The Transmission Mechanism of Monetary Policy in Japan: An Examination by the Credit View and the Money View with the Vector Error Correction Model

Kazuhiko NAKAHIRA*¹ and Sin-ichiro SAKAMOTO*²

*¹ The University of Shimane, Department of Policy Studies
*² Miyagi University, School of Project Design

Abstract

This paper examines the transmission mechanism of monetary policy in Japan since the 1980s from the two aspects, the "credit view" and the "money view", by applying the vector error correction model. The analysis by the impulse response function implies that the monetary channel was effective compared with the one of the credit channel. In this respect, the transmission mechanism of monetary policy in Japan since the 1980s was well described by the "money view" rather than the "credit view".

Key words: credit view, money view, unit root, cointegration, vector error correction model
JEL classification: E42; E44; E52

1. Introduction

Transmission mechanism of monetary policy is one of the traditional research topics in the field of monetary economics. It is apparent that a monetary policy affects economic activities, but we have not reached a clear consensus on its propagation mechanism. Moreover, this topic is closely related to the choice of operating variable of monetary policy by the central bank. In addition, the economics of information and the theory of monetary intermediaries have expanded the discussion with regard to this topic. In this paper, the empirical study on the transmission mechanism of monetary policy from the aspect of the "credit view" and the "money view" with the VECM(Vector Error Correction Model) is implemented.

The reminder of this paper is organized as follows. Section 2 is for the review of the past representative studies on the topic we focus on. Section 3 is constructed for the unit root tests and the cointegration tests to examine the property of the data. In section 4, the examination of the estimated impulse response functions based on the VECM is presented. Section 5 is for the conclusion.

2. Past Empirical Studies on the "Credit View" and the "Money View"

There have been many empirical studies based on the "credit view" and the "money view". For instance, Bernanke and Blinder(1992) found that the federal funds rate is the best information variable, in short, the most appropriate variable to predict the future behaviors of the major macroeconomic variables such as production, employment, and consumption through their VAR model. In addition, they showed that the rise in the federal funds rate due to a tight monetary policy leads the decline in banks' deposits and securities, and then the decline in bank loans and the rise in unemployment rate occur with six to nine months lag. They insisted that the simultaneous occurrence of the decline
in deposits and the increase in unemployment rate after the rise in federal funds rate could be regarded as the partial evidence for the existence of lending channel with respect to the transmission mechanism of monetary policy. However, King(1986) found that the proportion of movement in GDP explained by the change in deposits is larger than the one in bank loans applying the variance decomposition of forecast, and came to the conclusion that the monetary channel is dominant. Konishi, Ramey, and Granger(1993) adopted the VECM(Vector Error Correction Model) and showed that the monetary channel is more effective than the credit channel. Ramey(1993) was based on the VECM and concluded that the monetary channel is of significance compared with the lending channel. Ueda(1993) is the study for Japan. He applied the essence of Bernanke and Blinder(1992) to his analysis based on the variance decomposition of forecast with the data on industrial production, money supply, monetary base, bank loans, and short-term money market rate. The result of his study showed that the bank loans had a certain impact on production and the credit channel was effective in Japan.

It is instructive for us to take notice of the identification problem in respect of the VAR estimation. Concretely, it is usually impossible to distinguish a change in bank loan due to a change in demand-side factor from the one due to a change in supply-side factor. Romer and Romer(1990) dealt with this problem by making their special index, so-called the “Romer Dates”, that specifies the point in time when the Fed conducts a tight monetary policy. In Romer and Romer(1990), they applied it to examine which responds more quickly to a monetary policy, bank loans or deposits. They found that the response of the latter variable is more quickly than the former one, and concluded that the lending channel is relatively unimportant.\(^1\) Kashyap, Stain, and Wilcox(1993) classified the way of raising funds by firms into two categories, that is, bank loans and the leading substitutes for bank loans. They conducted the estimation which reflects their idea with the “mix variable” constructed by the bank loans and the CP(commercial paper), and concluded that the lending channel is more effective than the monetary channel. Kuroki(1999) is one of the other applications of the “mix variable”, and showed that the lending channel works in Japan. Gertler and Gilchrist(1994) studied the propagation mechanism of monetary policy in consideration of the scale of firms. They pointed out that bank loans are of importance in terms of the transmission mechanism of monetary policy deriving the conclusion which is consistent with the idea of the lending channel approach.

