3. Measuring the Effect of Monetary Policy

Here we analyse the effect of monetary policy in Japan using the structural VARs estimated in Section 2. We take the block-recursive model with domestic WPI for our base analysis, as it seems to identify monetary policy relatively well judging from the shapes of impulse responses. We also use the bank reserve model to check the robustness of the analysis, and to see how it affects the results if monetary policy is measured by different variables (specifically by call rate and by bank reserves).

(1) Block-Recursive Model with Domestic WPI

With the block-recursive model which includes the domestic WPI as a sensitive price variable, we have seen that a tight monetary policy would decrease output $y$, price $P$ (with initial rise in some cases), and money stock $M$ (see Figure 3-2). But how large is the importance of such monetary policy effects in the total economic fluctuations?

Figure 6-1 shows the results of the forecast error variance decomposition, which shows how much of the unanticipated changes of variables are explained by different shocks. As shown in the figures, the effect of monetary policy on real output $y$ is not very big. It accounts for only about 3 - 6% of the output fluctuation. The $y$ shock (which probably reflects real demand and/or supply shocks) and the $M$ shock (which is assumed to reflects monetary shock other than monetary policy) are far more important sources of the output fluctuation. These results do not depend on the specifications of data form and lag length.

The monetary policy influence on prices is also small in most specifications, again largely exceeded by the $M$ shock.

Looking at the fourth row of the figures, it might be worth noting that the WPI shock and the $M$ shock contributes significantly to the fluctuation of the call rate. The good contribution of WPI seems to support our assumption that the omission of WPI is a cause of price puzzle. It implies that the call rate changes caused by an endogenous policy reaction to the WPI shock is not small. If WPI were omitted from the VAR, such an endogenous policy reaction would be identified as an exogenous policy innovation, which would lead to the price puzzle.

The significant contribution of the $M$ shock to the call rate is puzzling: it contradicts our assumption of the call rate targeting. If the actual policy were near-complete call rate targeting, the $M$ shock would be almost fully accommodated by the BOJ’s supply of money, and should not have such a large effect on the call rate fluctuation. We will come back to this issue later.

Figure 6-2 gives the historical decomposition of the WPI model, which shows the accumulated effects of the current and the past shocks. A dotted line shows the total effect of all
the shocks (i.e., the forecast error of the dynamic forecast from the start of the sample period), and a solid line shows the contributions of the each shock.

The figure confirms the results of the variance decomposition analysis: monetary policy has not been an important source of the fluctuation in the real economy; the y shock and the M shock have played more important roles in the output fluctuation. It also can be seen that the WPI shock and the M shock have affected the call rate significantly.

A great merit of the historical decomposition is that we can follow the changes of monetary policy and its effect on the economy along time. Figure 6-3 plots the estimated monetary policy stance of the BOJ (as measured by the identified MP shock). The fourth column of the historical decomposition of Figure 6-2 shows the dynamic accumulated effects of such BOJ's policy stance on the economy.

As shown in Figure 6-3, the BOJ's policy stance was likely to be more expansionary than usual policy reaction during late 80s. This period is when the BOJ tried to decelerate the rapid appreciation of yen triggered by the Plaza accord. Those who argues that too expansionary policy of the BOJ of this period caused the following bubble may receive some support. Actually, Figure 6-2 exhibits that the monetary policy had expansionary effects on the economy than usual during this period. But the degree of it is not very strong, so that one might also doubt whether the effect was such strong to create the bubble.

The policy stance turned tight in 1990, and although the BOJ continued to lower the interest rate it mostly remained to be so (except around the year 1992) until 1995, when the discount rate was finally reduced to historical 0.5%. This might suggest that the policy action of the BOJ in this period had been forestalled by the rapid changes of the economy after the bubble crush. Accordingly, the historical decomposition shows that the monetary policy had a negative effect on the economy in the first half of the 90s (except the short period of around 1992).

After the MP shock marked some expansionary stance in 1995, it began to move around neutral or sometimes tight stance since 1996, although the call rate remained to be lower than unprecedented 0.5%. The historical decomposition accordingly shows negative monetary policy effect sometimes during the period. This may reflect the difficulty of further monetary loosening under the interest rate target scheme when the interest rate is nearly zero.

