Article

Monetary Policy in the Deflationary Economy; Japan's Experience [*]

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Abstract

The paper addresses the effectiveness of monetary policy in the prolonged Japan's recession. A large amount of research has been aimed at the topic. A majority of the previous paper denies the effectiveness of monetary policy in the deflation. The Bank of Japan always insists that monetary policy does not work well especially in the severe deflation. However the role of money should not be ignored when we considers M. Friedman's word "Both inflation and deflation are monetary phenomenon."

The paper will apply the Vector Error Correction Model into Japan's economy over the period from 1980q1 through 2009q1. The model examines whether or not there exists a long-run equilibrium relationship between the monetary base and economic activity, paying a close attention to the precautionary money demand caused by the financial anxiety. People are expected to increase the precautionary demand, facing the financial crisis. The survey data is used to quantify the financial anxieties. The result shows that the cointegration property among monetary base and economic acclivity still hold even after Japan's economy fallen into the deflation in 1997, when people's financial anxiety is taken into account.

The paper also analyzes the existence of the liquidity trap by the same model. The data analysis demonstrates the non-existence of the trap. Thus, we conclude that monetary policy is still effective and the BOJ's role is crucially important to combat against the prolonged recession.

Keywords: bubble, deflation, monetary base, cointegration, financial anxieties
JEL classification: E21, E22, E24, E44

1. Introduction

The paper addresses the effectiveness of monetary policy in the deflationary economy in the context of Japan's experience, especially the zero interest since the late 1990s. Japan's prolonged recession after the bust of the bubble in 1990 triggered the heated discussion among economists and politicians[1]. Discussions were basically aimed at the effectiveness of monetary policy and the responsibility of the BOJ. The BOJ strongly insisted the uncontrollability of money stock when its easy monetary policy was pointed out as the main reason of the bubble in the latter half of 1980s. The BOJ defended itself, arguing that it passively increased money stock to accommodate the strong money demand by the bullish real sector.

After the bust of the bubble, especially the severe recession in 1997and 1999[2], The BOJ insisted the inept of monetary policy in the deflation. The Bank repeatedly argued that monetary policy is extremely accommodative when policy rate decreased to almost zero percent in the late 1990s.   The BOJ emphasized that further aggressive monetary policy would deteriorate the balance sheet. It is often said that monetary policy in the deflation was just like "pushing on a string"[3]. The economists and politicians who defend the BOJ insisted that the prolonged recession came from real factors, such as an aging society, cheap goods imported from Asian countries, and the internationally converged technical level. They thought the microeconomic policies were necessary and there was no economic growth without structural reform.

The paper statistically examines the effectiveness of monetary policy, especially in the severe financial conditions after 1997. Japan's experience provide with a natural experiment of monetary policy at the low interest rate. The paper is organized as follows. Section 2 will briefly review the literatures on statistical evidence on the effectiveness of monetary policy at the low interest rate. Section 3 will apply Vector Error Correction Model in order to examine the long-run relationship among monetary base and other economic variables. In particular the paper focuses on the role of behavior of precautionary demand caused by the financial anxiety. The existence of a liquidity trap is also examined. Section 4 will

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[1] Japan's bubble and bust are chronologically explained in Miyagawa and Morita (2005, 2008). Miyagawa, Morita, and Sawada (2009) also compared Japan's financial crisis with Nordics'.

[2] Hokkaido Takushoku Bank, one of Japan's city banks (largest twenty banks), and Yamaichi Securities Company, one of Japan's four largest security companies, failed in November 1997. Long-Term Credit Bank and Nippon Credit Bank had failed in 1998.The failure of big financial institutions sent the sign that the government gave up the "too big to fail" policy. People thought no financial institutions were immune from failures. Rumors about the other banks' failure had spread out through Japan. The stock prices of many financial institutions sharply declined and "Japan premium" in the international money market jumped by around 100 basis points. Bonds issued not only by Japanese financial institutions but also by Japanese government were downgraded at the investment grade ratings by international credit-rating agencies, such as Moody's.

[3] The phrase "pushing on a string" was used first by Marriner S. Eccles, Governor of the Federal Reserve Board in 1935, who used it to explain the inept of monetary policy in the Great Depression in 1930s. See Meltzer (2006).

discuss the policy implication from the empirical evidence and provide the conclusion.

