rate spread are not statistically significant in both models. The coefficient of EC in model 1 which does not take the financial anxieties into consideration is not statistically significant either.

Table 4　The Error Correction Money Demand Regression without DV variable

Variable	Coefficient	t-Statistic	Prob.
Const.	0.007876	5.770409	0.000000
EC_{t-1}	-0.00641	-0.283447	0.777648
ΔY_t	0.298589	3.246851	0.001773
ΔY_{t-1}	0.254737	2.717706	0.008229
ΔR_t	-0.17541	-0.765343	0.446569
ΔS_t	0.018469	1.595665	0.114944
ΔS_{t-1}	0.027997	2.391113	0.019413
Adjusted R^2	0.269293		
S.E.	0.007611		
log likelihood	276.9406		
D.W.	1.026439		

Table 5 The Error Correction Money Demand Regression with DV variable

Variable	Coefficient	t-Statistic	Prob.
Const.	0.0075	6.814692	0.00000
EC_{t-1}	-0.09507	-4.97176	0.00000
ΔY_t	0.354186	4.40871	0.000004
ΔY_{t-1}	0.25116	3.197723	0.00207
ΔR_t	-0.12635	-0.63144	0.529778
ΔS_t	0.017284	1.726803	0.08852
ΔS_{t-1}	0.01951	1.85762	0.06737
ΔDV_t	0.013211	1.830898	0.071312
Adjusted R^2	0.455562		
S.E.	0.00657		
log likelihood	289.1163		
D.W.	1.25946		

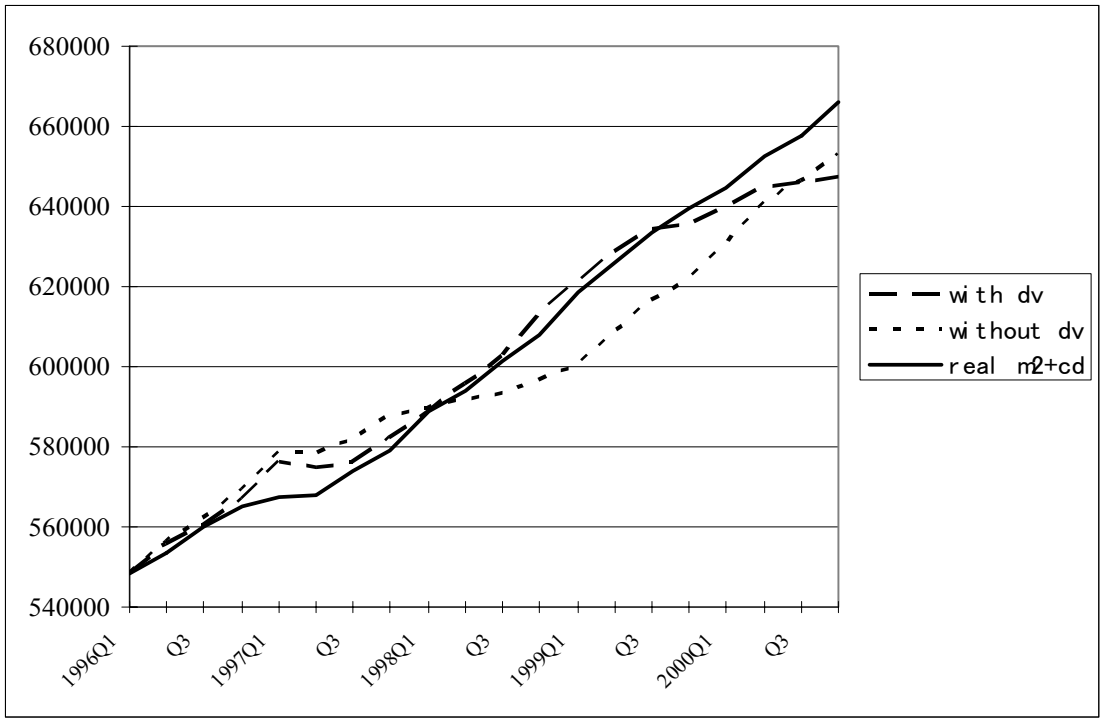
5. The Simulation test

We conducted the dynamic forecast, setting the staring point at the first quarter of 1996. The result is shown in Figure 6. The simulation result with the model without DV variables is added for the reference. The straight line is of the actual value of real money growth, while the dotted line is of the forecasted values with DV and the slender dotted line is of the forecasted values without DV variable.

The Figure indicates the forecasted line with the model taking financial anxieties into consideration is fitted better than the line without DV variable. Especially the model with DV pursues the behavior of money stock much better for the period from 1997/Q4 through 1998/Q4 when many banks had faced the financially risky situation and financial anxiety had spreaded out through the country.

However we have to keep a close attention to the future behavior of money demand, because household and firms tend to increase the risk free assets such as cash and demand deposit under the extremely low interest rates as at present.

Figure 6　Dynamic Forecast



6. Conclusion

The Japanese economy is still suffering from the deflationary pressure after the burst of the bubble economy in 1990. Many macro economic policies have been done including the large scaled public expenditures without success. Monetary policy is thought to be the last resort to recover the economy now.

The Bank of Japan continues to take the easing monetary policy. It begins to take the zero interest policy to induce the overnight call rate in the inter-bank money market into virtually zero in February 1999. Further it has decided to take the so-called quantitative easing policy after March 2001 to fight against the deflation, which means to increase the outright purchases of the long-term government bond to a certain level until the consumer price index (CPI) return to the positive on the year to year basis. The BOJ increased its target on the current account held with private banks to a range of 15 to 20 trillion yen in 2002 and further 30 to 35 trillion yen in 2004.

The BOJ´s new non-traditional policy bases on the conviction that money stock has a positive impact on the real economy. If so, the relationship between money stock and real economic activities must be stable. However the Bank of Japan (2003) recently reported that the long-run equilibrium relationship between money stock and real economic activity

can no longer be detected, though such relationship could be found before 1997.

We performed the cointegration test to find whether or not there exists a long-run equilibrium relationship between money stock and real economic activity. We could find the cointegration between money stock, real GDP and share price in the period over 1981/Q1 to 1997/Q4. However we also got the same result as the BOJ (2003) when the sample is extended beyond 1997. That is to say, we could no longer find the cointegration among them. The reason why the cointegration broke out seemed to come from the fact that financial anxieties spread out through the country in late 1997 when leading Japanese financial institutes suddenly collapsed. We thought that people's anxieties over the Japanese financial institutes induce both firms and household to increase the precautionary demand for money. We performed again the cointegration test by compiling a new variable which was thought to capture the people's psychology. The new variable was created by TARCH model with the data picked up from the Corporate Financial Position Diffusion Index issued by BOJ known as TANKAN. We could find the cointegration between money stock, real GDP, share price and financial anxiety even after 1997.

Next we estimated the money demand function with the error correction term. The result shows that the short-run coefficients are generally of the correct sign and are statistically significant. We also performed out of sample forecast after 1996/Q1. The out of sample forecast suggests that real money growth is still predicted well even after 1997 by the error correction model with financial anxieties variable. To sum up, we can conclude that the money demand is still stable at present. However we need to pay a close attention to the future development of money demand. Because there remains some risky possibility that money demand will turn to be unstable if the external factors such as an accumulation on non-performing loans following a fall in land and stock prices will get worse than the present and impair the financial institutions.

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