The summary of the changes of the BOJ's policy stance is given below. These are general results in all the data and lag specifications\(^\text{13}\). However, in general the effects of such policy stance changes on the economy were not very large.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Stance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986-1989</td>
<td>expansionary</td>
</tr>
<tr>
<td>1990-1992</td>
<td>tight</td>
</tr>
<tr>
<td>1992</td>
<td>expansionary</td>
</tr>
<tr>
<td>1993-1994</td>
<td>tight</td>
</tr>
<tr>
<td>1995</td>
<td>expansionary</td>
</tr>
<tr>
<td>1996-</td>
<td>neutral - tight</td>
</tr>
</tbody>
</table>

\(^{13}\) Monthly data results are also almost the same.
Figure 6-1: Variance Decompositions of the Block-Recursive Structural VAR [Domestic WPI]

(1) Log-Difference (4) [R: Level]  4 Lags

(2) Log-Difference (4) [R: Difference]  2 Lags
Figure 6-2: Historical Decompositions of Block-Recursive Structural VAR [Domestic WPI]

(1) Log-Difference (4) [R: Level] 4 Lags

[Variables]

\[ Y \]

\[ P \]

\[ Ps \]

\[ R \]

\[ M \]

\[ y \]  \[ P \]  \[ (Ps) \]  \[ MP(R) \]  \[ M \]
Figure 6-2: Historical Decompositions of Block-Recursive Structural VAR [Domestic WPI] (Continued)

(2) Log-Difference (4) [R: Difference] 2 Lags

<table>
<thead>
<tr>
<th>Variables</th>
<th>y</th>
<th>P</th>
<th>Ps</th>
<th>R</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Ps) [Shocks]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP(R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(M)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 6-3: Identified Policy Stance of the Block-Recursive Structural VAR [Domestic WPI]

(1) Log-Difference (4) [R: Level]  4 Lags

(2) Log-Difference (4) [R: Difference]  2 Lags
(2) Bank Reserve Model

We also analyse the changes of the monetary policy stance and the relative importance of its effect using the bank reserve models, both the call rate target model and the reserve target model, to see how the above-obtained results are affected by changing the models. A question of a special interest is what happens when we measure monetary policy by different variables (namely the call rate and the bank reserve).

First, let us confirm with Figures 7-1 through 7-3 that the main results did not change much from those of the previous section if we use the call rate target model. The stance of monetary policy shifts as [late 80s: loose] ⇒ [early 90s: tight except 91-92] ⇒ [late 90s: loose ⇒ neutral or tight]. But its influence on the output fluctuation is limited and overwhelmingly exceeded by the IS (y) and LM (M) shocks. The call rate is largely affected by the LM shock, somewhat contradicting with the assumption of call rate targeting. These could be regarded as general results with the structural VAR in which the call rate was specified as a sole policy variable. One notable difference from the WPI model is that the GDP deflator is now affected by monetary policy by a certain strength, but in the opposite direction reflecting the present price puzzle.

The reserve target model on the other hand gives very different results, as exhibited in Figures 8-1 through 8-3. The variance decomposition analysis shows that the effect of monetary policy is still negligible even if it is measured by the bank reserves (Figure 8-1). But the estimated policy stance has shifted quite differently from those of the previous two models (Figure 8-2: note that a positive shock indicates a ‘loose’ stance in this case). Actually it has shifted in almost the opposite direction in some periods: relatively tight in late 80s [1987-1989], turned loose in [1989-1990], again tight in [1990-1992], and loose in [1993-1994]. But if you look at the historical decomposition (Figure 8-3), you will find that the actual effect of the identified MP (RS) shock is again the opposite to such supposed stance, giving positive effect on output during the ‘tight’ period, and negative in the ‘loose’ period.

These inconsistencies of the results may be because of the misidentification of the monetary policy shock; i.e. the identified RS shock $\varepsilon_{RS}$ may reflect the reserve demand shock rather than the monetary policy shock. The fact that the reserve is almost solely affected by M and not affected by y and P (as shown in the variance decomposition [Figure 8-1] and the historical decomposition [Figure 8-3]) seems to support this interpretation. The reserve may be almost perfectly determined by the reserve requirement demand in accordance with M, and thus contains little information about the stance of monetary policy.

While it is one of the widely applied specifications in the structural VAR analysis of the U.S. monetary policy, identifying monetary policy by reserves seems to be problematic in the case of Japan.
Figure 7-1: Variance Decompositions of the Bank Reserve Model [Call Rate Target]
Log-Difference (4) [R: Level]  4 Lags

Figure 7-2: Identified Policy Stance of the Bank Reserve Model [Call Rate Target]
Log-Difference (4) [R: Level]  4 Lags
Figure 7-3: Historical Decompositions of the Bank Reserve Mode [Call Rate Target]

Log-Difference (4) [R: Level] 4 Lags

[Variables]

y

P

R

M

RS

IS(y)

AS(P)

MP(R)

[Shocks]

LM(M)

RD(RS)
Figure 8-1: Variance Decompositions of the Bank Reserve Model [Reserve Target]

Log-Difference (4) [R: Level] 4 Lags

Figure 8-2: Identified Policy Stance of the Bank Reserve Model [Reserve Target]

Log-Difference (4) [R: Level] 4 Lags
Figure 8-3: Historical Decompositions of the Bank Reserve Model [Reserve Target]

Log-Difference (4) [R: Level] 4 Lags

Variables:

- y
- P
- R
- M
- RS
- IS(y)
- AS(P)
- RD(R) [Shocks]
- LM(M)
- MP(RS)
(3) Possible Refinement of Identification of Monetary Policy

The example of the reserve target model suggests that the correct identification of monetary policy variables is decisively important when analysing monetary policy with a structural VAR.

We have so far obtained some plausible results by identifying monetary policy by the call market rate. But those results might be sensitive to the underlying somewhat extreme assumption of complete call rate targeting. Actually we have seen the signs of the possibility that the BOJ is not fully accommodating the fluctuation of money, but rather reacting to an increase of money demand by raising interest rate to suppress the large fluctuation of monetary aggregates. Remember that the call rate was greatly affected by the M shock in the variance decomposition analysis (e.g. Figure 6-1), which should not occur under the complete call rate target regime. Also remember that output and prices respond positively to the M shock, which indicates the possibility that the identified M shock contains some part of the monetary policy shock.\(^{14}\)

If we assume that the BOJ also cares about the stability of M, and reacts against the fluctuation of money demand, the policy reaction function should be specified as [30] below. The policy reaction curve is now positively sloped in the R-M plane rather than flat.

\[
R_t = a_{RM} M_t + a_{RY} Y_t + a_{RP} P_t + a_L (L) x_t + \varepsilon_{MP, R_t} \tag{MP}
\]

In this case the identified monetary policy shock will be a mixture of the reduced form R and M innovations with the weight of the slope coefficient \(a_{RM}\).

\[
\varepsilon_{MP, R_t} = u_{Rt} - a_{RM} u_{Mt} - a_{RY} u_{yt} - a_{RP} u_{Pt} \tag{MP shock}
\]

Note that this specification might help to reduce the price puzzle, if the estimated positive response of \(P\) to the M shock (\(\varepsilon_M\)) comes from the response to \(u_M\), i.e. \(\partial P/\partial u_M > 0\).

Note also that, if the estimated significant influence of the M shock (\(\varepsilon_M\)) over \(y\) and \(P\) (in the variance and historical decompositions, e.g. Figures 6-2 and 6-3) comes from \(u_M\), then with the specification of monetary policy like [30], the effect of monetary policy on output may not be negligible any more. Actually, with the Sims and Zha (1998) - type model where money stock (the Marshallian \(k\)) enters in the policy reaction function, we obtained somewhat larger monetary policy effect on \(y\) and \(P\) in some cases (Figures 9-1 and 9-2). The conclusion that monetary policy has little real effect on the economy may need a reservation.

A problem in identifying monetary policy by a formula like [30] is the fatal difficulty in distinguishing between money demand and monetary policy reaction. If we specify the policy reaction as [30] while maintaining the assumption that money demand responds to \(y\), \(P\) and \(R\) as

\(^{14}\) As we will mention later, Dr. Miyao indicated that M shock might contain not only monetary policy by the BOJ
specified in [5], then both the equations have the same endogenous variables and there is no way to identify them. We need to invent plausible identifying restrictions to explore the possibility in this line.

Here, just as a tentative experiment, we examine the effect of incorporating monetary aggregate in the monetary policy equation by changing the ordering of the block recursive WPI model. We place the call rate (monetary policy) equation last in the model: i.e. change the ordering from \([y, P, Ps, R, M]\) to \([y, P, Ps, M, R]\). This implies that money demand is predetermined without affected by current interest rate \(R\), while monetary policy sets interest rate reacting to fluctuation in monetary aggregate \(M\) contemporaneously. The result did not change much from before, as exhibited in Figures 9-1 and 9-2. Although the monetary policy effect on output increases slightly in most cases (from 3.5% to 5.6% in the variance decomposition for the \(\triangle\) Difference (4) [R level] 4 lags > specification), it is still not a major factor and remains to be by far exceeded by the \(M\) shock. (The shapes of impulse responses are also unaffected.)

Another experiment we implemented is to replace \(M2+CD\) by narrower monetary aggregates, namely \(M1\) and monetary base. Since broad monetary aggregates like \(M2+CD\) is not only correlated with monetary policy but also with various other sectors in the economy, incorporating \(M2+CD\) would make identification difficult and the resulting \(M\) shock would be a obscure mixture of various kind of shocks. Employing narrower money might help a sharp identification\(^{15}\). The results of employing \(M1\) instead of \(M2+CD\) are presented in Figures 10-1 through 10-3. Notably, the \(M\) shock now reduces output and prices. This fact reduces our concern of the muddling of the monetary policy shock into the \(M\) shock (although it is still inconsistent with the interpretation that the \(M\) shock largely reflects money demand shock, since the \(M\) shock now leads to interest rate decline rather than rise). Another notable result is that now large contribution of the \(M\) shock in the output fluctuation disappeared. However, this does not mean the increase of the estimated contribution of monetary policy. In actuality, what increased was the contribution of the own \(y\) shock. Thus the model turned out to be more or less unattractive because it cannot identify clearly what are the major sources of output fluctuations.

Looking at the results of these experiments together with the result of the test of the interest rate targeting and the reserve targeting in Section 2-(2), the danger of underestimating monetary policy effect by assuming the call rate target policy may not be as high as it first

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\(^{15}\) This point is indicated by Prof. Sims. Similar points are made by Dr. Miyao and by Dr. Shioji. Dr. Miyao maintained that discarding broad money and employing monetary base together with stock price (to remove the financial intermediation shock from the \(M\) shock) largely reduced the vagueness of the \(M\) shock (refer to Miyao (1999a)). Dr. Shioji informed us incorporating concrete monetary transmission pass into the model by including monetary base together with \(M2+CD\) (as well as including disaggregated demand components such as consumption and investment together with GDP) helped much in achieving shaper identification.
appeared. Even after considering the possibility that the BOJ cares about the fluctuation of money by changing the ordering, the estimated monetary policy effect did not much increased. The large contribution of the M shock on output shifted not to the monetary policy shock but to the own y shock when narrower money is employed. And the over-identification test results on the whole support call rate targeting and reject reserve targeting, which is thought to be the starting point of the control of broader money by the BOJ. The large contribution of the M (M2+CD) shock may not reflect a considerable contamination by the monetary policy shock, but may reflect other kind of shocks.

An alternative interpretation on the sources of the obscure M shock is given by Dr. Miyao. He indicated that the M shock may partly reflect the degree of financial intermediation by private banks\textsuperscript{16}. Considering the large fluctuation in bank lending paralleled with money and output during and after the bubble, this interpretation seems quite convincing.

But these conclusions are still tentative ones, and further investigation is required to identify the true sources of the obscure M shock, and to measure the accurate effect of monetary policy.

\textsuperscript{16} This view is expressed in his comment on the earlier version of this paper at the workshop in March 2000.
Figure 9-1: Variance Decompositions of the Block-Recursive VAR [Domestic WPI; R Last]
Log-Difference (4) [R: Level] 4 Lags

Figure 9-2: Historical Decompositions of the Block-Recursive VAR [Domestic WPI; R Last]
Log-Difference (4) [R: Level] 4 Lags
Figure 10-1: Impulse Responses of the Block-Recursive VAR [Domestic WPI; M1]
Log-Difference (4) [R: Level] 4 Lags

Figure 10-2: Variance Decompositions of the Block-Recursive VAR [Domestic WPI; M1]
Log-Difference (4) [R: Level] 4 Lags
Figure 10-3: Historical Decompositions of the Block-Recursive Structural VAR [Domestic WPI: M1]

Log-Difference (4) [R: Level] 4 Lags

[Variables]