2.   Review of Literatures on Statistical Evidence

Krugman (1998, 2000) argued that Japan's monetary policy would be impotent because the monetary base and bonds are already perfectly substitutes at very low interest rate. He suggested the BOJ to take an inflation target policy to exit from the liquidity trap. BOJ (2003) proved the inept of monetary policy by statistically estimating a long-run equilibrium among money and other economic variables. They performed a cointegration test among real M2+CD, real GDP, and interest rates using the Vector Error Correction Model. The results showed the long-run equilibrium was not identified if the sample was expanded beyond 1997 when financial system became fragile.

Miyao (2005) and others showed the same estimation results to deny the long-run relationship between money stock and economic activity. Miyao (2005) performed the cointegration test between money stock (M2) and economic activity for the period 1975 to 2003. He showed that the linkage between M2 and income or prices has largely disappeared, and also that M2 does not have the power to predict real GDP or prices if the sample includes the period of the low interest rate from the late 1990s. He thus concludes that money supply should not be used in the conduct of monetary policy in the recent years of financial instability and near zero interest rates.

Baig (2002) tried to estimate the effect of monetary policy by a VAR model based on the sample from 1980 through 2001. He found a positive impulse from monetary base to the economy. From the evidence he concluded that monetary policy is still effective even at the low interest rate. However his sample covers only small part of the period of zero interest rate policy after 1999. His estimation result might reflect the average effect of monetary base during the whole period. To judge accurately the effectiveness of monetary policy he would need more data of zero interest periods.

In order to avoid the data shortage problem, Kimura, Kobayashi, Muranaga, and Ugai (2003) used a time-varying VAR. Time-varying VAR can grasp the policy change and create impulse response that changes over time. They estimated the impulse response among price change, GDP gap, growth rate of monetary base, and call rate based on the period of 1971 q1 to 2002q1. The impulse response from monetary base to price change and GDP gap was not identified as of 2002 q2, though it was clear as of 1985q2. They concluded that monetary base do not have any positive impulse on the economy at the zero interest.

Fujiwara (2006) also performed a VAR model with monthly data of CPI, industrial production, long-run interest rate (JGB rate), and the monetary base from 1985 through 2004. He used the Markov Switching VAR model to consider the structural change in the monetary policy. He found that a structural change had occurred in around 2000 when the interest rate became almost zero, and that since then an impulse response of monetary base to industrial production and CPI was not statistically

significant. He thus concluded that monetary base do not have a significant impact on the economy at the zero interest. Sadahiro (2005) focusing on the role of export in the economy, examined the relationship between the Japan-U.S. monetary base ratio and exchange rate by using monthly data from March 2001 through September 2004. His regression showed that monetary base does not have any effect on the exchange rate.

Honda and others (2007) performed the VAR analysis focusing on the period of quantitative easing policy from March 2001 through February 2006. They estimated the VAR model in levels, which consists of 4 variables, industrial production, consumer price, stock prices, and current asset balance target at the BOJ. Their result suggested that monetary easing has a positive effect on the stock price. One problem of their paper is the shortage of sample and stationarity of the data.

Thus, the majority of previous empirical evidence, except for Honda and others (2007) suggests that the relationship between money and the economic activities is not recognized after 1997 and 98 when Japan's economy rapidly deteriorated.

Next we will perform the cointegration test between monetary variable and economic activities, taking into consideration the behavior of the precautionary demand. The reason why we focus on the precautionary demand is that precautionary demand fluctuated in accordance with up and down of the economy. Precautionary demand rapidly increase especially when the financial system become unstable because households, firms, and financial institutes try to increase the liquidity assets .On the contrary they will try to reduce it in the booming economy. Thus, the cointegration test which ignored the behavior of the precautionary demand would cause the wrong result.

## 3.　A Statistical Evidence

3.1 A Cointegration Analysis

We will apply Vector Error Correction Model into the Japan's economy over the period from 1980q1 through 2009q1. The test examine whether or not there exists a long-run equilibrium relationship between the monetary variable and economic activity. At the low interest rate, BOJ's main policy instrument became monetary base instead of an overnight call rate. Monetary base should be comprised into a model.