On the whole, we have not had a clear-cut conclusion with respect to the effectiveness of the “money view” and the “credit view”. The effect of monetary policy, by nature, is not the one that can be transmitted through the only one channel. In this respect, the core of our discussion is the consideration of relative significance of the credit channel and the monetary channel.

3. Unit Root Tests and Cointegration Tests

The aim of this section is to investigate the property of the variables for our estimation from the aspect of stationarity or nonstationarity. That is, the unit root test and the cointegration test are implemented. With respect to the VAR(Vector Autoregression)-type specification, we have to take cointegration property into account. If a set
of variables has a cointegration property, the application of the conventional VAR model (or the Box-Jenkins type VAR model) with the first differences of the variables is not appropriate. Instead of the conventional VAR, the VECM (Vector Error Correction Model) that includes error correction term(s) should be applied when we face with the cointegrated variables. Hence, conducting the unit root test and the cointegration test are necessary as the first step of our empirical analysis.

The variables used in our analysis are as follows.\(^2\)

- CR: collateralized overnight call rate (as a short-term money market interest rate)
- LO: quantity of the loans supplied by the commercial banks
- MS: M2+CD, the standard notation of money supply in Japan\(^3\)
- PR: implicit price deflator for GDP
- GP: GDP (Gross Domestic Product)

Properly speaking, uncollateralized overnight call rate has to be adopted as the variable for the interest rate factor since it is regarded as the operating variable of the Bank of Japan. However, the data on the uncollateralized overnight call rate before 1985 is not available. Therefore, the data on the collateralized overnight call rate is adopted as the proxy variable. LO, MS, GP are expressed in logarithm after deflated by the implicit price deflator for GDP to convert them into the real values. PR is simply expressed in natural logarithmic form. LO should be focused on when we test the effectiveness of the credit channel. On the other hand, special attention is required to choose the variable which is considered to examine the effectiveness of the monetary channel. In the general explanation of the “money view”, “deposits” in the liabilities part of the balance sheet is often taken notice of. However, this way of examination is for holding a consistent discussion with the one for the “credit view” from the aspect of balance sheet. The essence of the “money view” lies not merely in the characteristics of bank deposits but largely in the special property of banks in that they can create “money” by holding deposits. Therefore, the variable which consequently has to be focused on to investigate the property of the “money view” is the “money” supplied by the banks through the process of credit creation. But it is not possible to acquire the data on this kind of “money” directly, so we have no choice but to adopt “money supply” as the proxy variable for the “money” in our consideration. Hence, MS is regarded as the variable that should be applied to test the effectiveness of the monetary channel”.

The first procedure for our data analysis is to conduct the unit root test. The sample period runs from 1980:1 to 2000:4; quarterly. The end of the sample period is set at 2000:4 in order that the estimation can avoid being disturbed by the effect of the change in the operating variable of the Bank of Japan in March, 2001. For the period March, 2001 to March, 2006, the Bank of Japan temporarily changed its operating variable from the overnight call rate to the amount of reserve accounts of monetary institutions in the course of the “quantitative easing policy”. Table 1 shows the results of the ADF Tests (augmented Dickey-Fuller Tests). Test statistics for the levels are not smaller than the 5 percent critical value, while the ones for the first difference are not. Therefore, all the variables are found to be non-stationary I(1) variables.

Since all the variables are found to be I(1), our next task is to conduct the the cointegration test. Table 2 displays the results of the Johansen's Test
Table 1: Augmented Dickey-Fuller Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test Statistic</th>
<th>Opt. lags</th>
<th>Test Statistic</th>
<th>Opt. lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>-3.726034</td>
<td>4</td>
<td>-7.021210</td>
<td>4</td>
</tr>
<tr>
<td>LO</td>
<td>1.059861</td>
<td>3</td>
<td>-7.011881</td>
<td>1</td>
</tr>
<tr>
<td>PR</td>
<td>-0.860560</td>
<td>1</td>
<td>-42.51499</td>
<td>0</td>
</tr>
<tr>
<td>GP</td>
<td>-1.045089</td>
<td>4</td>
<td>-15.72611</td>
<td>1</td>
</tr>
<tr>
<td>MS</td>
<td>-2.890933</td>
<td>4</td>
<td>-28.90830</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes: ADF test includes drift and time trend. Critical values are in Fuller(1976).