Exchange rate should not be ignored since Japan's economy is an export oriented. Thus, we estimate the long-run relationship among four variables; the real monetary base, real GDP, exchange rate, and the overnight call rate. However our result showed that a cointegration property did not hold among these four variables.
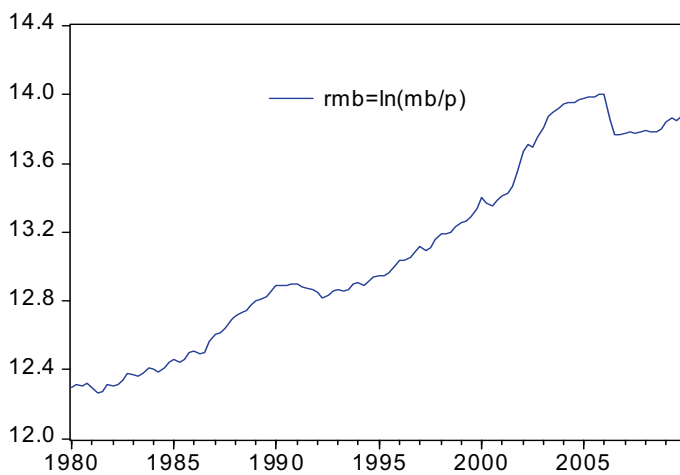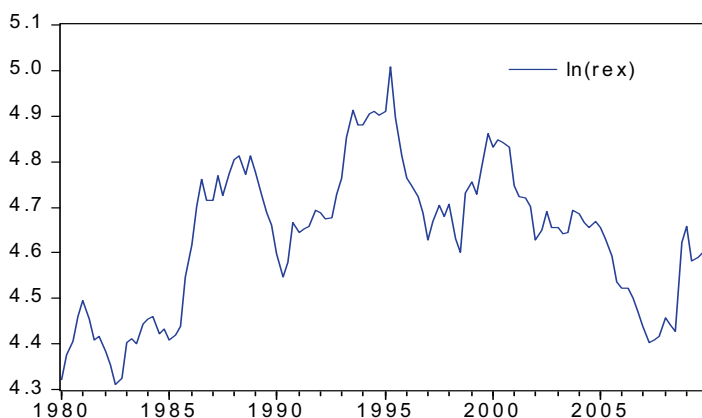
(Source) Bank of Japan
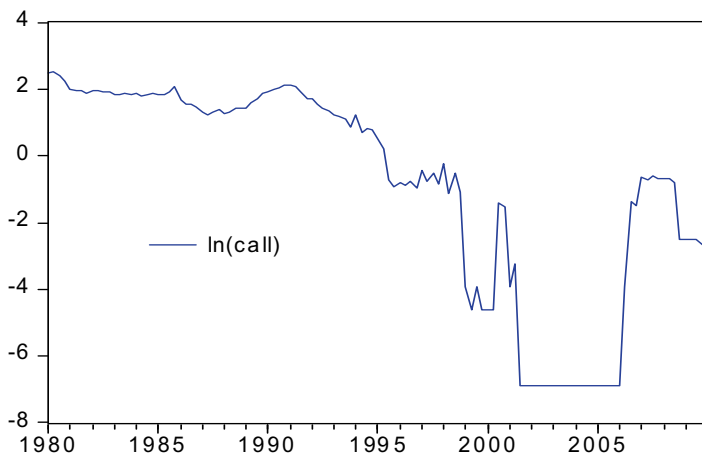
Figure 1 Real Monetary Base (log)
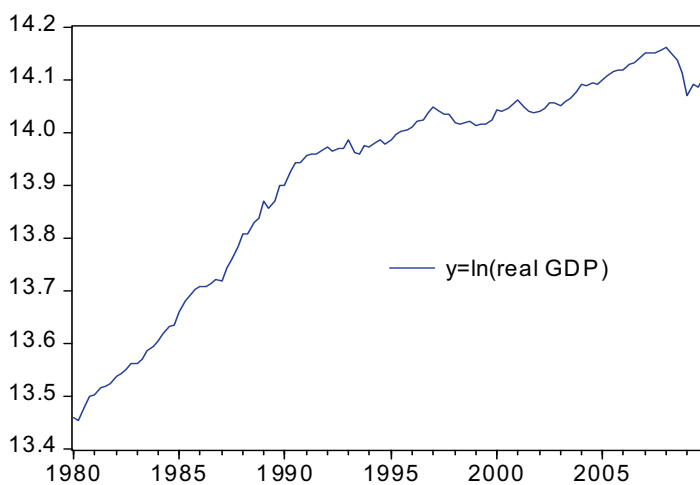
(Source)   Cabinet Office

Figure 2 Real GDP (log)

(Source) BIS

Figure 3 Effective Exchange Rate (log)

(Source) Bank of Japan

Figure 4 Overnight Call Rate (log)

The reason seems to come from the unstable behaviour of the precautionary demand. Since the bust of the bubble of 1990, Japan's economy had experienced the severe recession, including the financial crisis in 1997-98 when Japan premium rapidly increased in the oversea markets. Households, firms, and financial institutes will try to increase the precautionary demand when they face the financial crisis. A severe financial distress will make people feel anxiety and hold more money just in case. Thus, the financial crisis seems to break out temporarily the long-run relationship between money and

economic activity.

Therefore our model needs to comprise a new variable to capture the behaviour of precautionary demand for money. In order to qualify the unobservable variable we use Business Condition Diffusion Index from *the short-term Economic survey of Enterprises in Japan* known as TANKAN[4].

We set v = business activity. v_- and v_+ respectively mean the magnitudes of the negative and positive part of business activity. Both are defined as follows.

$$v_- = |\min\{v(t),\ 0\}|$$
$$v_+ = \max\{v(t),\ 0\}$$
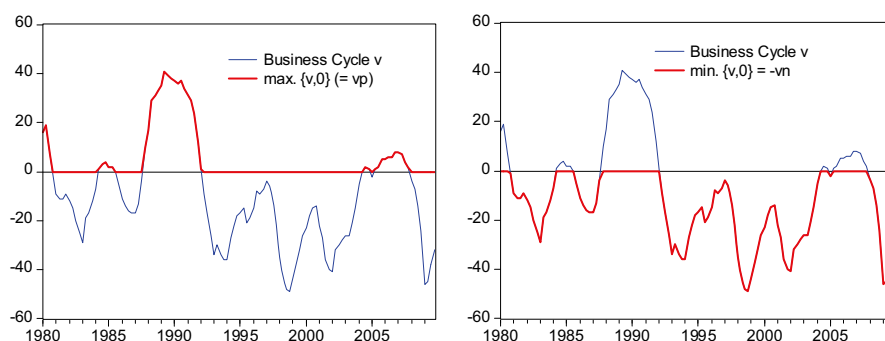
(Source) Bank of Japan

Figure 5 Business Conditions DI

We shall set the adjusted money as

$rmb_{adj}(t)$ = real monetary base – precautionary money demand
$$= rmb(t) - (c_0 + c_1 * v_-(t) + c_2 * v_+(t))$$

where the precautionary demand is assumed to be proportional to the magnitude of business activity:

Precautionary money demand $= c_0 + c_1 * v_-(t) + c_2 * v_+(t)$

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[4] TANKA is a statistical survey conducted on the quarterly basis by Bank of Japan. Answers from the responding enterprises are aggregated into the Diffusion Index (DI). Business conditions DI is shown as the following percentage points. About 10,000 enterprises except for financial institutes are asked to choose one of the three categories; 1. Favorable, 2. Not so favorable, 3. Unfavorable.
DI (percentage points)= "Favorable"-"Unfavorable" for responding enterprises

We estimate the following VEC model[5].

$$\Delta rmb_{adj}(t) = c_{m0} + \alpha_m ect(t-1) + \sum_{i=1}^{k} c_m^i \Delta rmb_{adj}(t-i) + \sum_{i=1}^{k} d_m^i \Delta y(t-i)$$
$$+ \sum_{i=1}^{k} e_m^i \Delta \ln rex(t-i) + \sum_{i=1}^{k} f_m^i \Delta \ln r(t-i) + \varepsilon_m(t) \tag{1}$$

$$\Delta y(t) = c_{y0} + \alpha_y ect(t-1) + \sum_{i=1}^{k} c_y^i \Delta rmb_{adj}(t-i) + \sum_{i=1}^{k} d_y^i \Delta y(t-i)$$
$$+ \sum_{i=1}^{k} e_y^i \Delta \ln rex(t-i) + \sum_{i=1}^{k} f_y^i \Delta \ln r(t-i) + \varepsilon_y(t) \tag{2}$$

$$\Delta \ln rex(t) = c_{ex0} + \alpha_{ex} ect(t-1) + \sum_{i=1}^{k} c_{ex}^i \Delta rmb_{adj}(t-i) + \sum_{i=1}^{k} d_{ex}^i \Delta y(t-i)$$
$$+ \sum_{i=1}^{k} e_{ex}^i \Delta \ln rex(t-i) + \sum_{i=1}^{k} f_{ex}^i \Delta \ln r(t-i) + \varepsilon_{ex}(t) \tag{3}$$

$$\Delta \ln r(t) = c_{r0} + \alpha_r ect(t-1) + \sum_{i=1}^{k} c_r^i \Delta rmb_{adj}(t-i) + \sum_{i=1}^{k} d_{er}^i \Delta y(t-i)$$
$$+ \sum_{i=1}^{k} e_r^i \Delta \ln rex(t-i) + \sum_{i=1}^{k} f_r^i \Delta \ln r(t-i) + \varepsilon_r(t) \tag{4}$$

where *ect(t-1)* is an error correction term defined by

$$ect(t-1) = rmb_{adj}(t-1) + \beta_1 y(t-1) + \beta_2 \ln rex(t-1) + \beta_3 \ln r(t-1) + \beta_0. \tag{5}$$

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[5] We performed ERS test with the null hypothesis as unit root and KPSS test with the null hypothesis as stationarity. But neither unit root nor stationarity of two variables, rmb$_{adj}$ and lnrex were rejected. The other variables y and lnr were detected to be nonstationary by ERS and KPSS tests. We shall treat all variables as nonstationary. The detail results are provided upon request.

Notice that unknown parameter c_0 is not necessary to be estimated in the VEC model, because in Eq. (1)

$$\Delta rmb_{adj} = \Delta(rmb - c_0 - c_1 * v_- - c_2 * v_+)$$
$$= \Delta rmb - c_1 * \Delta v_- - c_2 * \Delta v_+$$

and because in Eq.(5) the constant term $-c_0 + \beta_0$ cannot be decomposed into each parameter. Therefore, without loss of generality, we set c_0 to be zero.

The estimation procedures are rather complicated, and are stated in the following.

(i)   For fixed parameters c_1 and c_2, real data of rmb_{adj} can be obtained.

(ii)   VEC model of *(rmb_{adj}, y, lnrex, lnr)* can be estimated in Johansen's method by maximizing Likelihood Function of the VEC model.

(iii)   Another set of *(c_1, c_2)* can also give us estimation of VEC model by maximizing Likelihood Function.

(iv)   Optimization method is adopted such that the log-likelihood function of $\Delta y(t)$ in Eq.2 should be maximized with respect to *(c_1, c_2)* .

The criterion in (iv) is introduced because the model error of Δrmb_{adj} takes the minimum value at $c_1 = c_2 = 0$, and because $\Delta y(t)$ should be explained by *(Δrmb_{adj}, $\Delta lnrex$, Δlnr)*.

The estimation result is shown in Table 1.   The calculation result shows that $c_1 = 0.0127$, $c_2 = -0.0066$. The result indicates that a cointegrating property among four variables still hold when the behavior of the precautionary demand is taken into consideration.

Table 1 cointegration test of (rmb$_{adj}$, y, lnrex, ln(call)) in 1980q1- 2009q1

Test for the number rc of cointegrating vectors

Eigenvalues	0.268	0.141	0.126	0.0299
Hypotheses	rc=0	rc<=1	rc<=2	rc<=3
λmax	35.6*	17.35	15.47*	3.46
λtrace	71.89*	36.29*	18.94*	3.46
p(λmax)	0.0038	0.156	0.032	0.0627
p(λtrace)	0.0001	0.0077	0.0145	0.0627

Adjustment coefficients	α			
Δrmb$_{adj}$	-0.0140			
Δy	0.0119			
Δlnrex	-0.0057			
Δln(call)	-0.0766			

Normalized cointegrating coefficients β'				
rmb$_{adj}$	y	lnrex	In (call)	
1	-3.956	1.479	0.0882	

Notes: 1. Lagged difference is decided to be 2.

2. We can see three cointegrating vectors in trace test, while one cointegrating vector in maximum eigenvalue tests. It may be because unit root of rmb$_{adj}$ as well as lnrex is not rejected by unit root test and stationarity of them is also not rejected by KPSS test.   Focusing our attention on the maximum eigenvalue test, we regard that there is one cointegrating vector.

3. * denotes rejection of the hypothesis at the 0.05 level.

4. p (λmax) and p(λtrace) are p-values given by MacKinnon-Haug-Michelis (1999).

3.2 Deflation and Monetary base

Next we examine the causal relationship between deflation and monetary base by considering the estimation result of our VEC model. Figure 8 compares the behavior of error correction term (right scale) with the year on year growth rate of consumer price index (left scale). Positive value of error correction term reveals that the level of real monetary base exceeds that implied by its long-run relationship with real GDP, or an excess supply of monetary base, while negative value means the

shortage of monetary base. Excess money would give an upward pressure on prices, while shortage would give a downward pressure on prices, as far as a long-run relationship is maintained between monetary base and real economic activity. Monetary base was in the excess supply by 1990 when the bubble had busted. On the contrary monetary base continued to fall short of the long-run equilibrium level after that, though it showed temporally the rise in 2001 when The BOJ decided to take quantity easing policy. The rapid rise of price in 1997 reflects the increase of consumption tax from 3 to 5 percent. The temporal increase of monetary base in 2000 reflects the Y2K problem. The figure seems to indicate that price tend to commove with monetary base, when these special cases are taken into consideration.

We perform the Granger causality test to determine statistically whether such causality actually exists. A causal relationship was found in which deviation of real monetary base from the equation lead to a rise in the year on year rate of increase in price level. The test result shows that the hypothesis that deviation of the monetary base changes price level is not rejected at the one-sided 5 percent significance level, while the hypothesis that changes in price level cause deviation of monetary base from the long-run equilibrium is rejected at the same 5 percent significance level.

The result shows that the monetary base has a leading property for price change.
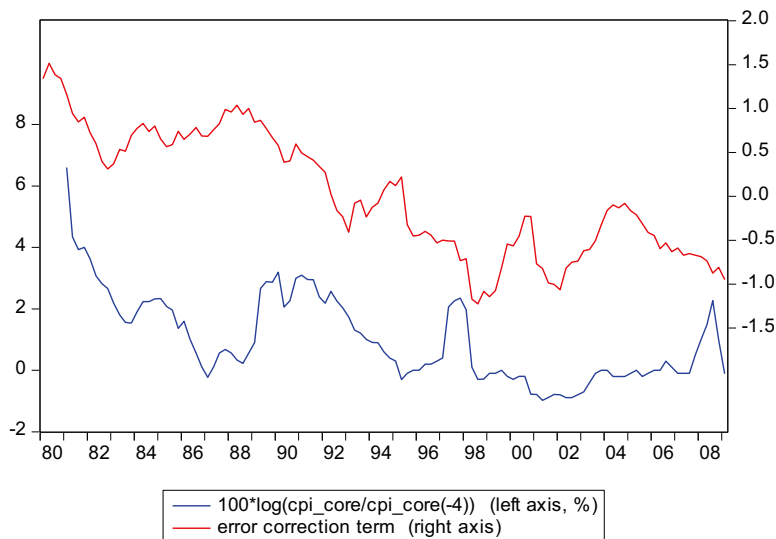
Figure 6   Price Change and Error Correction Term

3.3 Liquidity Trap

Next we will explicitly examine whether liquidity trap exists or not. We already showed that the cointegration property holds among monetary base and other variables. The property means that these variables do not move independently of one another, and keep the certain relationship in the long-run even if some of the variables temporarily diverged from the long-run relationship. However some might be skeptical about the shape of the money demand curve. They might argue that any additional money would be hold by economic agencies, when adjusted money demand curve become perfectly flat at certain low interest rate.

Kimura and others (2002) tested whether there is a satiation level of money demand at zero interest rate. We will follow their procedures here. They consider the following money demand function[6] and suggest that liquidity trap depend on δ. In the case of δ =0, there exist a liquidity trap, while in the case of δ >0, no liquidity trap.

$$m_t - p_t = \alpha y_t - \beta \ln(i_t + \delta) + \gamma,$$

Marshallian k_t can be defined as follows.

$$k\mid_{i=0} = \delta^{-\beta} e^{\gamma}. \quad \text{where} \quad k_t = \frac{M_t}{P_t Y_t^{\alpha}}$$

The ratio k is finite if δ>0, while k is infinite if δ=0. In the case of δ=0, people will try to hold any additional money supplied by central bank. In this case, monetary policy would not have any positive effect on the economy. This situation can be called a liquidity trap. On the contrary, people would try to stop to hold money beyond a satiation level ($\delta^{-\beta} e^{\gamma}$.) if δ>0. Thus, as far as δ>0, monetary base would have a positive effect on the economy even at zero interest, because people would try to change additional money beyond satiation level to other assets, which are expected to be ultimately transmitted to the rise of consumption and investment.

We perform the cointegration test by the following monetary base demand function.

$rmb_{adj}(t) = a_1 * y(t) + a_2 * lnrex(t) + a_3 * \ln(call(t) + \delta) + C$

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[6]   They actually assume the following long-run money demand function.

$$\frac{M_t}{P_t} = e^{\gamma} Y_t^{\alpha} \left(\frac{i_t}{i_t + 1} + \delta \right)^{-\beta}, \qquad \alpha > 0, \quad \beta > 0, \quad \text{and} \quad \delta \geq 0.$$ where $M, P, Y,$ and i are monetary base, price level, real income, and call rate, respectively.

The estimation starts from the same VEC model described by Eqs.(1) to (4) with ln *(call(t))* replaced by ln *(call(t)+ δ)*. Strictly speaking, nonlinearity of ln *(call(t)+ δ)* makes Johansen's method impossible to use. However, for fixed δ, we can use Johansen's estimation method of VEC model. We use a similar criterion as was introduced in estimating adjusted money in the previous section.

Estimation procedures are in the following:

(i)   For fixed values of parameters in adjusted money and for fixed value of δ, we can estimate VEC model by Johansen's method.

(ii)   For another set of parameter values and δ, we also can estimate VEC model.

(iii)   Optimization procedure is taken into consideration under the criterion such that the log-likelihood function of Δy-process should be maximized with respect to parameters in adjusted money and δ.

It should be noted that the model error of adjusted money takes the minimum value when we don't consider the effect of precautionary demand and that, since zero interest rate policy gives us the extraordinary drastic behavior of ln *(call(t))*, the model error of ln *(call(t)+ δ)* decreases monotonously as δ increases from the value of zero. Therefore, we adopt the criterion of maximizing the log-likelihood of $\Delta y(t)$, excluding log-likelihood functions of the other variables.

We finally got the result of $\delta = 0.174$ together with the estimation of adjusted money:

rmb$_{adj}$(t) =rmb(t)-0.0197*v$_-$(t)+0.0027*v$_+$(t)

One cointegrating vector is shown to hold in Table 2.
The result indicates that there exists no liquidity trap in the Japan's economy even at the very low interest rate.

Table 2 cointegration test of (rmb$_{adj}$, y, lnrex, ln (call +0.174)) in (1980q1, 2009q1)

Eigenvalues	0.301	0.153	0.135	0.0219
Hypotheses	rc=0	rc<=1	rc<=2	rc<=3
λmax	40.83*	19.00	16.57*	2.526
λtrace	78.94*	38.10*	19.10*	2.526
p(λmax)	0.0006	0.0967	0.0212	0.1120
p(λtrace)	0.0000	0.0044	0.0137	0.1120
Adjustment coefficients α				
Δrmb$_{adj}$	-0.0176			
Δy	0.00918			
Δlnrex	-0.0030			
Δln (call+0.047)	-0.0174			
Normalized cointegrating coefficients β'				
rmb$_{adj}$	y	lnrex	ln (call+0.174)	
1	-4.106	2.004	0.270	

Notes : 1. Lagged difference is decided to be 2.

2. We can see three cointegrating vectors in trace test, while one cointegrating vector in maximum eigenvalue test. It may be because unit root of rmb$_{adj}$ as well as lnrex is not rejected by unit root test and stationarity of them is also not rejected by KPSS test.   Focusing our attention on the maximum eigenvalue test, we regard that there is one cointegrating vector.

3. * denotes rejection of the hypothesis at the 0.05 level.

4. p (λmax) and p (λtrace) are p-values given by MacKinnon-Haug-Michelis (1999).

3.4 Stationarity of Precautionary Demand

Next we will check whether the precautionary demand is stationary or not. Monetary policy would have no effect on the real economy, if precautionary demands infinitely increase, because any additional monetary base created by central bank would be absorbed passively by banks, firms and households. We perform unit root test to check the stationarity of the precautionary demand defined by the following equation.

$$m_{prec} = c_0 + c_1 * v_- + c_2 * v_+,$$
$$= 0.0197 * v_- - 0.0027 * v_+$$

where c_0 is set to be zero.

ERS test and KPSS test are conducted. As shown in Tables 3 and 4, ERS test suggest the null hypothesis that m_{prec} follows a non-stationary process can be rejected at 10 % significance level, while KPSS test suggest null hypothesis that m_{prec} follows a stationary process cannot be rejected. Both tests suggest m_{prec} would follow a stationary process. Thus, money demand would not become infinite.

Table 3   ERS test

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.184006
Test critical values:	1% level	-2.584877
	5% level	-1.943587
	10% level	-1.614912

*MacKinnon (1996)

Table 4   KPSS test

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.236504
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

precautionary demand
$=c0+c1*v\_n+c2*v\_p$
(c0 is set to be zero)
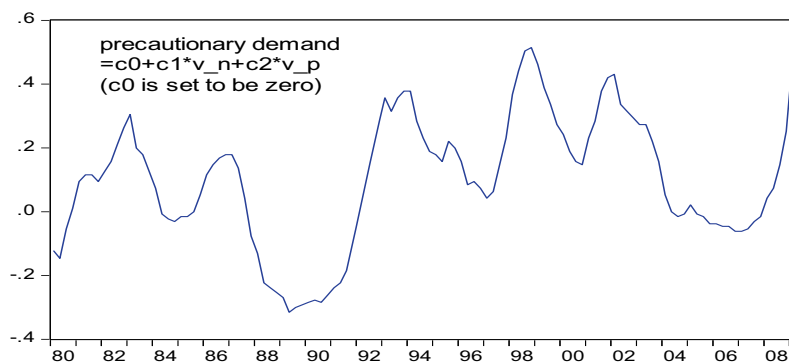
Figure 7 Behavior of Precautionary Demand

4. Conclusion

The paper discussed the role of monetary policy in the deflationary economy. Monetary policy is often exampled to a string, because it has a strong effect on the inflation, but has no effect on the deflation. Aggressive monetary policy in the deflation is just like "pushing on a string". However we should keep in mind that not only inflation but also deflation is a monetary phenomenon.

We conducted a cointegration test in order to strictly examine the effectiveness of monetary policy, especially focusing on the deflationary period after the zero interest policy. The test was implemented from 1985q1 through 2009q1 with special emphasis on the behavior of precautionary demand. Precautionary demand tends to fluctuate with the business condition. Especially its demand rapidly increase with a rise of financial anxiety in the financial crisis, like in 1997and 98. The majority of previous researches denied the effectiveness of monetary policy in the sample period comprising the zero interest policy. Our evidence comprising a new variable, financial anxiety, finds that monetary policy still have a relationship with the real economy even at the low interest rate. Our evidence also showed that prices paralleled with the behavior of adjusted money. Monetary easing would contribute to the dissolution of deflation.

We also estimated a shape of money demand (adjusted real monetary base) function at the low interest rate. Any additional money created would be hold if the money demand curve flat at the zero interest rate. The result rejected the null hypothesis that the interest rate elasticity of money demand becomes infinite at the zero interest rate.

Lastly we estimated the stationarity of the precautionary money demand. The Unit Root tests accepted the hypothesis of stationarity, which denies the possibility of infinite money demand. Thus the BOJ still have the responsibility for the deflationary economy. The BOJ should actively provide affluent money with the markets in the deflation. There is no doubt that the present Japan's economy heavily depends on the BOJ's monetary policy.

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