Table 2: Johansen’s Test

<table>
<thead>
<tr>
<th>CE(s)</th>
<th>Statistic</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\lambda_{\text{trace}}$</td>
<td>$\lambda_{\text{max}}$</td>
</tr>
<tr>
<td>None</td>
<td>127.1512</td>
<td>0.60113</td>
</tr>
<tr>
<td>At most 1</td>
<td>55.45985</td>
<td>0.296088</td>
</tr>
<tr>
<td>At most 2</td>
<td>28.07388</td>
<td>0.22579</td>
</tr>
<tr>
<td>At most 3</td>
<td>8.11277</td>
<td>0.084772</td>
</tr>
<tr>
<td>At most 4</td>
<td>1.20336</td>
<td>0.015309</td>
</tr>
</tbody>
</table>

Normalized cointegrating vectors

<table>
<thead>
<tr>
<th>CR</th>
<th>LO</th>
<th>MS</th>
<th>PR</th>
<th>GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-1.37519</td>
<td>1.696154</td>
<td>-17.3159</td>
<td>-6.95516</td>
</tr>
<tr>
<td>1</td>
<td>(-1.79598)</td>
<td>(-3.20525)</td>
<td>(-5.21239)</td>
<td>(-4.96607)</td>
</tr>
</tbody>
</table>

Adjustment coefficients (standard error in parentheses)

<table>
<thead>
<tr>
<th>CR</th>
<th>LO</th>
<th>MS</th>
<th>PR</th>
<th>GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.99078</td>
<td>-0.00618</td>
<td>-0.0013</td>
<td>0.0049</td>
<td>-0.01411</td>
</tr>
<tr>
<td>(-0.00618)</td>
<td>(-0.02157)</td>
<td>(-0.00622)</td>
<td>(-0.00417)</td>
<td>(-0.00972)</td>
</tr>
</tbody>
</table>


(Both the Trace Test ($\lambda_{\text{trace}}$) and the Maximal Eigenvalue Test ($\lambda_{\text{max}}$)). The result of the Trace Test indicates two cointegrating equations at 1% level of significance, while the Maximal Eigenvalue Test indicates one cointegrating equation at 1% level. Despite the above inconsistent results, the variables included in our model are considered to have one cointegrating equation to make our discussion simple.

4. Estimations with the Vector Error Correction Model

In this section, the empirical analysis is conducted to explore the effectiveness of the "money view" and the "credit view" in Japan since the 1980s. Specifically, the estimation with the VECM(Vector Error Correction Model) is applied to derive impulse response function.

As the first step, the error correction term has to be constructed with the cointegrating vectors estimated through the process of Johansen’s Test described in the former section. An error correction term works as the indication of the tendency for recovering the long-run equilibrium. Concretely, the error correction
term (ECT) for our estimation is constituted as follows.

\[ ECT = \ln CR - 1.375189 \cdot \ln LO + 1.696154 \cdot \ln MS - 17.31594 \cdot \ln PR - 6.955159 \cdot \ln GP \]

The error correction term is built in the model for our estimation as the one-period lagged variable as ECT(-1).

The second step we have to take before conducting the estimation is to consider the order of the variables placed in the model or the order of the Cholesky decomposition. Traditional discussions with respect to the VAR-type specification generally insist that the order of the variables in the model should be arranged in accordance with the exogeneity. On the other hand, Bernanke and Blinder(1992) proposed that the variable which measures the true structural response to monetary policy, for instance, the federal funds rate, should be placed relatively in the latter part in the model since it affects the real variables with a lag. In our estimation, however, the order of the Cholesky decomposition is set as CR, LO, MS, PR, and GP based on the idea that the policy variable, call rate, which is the operating variable of the Bank of Japan (except the period of the “quantitative easing policy”), is not affected by the other variables simultaneously. This idea can be regarded as the modified version of Sims(1986, 1992). Consequently, the model for our estimation is as follows. (C: constant term, ECT: error correction term, ε: error term, i: 1 - 4)

\[ \Delta CR(t) = C_{cr} + a_{cr} \cdot ECT(-1) + \sum a_{cr} \cdot \Delta CR(t-i) + \sum b_{cr} \cdot \Delta LO(t-i) + \sum c_{cr} \cdot \Delta PR(t-i) + \sum d_{cr} \cdot \Delta GP(t-i) + \varepsilon_{cr}(t) \]

\[ \Delta LO(t) = C_{lo} + a_{lo} \cdot ECT(-1) + \sum a_{lo} \cdot \Delta CR(t-i) + \sum b_{lo} \cdot \Delta LO(t-i) + \sum c_{lo} \cdot \Delta PR(t-i) + \sum d_{lo} \cdot \Delta GP(t-i) + \varepsilon_{lo}(t) \]

\[ \Delta MS(t) = C_{ms} + a_{ms} \cdot ECT(-1) + \sum a_{ms} \cdot \Delta CR(t-i) + \sum b_{ms} \cdot \Delta LO(t-i) + \sum c_{ms} \cdot \Delta PR(t-i) + \sum d_{ms} \cdot \Delta GP(t-i) + \varepsilon_{ms}(t) \]

\[ \Delta PR(t) = C_{pr} + a_{pr} \cdot ECT(-1) + \sum a_{pr} \cdot \Delta CR(t-i) + \sum b_{pr} \cdot \Delta LO(t-i) + \sum c_{pr} \cdot \Delta PR(t-i) + \sum d_{pr} \cdot \Delta GP(t-i) + \varepsilon_{pr}(t) \]

\[ \Delta GP(t) = C_{gp} + a_{gp} \cdot ECT(-1) + \sum a_{gp} \cdot \Delta CR(t-i) + \sum b_{gp} \cdot \Delta LO(t-i) + \sum c_{gp} \cdot \Delta PR(t-i) + \sum d_{gp} \cdot \Delta GP(t-i) + \varepsilon_{gp}(t) \]

The sample period is 1980:1 - 2000:4. The variables CR, LO, MS, PR, and GP are employed as the first difference forms since they follow the unit root processes as shown by the results of the ADF tests.

Figure 1 is for the cumulative (or accumulated) impulse responses of the variables to Cholesky one standard error innovations. With respect to the response of GP to LO, the initial shock in LO (“credit”) gives the negative effect on GP (“output”), and the cumulative effect is also negative. On the other hand, we can figure out that the response of GP to MO (“money”) is strongly positive over time. These results imply that the “money view” was well fitted compared with the “credit view” in the last two decades.

One of the important points that we have to consider with regard to the VAR specification is the fact that the result of innovation accounting could be changed with a different order of the Cholesky decomposition. In our context, to conduct the Cholesky decomposition with the reversed order of LO and MS could be meaningful. Hence, the other derivation of impulse response function with the order of the Cholesky decomposition as CR, MS, LO, PR,
Figure 1: Cumulative Impulse Response Function (1)

Accumulated Response to Cholesky One S.D. Innovations

Accumulated Response of CR to CR
Accumulated Response of CR to LO
Accumulated Response of CR to MS
Accumulated Response of CR to PR
Accumulated Response of CR to GP

Accumulated Response of LO to CR
Accumulated Response of LO to LO
Accumulated Response of LO to MS
Accumulated Response of LO to PR
Accumulated Response of LO to GP

Accumulated Response of MS to CR
Accumulated Response of MS to LO
Accumulated Response of MS to MS
Accumulated Response of MS to PR
Accumulated Response of MS to GP

Accumulated Response of PR to CR
Accumulated Response of PR to LO
Accumulated Response of PR to MS
Accumulated Response of PR to PR
Accumulated Response of PR to GP

Accumulated Response of GP to CR
Accumulated Response of GP to LO
Accumulated Response of GP to MS
Accumulated Response of GP to PR
Accumulated Response of GP to GP
Figure 2: Cumulative Impulse Response Function (2)

Accumulated Response to Cholesky One S.D. Innovations

Accumulated Response of CR to CR
Accumulated Response of CR to MS
Accumulated Response of CR to LO
Accumulated Response of CR to PR
Accumulated Response of CR to GP

Accumulated Response of MS to CR
Accumulated Response of MS to MS
Accumulated Response of MS to LO
Accumulated Response of MS to PR
Accumulated Response of MS to GP

Accumulated Response of LO to CR
Accumulated Response of LO to MS
Accumulated Response of LO to LO
Accumulated Response of LO to PR
Accumulated Response of LO to GP

Accumulated Response of PR to CR
Accumulated Response of PR to MS
Accumulated Response of PR to LO
Accumulated Response of PR to PR
Accumulated Response of PR to GP

Accumulated Response of GP to CR
Accumulated Response of GP to MS
Accumulated Response of GP to LO
Accumulated Response of GP to PR
Accumulated Response of GP to GP
and GP. Re-estimated impulse response functions are indicated in Figure 2. Considering the new results, we are able to know that the effects of the shocks in LO and in MS are very close to the ones indicated in Figure 1. In other words, we cannot find out any particular differences between the above two kinds of estimated result.

5. Conclusion

In this paper, the empirical study on the transmission mechanism of monetary policy in Japan since the 1980s in terms of the "credit view" and the "money view" was conducted by applying the vector error correction model. Through the examination into the estimated impulse response functions, we came to the conclusion that the monetary channel was effective. In other words, the transmission mechanism of monetary policy in Japan since the 1980s was well described by the "money view" compared with the "credit view".

We have to consider, however, the structure of the Japanese financial system from the aspect of the credit channel. Generally speaking, funds for equipment investment by small firms are raised mainly by means of bank loans rather than of corporate bonds (or commercial papers) as the particular system, so-called the "indirect finance". Certainly, the way of fund raising of major large companies in Japan has been inclined to shift from bank loans to corporate bonds owing to the de-regulations since the 1980s. But small firms are still obliged to rely on bank loans in order to raise their funds due to their insufficient abilities for issuance of corporate bonds. Further, investors and firms are ought to face with the asymmetric information. In other words, investors are usually inferior to firms in getting information of the ex-post result of the investment. Hence, a certain level of risk premium as the agency (or information) cost is imposed on the interest rates of corporate bonds. In addition, banks can supply certain levels of credit (or loans) to firms with relatively lower costs based on their particular ability of evaluation with respect to the characteristics of the borrowers. Under these circumstances, the costs of fund raising by firms, especially by small firms, utilizing bank loans are generally lower than those of the substitutes. Thus, the role of bank loans still cannot be ignored although its significance was relatively lowered.

The factors mentioned above imply the potential significance of the credit channel of the transmission mechanism of monetary policy. Hence, more investigations with respect to the "credit view" need to be implemented.

Notes:
1. Romer and Romer(1990) insisted that the lending channel loses its efficiency, in this context, due to the compensation for the reduced level of bank loans by the issuance of certificate of deposits when the monetary policy is tightened.
2. The data description is as follows.
*CR: Collateralized Overnight Call Rate, Average Rate, %. (Data Source: Toyo Keizai Shinposha(ed.) (2005), Keizaitoukeinenkan 2005 (in Japanese), Toyo Keizai Shinposha.)
*LO: Banking Accounts of Domestically Licensed Banks; Loans and Discounts; outstanding at the end of period, billion yen, (Data Source: Toyo Keizai Shinposha(ed.) (2005), Keizaitoukeinenkan 2005 (in Japanese), Toyo Keizai Shinposha.)
*MS: M2 + CD, billion yen, (Data Source: Toyo Keizai Shinposha(ed.) (2005),
Keizaitoukeinenkan 2005 (in Japanese), Toyo Keizai Shinposha.)

With respect to the M2+CD, long run sequential time series data is not available due to the renewal of the statistics by the Bank of Japan. Therefore, the data on M2+CD excluding foreign banks in Japan, etc. was used for 1980:1 – 1999:1 and the one including foreign banks in Japan, etc. was used for 1999:2 – 2000:4.


3. M2+CD = currency + demand deposits + time deposits + CD(certificate of deposits). This is the standard notation of money supply in Japan.

4. In this kind of cointegration literature, "equilibrium" means a certain observed relationship which has been maintained on average in the long run by a set of variables.

References:


