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Is the Lending Channel of Monetary Policy Dominant in Australia? (Revised)

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Abstract
A long-standing macroeconomic issue is how monetary policy affects the real economy. The lending view is that tight money affects aggregate demand by shifting the supply schedule left in the bank loan market. Previous studies have found that loans contract following tight money. It is not clear whether the financial contraction reflects a shift of the supply schedule or the demand schedule in the loan market, however. In an attempt to identify the shifts of the demand and supply schedules in the Australian loan market, this paper employs an original approach, which includes the quantity and the price of new loans. A variety of robustness check confirms that the lending view is not supported. The paper also examines features of Australian bank behaviour which make the lending view less plausible.

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1 Introduction

A long-standing and recurrent macroeconomic issue is how monetary policy affects the real economy. While standard macroeconomic models of aggregate demand have granted a significant role to money, there have always been economists who have stressed the importance of bank loans in the transmission process of monetary policy. Their views are collectively called the "lending view". In a nutshell, the lending view is that a monetary tightening shifts the supply schedule of bank loans left, thereby forcing bank-dependent borrowers to contract investments. This transmission mechanism of monetary policy is the "lending channel".

The lending view has an important implication. According to the lending view, the supply schedule of bank loans shifts left in the wake of tight money because banks have less money to lend. In other words, the banks will cut back on lending even though there are perfectly good loans to be made. In such a case, the supply-based contraction of bank loans has an independent impact on the real economy. (If the banks cut back on lending because firms are in bad shape or demand less money, the cutback will simply reflect the developments of the economy and hence have no independent impact on the economy.) It is this implication which distinguishes the lending channel from other channels of monetary policy.

There are reasons why it is important to study the lending channel of monetary policy. First, a credit aggregate may be a better indicator of monetary policy than an interest rate or a monetary aggregate. Second, a monetary tightening can have distributional consequences. While bank loans are a primary source of finance to small firms, large firms have a variety of financial sources. As a consequence, small firms will bear full brunt of the cutback of bank loans. Third, conventional prescriptions for a recession may not work. Suppose that the lending channel is usually operative. If the bank capital is depleted in recessions, the lending channel is likely to be weaker. In extreme cases, the injection of capital into the banking sector may be a better option than expansionary monetary policy and/or fiscal one. For these reasons, it is of fundamental importance, to policy makers in particular, to study the lending view.

The early literature typically tests the lending view with time series data, a common finding of which is contraction of bank loans in the wake of tight money. An influential work is that of Bernanke and Blinder (1992) who estimate a vector autoregression (VAR) model for the U.S. over the period 1959:8 to 1979:9, including the funds rate, the unemployment rate, the consumer price index (CPI), and bank balance-sheet variables (deposits, securities, and loans) all deflated by the CPI. They calculate impulse response functions to an innovation to the funds rate, finding that contraction of bank loans follows an unanticipated hike of the funds rate. Many researchers have employed this method for studies of different countries with different sample periods of data, reproducing essentially same results. With Australian data, for instance, Suzuki (2001) estimates a similar VAR model over the period 1985:Q1 to 2000:Q2, finding an unanticipated hike of the cash rate followed by contraction of bank loans. These findings are certainly *not inconsistent* with the hypothesis that monetary policy dominantly operates through the lending channel.

Unfortunately, however, contraction of bank loans in the wake of tight money cannot be an unambiguous evidence for the lending view. This is primarily due to high correlation between monetary and credit aggregates. When bank loans contract, deposits are also likely to contract. Therefore, one can argue that a monetary tightening depresses aggregate demand through the conventional money channel resulting in a decrease of demand for bank loans (i.e., the money view). In other words, it is necessary to identify the shifts of the supply and demand schedules in the bank loan market. Thus, the contraction of bank loans is consistent with the lending view as well as the money view. This observational equivalence is called the "supply-versus-demand puzzle" (Bernanke 1993). An empirical resolution of the puzzle is the main objective of this paper.

The supply-versus-demand puzzle has made it common to test the lending view, particularly in the U.S. literature, by examining the responses of banks to monetary policy with micro-data on banks' balance sheets (e.g., Kashyap and Stein 2000). In Australia, however, the banking sector is highly concentrated, which makes it of little use to analyse cross-sectional or panel data on banks' balance sheets.[1] Thus, testing the lending view for Australia requires an original approach with time series data. The next section discusses an original approach of this paper to resolve the supply-versus-demand puzzle with aggre-

[1] Four major banks have accounted for approximately 70% of total bank lending over the past decade in Australia. See, for instance, Tallman and Bharucha (2000).

gate time series data. As will be shown shortly, the results show that the lending channel of monetary policy is not dominantly operative in Australia. The third section examines features of Australian banks' behaviour which make the lending channel of monetary policy transmission less dominating. The fourth section concludes.

2 Empirical Resolution of the Puzzle

2.1 Model

This paper employs a vector autoregressions (VAR) approach, a main characteristic of which is a relatively small number of variables describing the dynamics of the economy. Let x_t denote a vector containing the values that the variables of interest assume at date t. Then, a VAR approach approximates the economy by a linear system of equations with constant terms and linear time trends being typically included:

$$\mathbf{B}_0\mathrm{x}_t = \mathbf{k}_0 + \mathbf{k}_1 t + \mathbf{B}_1\mathrm{x}_{t-1} + \cdots + \mathbf{B}_p\mathrm{x}_{t-p} + \mathbf{u}_t, \tag{1}$$

with $\mathbf{u}_t \sim$ i.i.d. $N(\mathbf{0}, \mathbf{D})$ where $\mathbf{D}$ is a diagonal matrix.

A macroeconomic VAR model commonly includes, at least, four variables: output (Y), price (P), money (M), and a short-term interest rate (R). These correspond to the variables of a standard IS-LM model. The four-variable VAR model, however, often results in the price puzzle, which is a finding of a sustained price rise following an unanticipated monetary tightening that is represented by a positive innovation to the interest rate. Sims (1992) conjectures that the price puzzle is a result of omitting variables which the monetary authority observes to obtain information on future inflationary pressures, suggesting that it should be resolved by including the exchange rate (XR) and the commodity price (CP) in a set of variables. Hence, six variables are considered fundamental in macroeconomic VAR modelling.

This paper expands the fundamental set of variables in order to study the lending channel of monetary policy. Bernanke and Blinder (1988) formalise the lending view by including the credit market in an IS-LM model, suggesting that the interaction among three markets (goods, money, and credit) be examined. Following their formalisation, the VAR model of this paper includes the loan price (LP) and the loan quantity (LQ) in a set of variables to model. As will be discussed shortly, the inclusion of the bank loan price enables the VAR model of the paper to test the lending view, distinguishing it from other similar models in the literature. As such, a minimal set of variables must consist of the prices and quantities of the three markets as well as the exchange rage and the commodity price.[2]

The openness of the Australian economy further suggests that the interaction between the Australian economy and the rest of the world should be modelled explicitly. No one would deny, for instance, that a change in the funds rate in the U.S. could affect the monetary policy in Australia. As Eichenbaum (1992) shows, a closed-economy VAR model for a non-U.S. country can lead to the price puzzle. Although the inclusion of the exchange rate may resolve the price puzzle, it often results in the exchange rate puzzle - that a depreciation of the domestic currency against the U.S. dollar follows a positive innovation in the short-term interest rate. Kim and Roubini (2000) estimate VAR models for non-U.S. G7 countries, finding that inclusion of the U.S. interest rate can eliminate those anomalous results. Brischetto and Voss (1999) confirm this finding by estimating a similar VAR model for Australia. Following their finding, the model of this paper includes the U.S. interest rate (R^U) in a set of variables.

The U.S. interest rate is not the only overseas variable which may affect a small open economy. In an attempt to model interdependence between economies, Cushman and Zha (1997) estimate an open-economy VAR model for Canada including the U.S. industrial production, the U.S. consumer price index, the federal funds rate, and the commodity price index in the U.S. dollar as the overseas variables. Dungey and Pagan (2000) also estimate an open-economy VAR model for Australia under the assumption that the rest of the world is represented by the U.S. economy, which is described by a group of U.S. variables: GDP, a real interest rate, the terms of trade, a measure of asset prices, and real exports. Dungey and Fry (2000) extend this modelling philosophy into a three country model. They estimate a three country VAR model treating the U.S. and Japan as the rest of the world to Australia. Following these works, this paper estimates an open-economy VAR model

[2]The earlier version of this paper analyses a VAR model consisting of the eight variables: output, the general price level, money, the short-term interest rate, bank loans, the price of bank loans, the exchange rate, and the commodity price. See Suzuki (2001) for the results.

where the U.S. is assumed to be the rest of the world to Australia. In particular, the set of variables includes the U.S. output (Y^U) and the U.S. price (P^U) as well as R^U. Thus, the VAR model of this paper consists of the eleven variables:

$$\mathrm{x}_t' = (P_t, Y_t, R_t, M_t, LP_t, LQ_t, XR_t, CP_t, P_t^U, Y_t^U, R_t^U)'. \tag{2}$$

2.2 Hypothesis

This section formalises the hypothesis, that monetary tightening dominantly operates through the lending channel, in a statistically testable form. (Note that the lending channel and the money channel are not exclusive to each other.) If the lending channel is operative, a monetary tightening will shift the supply schedule of bank loans. The early literature examines aggregate time series data, finding that contraction of bank loans follows a monetary tightening (e.g. Bernanke and Blinder 1991). As is mentioned in section 1, however, contraction of bank loans, of itself, is not necessarily a consequence of a leftward shift of the supply schedule (i.e., the supply versus demand puzzle). Thus, testing the lending view requires identifying the supply and demand schedule of bank loans.

For the purpose of identification, the set of variables includes the price and quantity of bank loans (see equation 2). A simple diagram of the demand and supply curves in the bank loan market can illustrate the idea. Suppose that a monetary tightening operated through the lending channel, shifting the supply curve of bank loans left from S to S′ in Figure 1. Then, one would expect to observe a rise of the price and a decrease of the quantity, so long as the demand schedule lies between D′ and D″. Similarly, a leftward shift of the demand schedule for loans, which the conventional money view predicts, would lead to decreases of the price and quantity of bank loans. As such, the inclusion of the price and quantity of bank loans reduces the puzzle to a problem like simultaneous equation bias, enabling us to test the lending view.

If the lending channel of monetary policy is dominant, a leftward shift of the supply schedule must be clearly observed following a monetary tightening. As Figure 1 depicts, a rise of the loan price detects a leftward shift of the supply schedule of bank loans unless the quantity of bank loans increases. For the study of the lending channel to be meaningful,

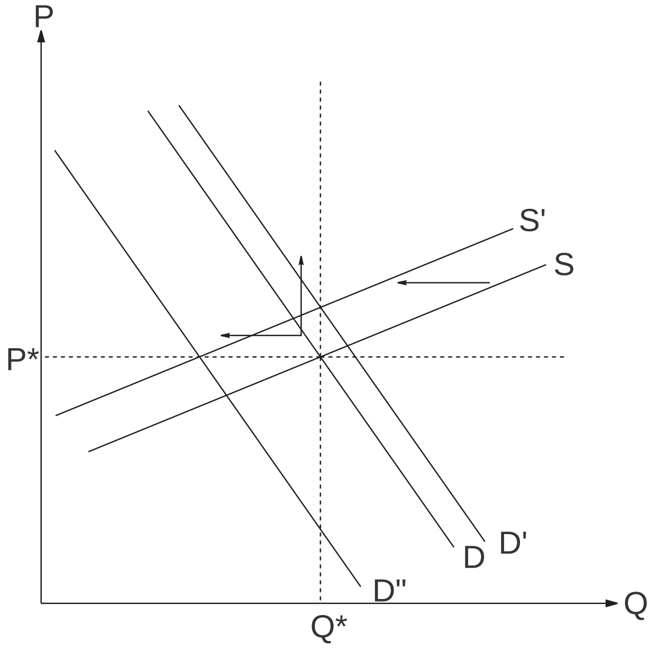

Figure 1: Consequences of a leftward shift of the supply curve.

it may be also worthwhile to test the effectiveness of monetary policy. Thus, the lending view will be accepted if:

H1 the quantity of bank loans (LQ) does not increase,

H2 the price of bank loans (LP) rises,

H3 and real output (Y) decreases,

following a monetary tightening. For the purpose of testing H1 to H3 statistically, the system of linear equations (1) is estimated to simulate impacts of monetary policy on the economy.

In macroeconomic modelling in general, however, it is always difficult to measure monetary policy in a convincing way. The early VAR literature in the U.S., for instance, often interprets an equation associated with the funds rate as the reaction function of the Fed, which implies that an innovation to the funds rate represents monetary policy. This practice has been subject to criticism, partly because of its anomalous results.[3] In contrast,

[3] See the debate between Rudebusch (1998) and Sims (1998). Rudebusch argues that an equation of

a similar practice produces no anomalous result in Australian VAR modelling. Consequently, it is now common to assume in the Australian literature that an innovation in the cash interest rate represents monetary policy (e.g., Brischetto and Voss 1999, Dungey and Fry 2000, and Dungey and Pagan 2000). Following the tradition, this paper assumes that a positive innovation to the interest rate (u^R) represents its unexpected hike by the RBA.

Simulating the dynamic responses of macroeconomic variables to monetary policy is equivalent to calculating the impulse response functions of those variables to an innovation to the interest rate. The impulse response function of LQ, for instance, is defined as

$$\frac{\partial\ E(LQ_{t+i}|I_t)}{\partial\ u_t^R} \text{ for } i = 0, 1, \cdots,$$

where the numerator denotes the expected value of LQ at time $t+i$ conditional on the information set available at time t. The impulse responses are calculated to test the hypotheses H1 to H3. H1 and H2 will hold if

$$\text{H1: } \frac{\partial\ E(LQ_{t+i}|I_t)}{\partial\ u_t^R} \leq 0 \text{ for } i = 0, 1, \cdots, \tag{3}$$

and

$$\text{H2: } \frac{\partial\ E(LP_{t+i}|I_t)}{\partial\ u_t^R} > 0 \text{ for } i = 0, 1, \cdots. \tag{4}$$

H3 will be similarly supported if

$$\text{H3: } \frac{\partial\ E(Y_{t+i}|I_t)}{\partial\ u_t^R} < 0 \text{ for } i = 0, 1, \cdots. \tag{5}$$

Thus, the impulse response functions of LQ, LP, and Y enables us to test the hypothesis that monetary policy dominantly operates through the lending channel.

2.3 Estimation

To calculate the impulse responses, the parameters of the system of linear equations (1) needs to be estimated with data. P and Y are conventionally measured by the log of CPI and the log of real GDP, respectively. The U.S. general price and output are similarly measured in logs. M is measured by the log of base money. Base money is chosen in an

the funds rate does not correctly model the reaction of the Fed. Regarding this sort of issues as universal in macroeconomic modelling, however, Sims criticises such critiques as unconstructive quibbles.

attempt to avoid possible problems caused by high correlation between money and bank credit. The cash rate is chosen for R, as it is the policy instrument of the Reserve Bank of Australia. R is measured in per cent. A positive innovation to R is interpreted as an unanticipated monetary tightening under the assumption that the equation associated with R is a reaction function of the RBA. R^U is similarly measured by the federal funds rate in per cent. XR is the log value of the Australian dollar measured in the U.S. dollars, which means that a rise in XR represents an appreciation of the Australian currency against the U.S. currency. CP is measured by the log of the world non-fuel commodity price index. LQ is the log of loans and advances by Australian banks. The sources of data are provided in the Appendix.

Measuring LP is not straightforward. A candidate for the loan price (i.e., the marginal cost of loans to borrowers) is an interest rate on new loans. Although data on the weighted average interest rate on total credit are available from 1993:Q4, there is no series available which gives the interest rate on new loans.[4] An alternative candidate is the diffusion index in the "Survey of Industrial Trends" conducted by the Australian Chamber of Commerce and Industry (ACCI) and the Westpac Banking Corporation. Question 4-b of the survey is "Do you find it is now harder, easier or the same as it was three months ago to get finance?" The diffusion index is calculated by subtracting the percentage of the firms answering "Easier" from the percentage of those answering "Harder." Suppose that the marginal cost of loans to borrowers rose due to a leftward shift of the supply curve of loans, a rightward shift of the demand curve for loans, or both. Then, firms would find it "Harder" to get finance. Consequently, one would observe a rise of the diffusion index. As such, the marginal cost of loans to borrowers and the ACCI-Westpac diffusion index may be positively correlated. Data on the diffusion index are available from 1966:Q2. In addition to providing a longer time series of data, the diffusion index is also expected to capture non-price components of the marginal cost of loans to borrowers such as collateral, or in extreme cases, the cost of being rationed out of the bank loan market. For these two advantages, the ACCI-Westpac diffusion index is utilized to measure LP (see Appendix A for further discussion on the ACCI-Westpac diffusion index).

[4] The weighted average interest rate is calculated from all the interest rates on outstanding loans. Consequently, it is too sticky to represent the current conditions of the loan market.

With those data, the system of linear equations (1) is estimated over the period 1985:Q1 to 2000:Q2. The beginning period reflects the abolition of monetary targeting in Australia (see MacFarlane 1999). The end of the period is chosen to avoid possible problems caused by the introduction of the goods and services tax (GST) in July 2000. The choice of this sample period means that we have 62 observations. A number of parameters in system equations (1) quickly consumes degrees of freedom, however.[5] In order to guarantee meaningful degrees of freedom, it may be worthwhile to restrict some of the parameters to be zero.

A less-disputable way to reduce the number of parameters may be to assume that Australian is a small open economy. For formalising this assumption, the eleven variables are divided into two groups: the overseas variables and the domestic variables. The group of the overseas variables consists of the three U.S. variables as well as the commodity price index. The other seven variables are the domestic variables. Then, x_t can be written as:

$$\mathrm{x}_t' = (\mathrm{x}_t^{o\prime}, \mathrm{x}_t^{d\prime})'.$$

where x^o and x^d denote the vector of the overseas variables and that of the domestic variables, respectively. If the coefficient matrices in the model (1) are partitioned conformably with x_t as

$$\mathbf{B}_j = \begin{pmatrix} \mathbf{B}_{11}^j & \mathbf{B}_{12}^j \\ \mathbf{B}_{21}^j & \mathbf{B}_{22}^j \end{pmatrix} \text{ for } j = 0, \cdots, p,$$

the restriction is equivalent to

$$\mathbf{B}_{12}^j = \mathbf{0} \text{ for } j = 0, \cdots, p. \tag{6}$$

In other words, the variables in x^o are assumed to be block-exogenous with respect to the variables in x^d. Such a prior is often utilised in open-economy VAR modelling, but rarely tested. The earlier version of this paper tests the block exogeneity by employing the procedure of Toda and Yamamoto (1995). Unfortunately, however, the test statistics

[5] Degrees of freedom certainly depend on the number of lags, which can also affect the estimation results. The system of equations (1) are estimated with different numbers of lags, ranging from one to four. In what follows, the number of lags is set as two. The estimation results are qualitatively robust to the choice of the number of lags, however. See Appendix B.

are suspiciously large even after correcting small sample bias (see Suzuki 2001). In what follows, the simulation results are derived from both the unrestricted and restricted models.

Since the system of equations (1) is a simultaneous equation model, a set of identifying restrictions are required. Like most other VAR models, this paper assumes that $\mathbf{B}_0$ is lower triangular. The domestic variables are placed after the overseas variables (CP, P^U, Y^U, and R^U) under the assumption that the domestic variables cannot instantaneously affect the overseas variables. The domestic economic conditions can have influences on the rest of the world, if any, with certain time lags. The order of the domestic variables is P, Y, M, R, XR, LQ, and LP. Due to the prior that the price adjustment is sluggish, P is placed before all the other domestic variables, which means that the other domestic variables can affect P only with lags. Y is placed before M and R, which implies that M and R can affect Y with lags, under the assumption that "fine tuning" is a difficult task. The position of M before R reflects the prior that the RBA takes into account the current demand for money when it determines the targeted level of the cash rate. LQ and LP are placed after R because the RBA does not conduct survey of enterprises about the financial conditions, which means that the RBA can obtain information on the bank loan market with time lags.[6]

2.4 Results

First, the simulation results from the unrestricted eleven-variable VAR are examined. The impulse response functions of the variables to a positive shock in the cash rate calculated. In each graph of Figure 2, the solid line is the impulse response function of each variable to a positive shock in the cash rate. The size of the shock to the cash rate is one-standard-devation, which is calculated as an increase of approximately 0.55 percentage point in the cash rate. Figure 2 also displays the 90% confidence intervals for the estimated impulse responses by the dotted lines. Following Runkle (1987), this paper numerically generates the confidence intervals by "bootstrapping".[7] The 90% confidence intervals are

[6] As a different ordering of the variables can produce different results, robustness checks are conducted with different orderings. The qualitative results concerning the lending view are not sensitive to the ordering of the variables, however. See Appendix B.

[7] The procedure is as follows. First, the model (1) is estimated, and the estimated coefficients and the fitted residuals are saved. Then, the residuals are reshuffled with replacement, and the data set is artificially

used for one-tail tests at 5% significance level. In Figure 2, the loan price is measured in percentage point. The other variables are in logs and multiplied by 100, so that the impulse response functions approximate the percentage change of these variables in response to an unexpected 0.55 percentage point hike of cash rate. The same scale is used for all the variables except for the loan price.

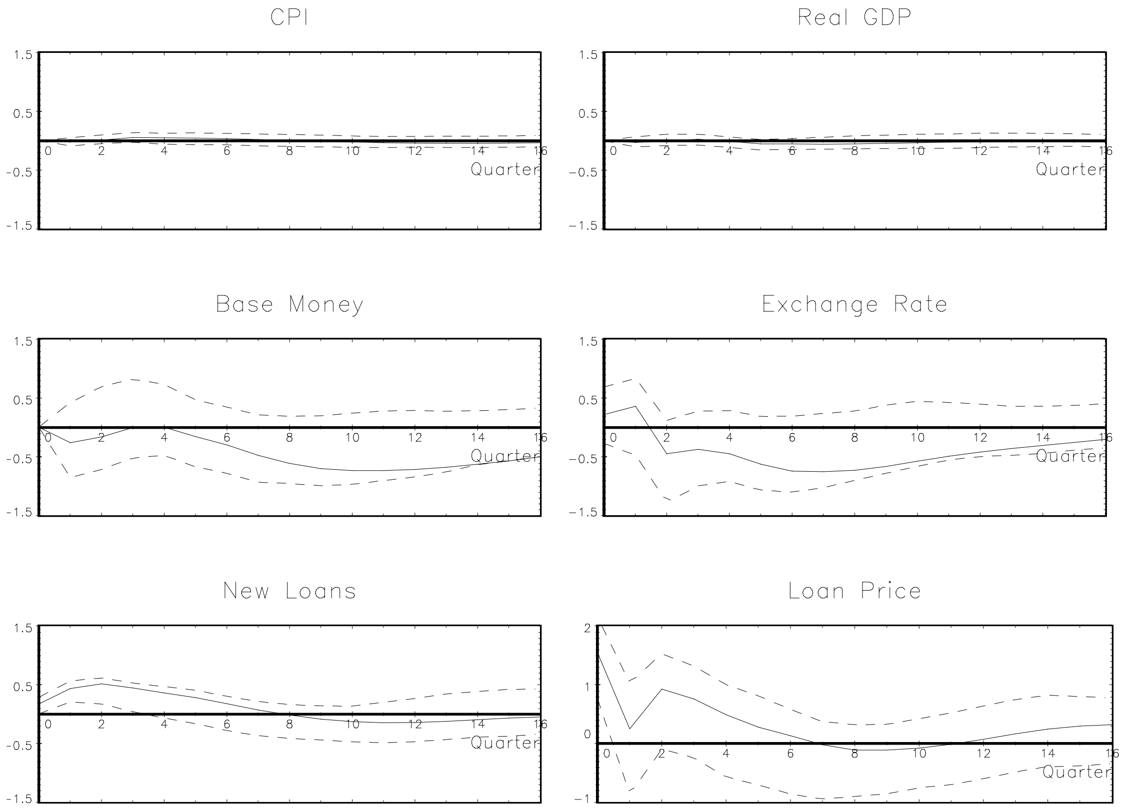

Figure 2: Responses to a cash rate shock (the unrestricted model)

Notes: The loan price is measured in percentage point.

The other variables are in logs and multiplied by 100.

The upper two graphs of Figure 2 indicate that impacts on the price and output

created using the estimated VAR as the true data-generation process. In this paper, a series of 1000 such simulations are undertaken. With each of the 1000 synthetic data sets, the model is re-estimated and the impulse response functions are calculated. The confidence intervals for the originally estimated impulse response functions are inferred from the ranges that include 90% of the values for the 1000 simulated impulse responses.

of a change in the cash rate are negligible. In particular, the left graph provides the statistical test for H3 (i.e., the effectiveness of monetary policy). The decline of real GDP is significantly different from zero only in the fifth quarter at 5% significance level:

$$\frac{\partial\ E(Y_{t+5}|I_t)}{\partial\ u_t^R} < 0.$$

While this seems to imply the effectiveness of monetary policy, its impact on the real GDP is negligible. The point estimate shows that the maximum effect is a decline of approximately 0.06% in real GDP in the seventh quarter following an unanticipated 0.55 percentage point rise of the cash rate. Are the results consistent with those of other Australian studies? Dungey and Pagan (2000), for instance, estimate an open-economy VAR model over the period 1980:Q1 to 1998:Q3. The maximum effect is a decline of nearly 0.3% in real GDP in the seventh quarter following an unanticipated 1.4 percentage point hike in the cash rate. Although the response of real GDP is significant at 5% significance level in their analysis, the size of the response is small. Brischetto and Voss (1999) similarly estimate a seven-variable VAR (real GDP, the CPI, M1, the cash rate, the exchange rate, the world oil prices, and the U.S. interest rate) over the period 1980:Q1 to 1998:Q4 finding that an unexpected 0.25 percentage point rise of the cash rate is followed by a decline of approximately 0.2% in real GDP in 12 quarters. The decline of real GDP is not significant at 5% significance level in their analysis, however. Thus, it seems reasonable to conclude that the effects of monetary policy are estimated to be small.

The centre graphs of Figure 2 show the impacts of an unanticipated hike of the cash rate on base money and the exchange rate, which can be displayed for the purpose of detecting, if any, misspecification(s) of the model. The point estimate of the left graph implies that base money initially falls by nearly 0.3% in response to the unexpected hike of the cash rate. The point estimate in the right graph is reasonable: the Australian dollar immediately appreciates by approximately 0.4% against the U.S. dollar following the same change in the cash rate. Although the responses of money and the exchange rate are not significantly different from zero, the point estimates are not anomalous.

As for testing the lending view, the lower two graphs in Figure 2 are of particular importance. The point estimates in these graphs show that the quantity and price of bank loans initially increase. While H2 is accepted, H1 is rejected at 5% significance level. Consequently, the hypothesis that the lending channel is dominant is rejected at 5% significance level. As can be inferred from Figure 1 in subsection 2.2, this pattern of co-movements between the price and the quantity implies that the demand schedule for bank loans shifts right in response to a monetary tightening. Such a temporary rightward shift of the demand schedule for bank loans is commonly found in the U.S. literature. Gertler and Gilchrist (1993), for instance, argue that U.S. firms temporarily increase the demand for bank loans in order to smooth reductions in their cash flows in the wake of tight money. Their argument may apply to the Australian case. After an initial increase, the quantity of bank loans begins to decrease. In the first quarter after a positive innovation in the cash rate, the quantity of loans increases while the price of loans falls. These movements of the price and quantity of bank loans contradict the hypothesis that the lending channel of monetary policy is dominant. Rather, the results imply that Australian banks accommodate the temporarily increased demand for bank loans.

For the purpose of robustness check, the structural model (1) with the restriction of block exogeneity (6) is also estimated over the same period using the same data. The calculated impulse response functions are shown in Figure 3. The initial positive response of loans is no longer significantly different from zero. It is significant at 10%, however.[8] The responses of the quantity and loans of bank loans are similar to those of the previous models. Therefore, the lending view is not again supported. The responses of the other variables are also consistent with those calculated from the restricted model.

3 Banking Behaviour

As is shown in the previous section, loans initially expand when money is tightened. It is also shown that the positive response of bank loans accompanies a rise of the marginal cost of bank loans to borrowers. Therefore, the previous section concludes that the initial positive response of bank loans is due to an rightward shift of the demand schedule in the bank loan market. This is consistent with the argument of Gertler and Gilchrist (1993) that firms temporarily increase demand for bank loans to smooth reductions in their cash

[8] This means that a similarly calculated 80% confidence interval lies above zero at the initial three quarters.

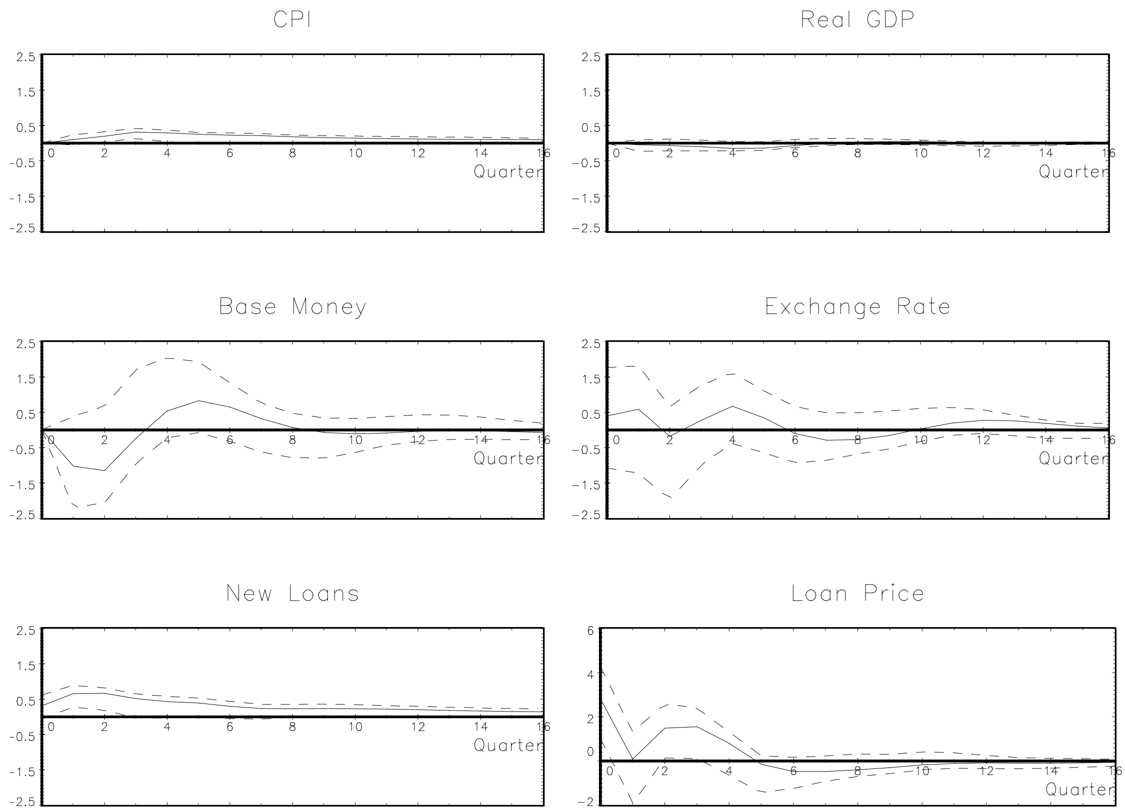

Figure 3: Responses to a cash rate shock (the restricted model)

Notes: The loan price is measured in percentage point.

The other variables are in logs and multiplied by 100.

flows in the wake of tight money. Then, a question arises. How can Australian banks accommodate the change in the demand schedule for bank loans when the Reserve Bank of Australia tightens money?

In the U.S. context, Bernanke and Blinder (1992) emphasize the role of banks' security holdings in mitigating impacts of monetary contraction on their supply schedules of bank loans. Due to the contractual nature of bank loans, banks cannot immediately cut their supply of loans. Therefore, banks reduce their security holdings in the wake of tight money. This argument seems to apply to the Australian case. Suzuki (2001) estimates a VAR model for Australia, finding that deposits do not immediately fall in response to a hike in the cash rate. An important finding is that when loans begin to fall, deposits also begin to fall. He also finds that a fall of security holdings immediately follows a hike of the cash rate, and that the security holdings recover as deposits fall. These findings imply that Australian banks use their security holdings as a buffer stock.

By adjusting their liabilities, banks may be able to accommodate the temporarily increased demand for bank loans when money is tightened. Romer and Romer (1990) argue that U.S. banks raise funds by issuing the certificates of deposit (CDs) when the Federal Reserve Bank tightens money. To examine whether their argument holds for Australia or not, a VAR model is estimated over the period 1989:Q4 to 2000:Q2 including the cash rate, two components of bank liabilities (deposits and CDs) both deflated by the CPI, the unemployment rate, and the CPI itself. Deposits, CDs, and the CPI are in logs.[9] Two lags of each variable are included. Constant terms are also included. Figure 4 shows the impulse response functions of the unemployment rate and bank liabilities to a positive innovation in the cash rate. Clearly, CDs decrease in response to a monetary tightening. As a higher interest rate can make the issuance of CDs more costly to banks, the decrease of CDs is plausible. Thus, the Romers' argument does not hold for the Australian case.

Another feature of Australian bank behaviour which may insulate the supply schedule of bank loans from impacts of monetary contraction is their borrowing from overseas.[10] Australian banks have continuously increased borrowings from overseas over the past two decades. The ratio of Australian banks' foreign currency liabilities to their total liabilities grew from 3.39 % in October 1985 to 17.59 % in June 2000. A VAR is estimated over the period 1986:Q2 to 2000:Q2 including (in order) the cash rate, three bank balance-sheet variables (deposits, foreign currency liabilities, and loans) all deflated by the CPI,

[9] Data on CDs are available from 1989:Q2.

[10] The U.S. literature has not tested the hypothesis that U.S. banks make use of foreign currency liabilities to mitigate impacts of monetary contraction on their supply schedule of loans. This may be because many U.S. banks were too small to raise funds from overseas. The McFadden Act of 1929 required U.S. banks to obey state restrictions on branching, and interstate branching was prohibited by all the states. Individual states also restricted intrastate branching. In the most restrictive regime, each bank was limited to a single office. As a consequence, U.S. banks were generally small. In 1980, for instance, 9,900 of 12,290 banks were with less than $100 million in total assets, and domestic deposits (including CDs $\geq$ $100,000) accounted for 96.8% of their total liabilities. It was not until the passage of the Riegle-Neal Act of 1994 that interstate branching was allowed. See Berger, Kashyap, and Scalise (1995).

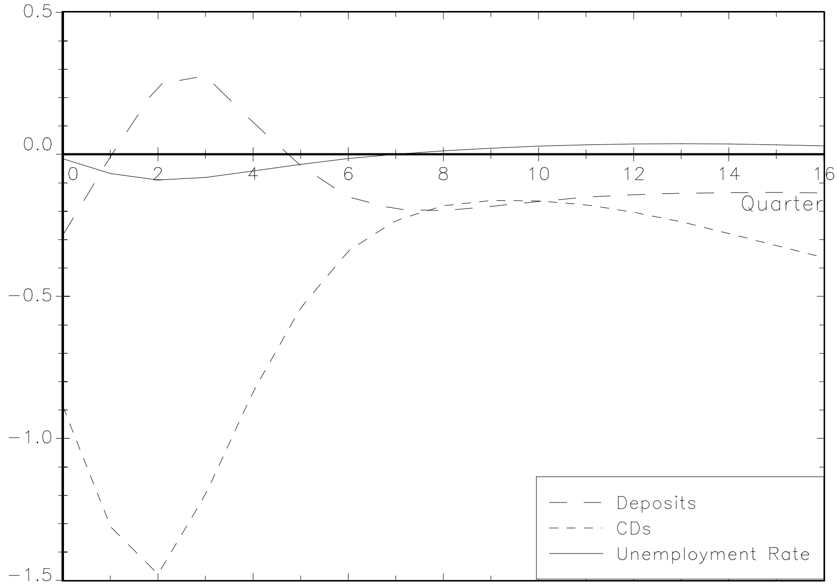

Figure 4: Responses to a Shock to the Cash Rate

Notes: Unemployment rate is measured in per cent.

CDs and Deposits are in logs and multiplied by 100.

the unemployment rate, and the CPI itself.[11] Two lags of each variables are included. Constant terms are also included. Except for the cash rate and the unemployment rate, all the variables are in logs and multiplied by 100. The calculated impulse response functions of the unemployment rate and bank balance-sheet variables to a positive innovation in the cash rate are shown in Figure 5. After an initial fall, foreign currency liabilities clearly increase in response to a hike of the cash rate. The timing of the increase of foreign currency liabilities coincides with the timing of the expansion of loans, even though foreign currency liabilities continue to accumulate for two quarters after loans begin to decrease. Therefore, we may conclude that Australian banks accommodate a rightward shift of the demand schedule for bank loans by borrowing from overseas when the RBA tightens money.

In summary, Australian banks can accommodate the temporarily increased demand for bank loans in the wake of tight money by decreasing their security holdings and borrowing

[11] Data on foreign currency liabilities are available from 1985:Q4.

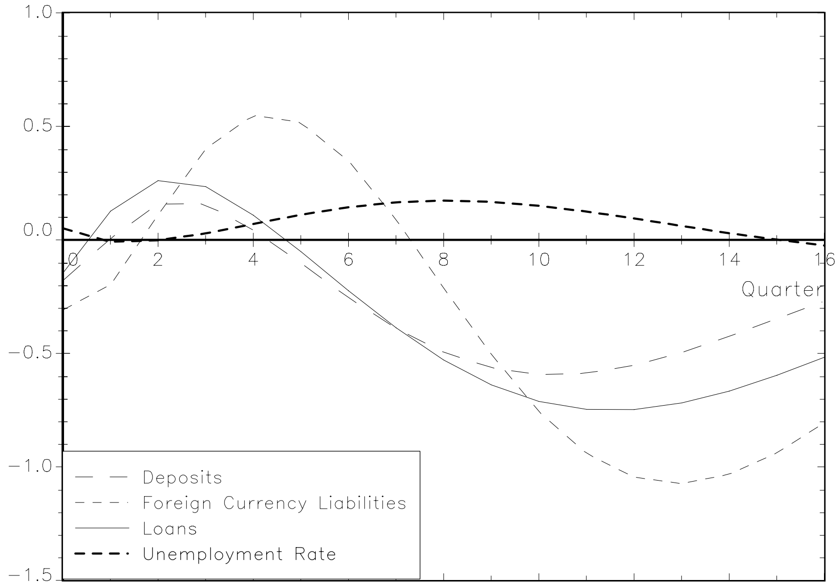

Figure 5: Responses to a Shock to the Cash Rate
Notes: Unemployment rate is measured in per cent.
The other variables are in logs and multiplied by 100.

from overseas. By adjusting their assets and liabilities, Australian banks can mitigate impacts of monetary contraction on their supply schedules of bank loans. These features of Australian bank behaviour make the lending channel of monetary policy transmission less important.

4 Conclusion

This paper tests the hypothesis that monetary policy dominantly operates through the lending channel in Australia. For this purpose, an original approach is proposed, which includes the variable for the quantity of new loans and the constructed variable measuring the "full price" of new loans. A central finding is that, even though bank loans contract following a monetary tightening, the contraction of bank loans is largely due to a left-ward shift of the demand schedule in the bank loan market. This finding is consistent with that of the earlier version of this paper employing the Kashyap, Stein, and Wilcox

(1993) approach that is commonly used in the U.S. literature. Thus, the hypothesis is not statistically supported.

The results of this paper do not reject the dominance of the lending channel of monetary policy in other countries, however. In the U.S. literature, the lending channel has been often found to be significantly operative. Employing a variety of approaches, for instance, Kashyap and Stein (1994) conclude that the evidence for the existence of the lending channel in the U.S. is quite strong. The hypothesis that the lending channel is operative is also supported for Japan. Using approaches similar to those of this paper with sample from 1975 to 1993, Suzuki (2001) argues that bank loans played a distinctive role in the transmission process of monetary policy in Japan. Thus, the results of this paper are in contrast to those of similar studies for the U.S. and Japan.

The significance of the lending view may be sensitive to institutional characteristics of the financial markets. An important finding of section 3 is that Australian banks borrow from overseas to mitigate impacts of monetary contraction on their supply schedules of bank loans. (Another finding of section 3 is that Australian banks use their holdings of public securities as a buffer stock.) In contrast, U.S. banks were generally too small to make use of foreign currency liabilities because of the McFadden Act which effectively prohibited their interstate and intrastate branching. The Japanese banking industry was also heavily regulated. For instance, it was not until May 1979 that the issuing of certificates of deposit was authorised in Japan. In addition, the Bank of Japan directly controlled the amount of commercial bank loans through "window guidance" (see Ueda 1993). As such, Australian banks are allowed to have more diversified portfolios and provide a wider range of services than were U.S. banks and Japanese banks. By further studying the lending view for different countries and/or different periods, we might be able to draw inferences about the consequences of the financial deregulation or innovation on the transmission mechanism of monetary policy.

A Data Appendix

Table 1 summarises the data used in section2. The data on the CPI are extracted from the dX data. Some mention has to be made of the construction of the CPI. The ABS incorporated mortgage interest charges and consumer credit charges into the component of the CPI (for all groups) between 1986:Q4 and 1998:Q2. The inclusion of interest charges makes the CPI unsuitable for evaluating monetary policy, as changes in the policy instrument mechanically result in movements in the CPI. For this reason, the "CPI excluding housing" is used.

Table 1:
Data for Sections 3.2 and 3.3

Variable	Source	Code/Table	Abbreviation
Commodity price index (non-fuel)	IMF	00176AXD	CP
Exchange rate (US$ per A$)	IMF	193AG	XR
CPI excluding housing	ABS	6401-09	P
Real GDP	IMF	19399BVR	Y
Money base	RBA	D03	M
Cash rate (11 am call)	RBA	F01	R
Loans and advances by banks	RBA	D02	LQ
Proxy for the loan price	ACCI & Westpac	Q. 4-b	LP
U.S. real GDP	IMF	11199BVR	Y^U
U.S. CPI	IMF	11164	P^U
U.S. federal funds rate	IMF	11160B	R^U

As is mentioned in the text, this paper utilises the diffusion index in the "Survey of Industrial Trends" conducted by the Australian Chamber of Commerce and Industry (ACCI) and the Westpac Banking Corporation as a proxy for the marginal cost of loans to borrowers. A potential problem with the ACCI-Westpac diffusion index arises from the fact that it omits information provided by the firms answering "Same." Suppose that 55% of the firms answered "Harder" and 45% answered "Easier." Then, the diffusion index is calculated as 10. The same value of the diffusion index is obtained, for instance, if 10% of the firms answer "Harder" and no firm answers "Easier." As such, any particular value of the diffusion index is consistent with an infinite number of different survey results. To check if this problem is evident or not, Figure 6 plots the percentages of the firms answering

"Harder" and "Easier" against the resulting diffusion index. Roughly speaking, there are nearly one-to-one relationships from the percentages of the firms answering "Harder" and "Easier" to the diffusion index. In this sense, the diffusion index may correctly provide information about the loan market.

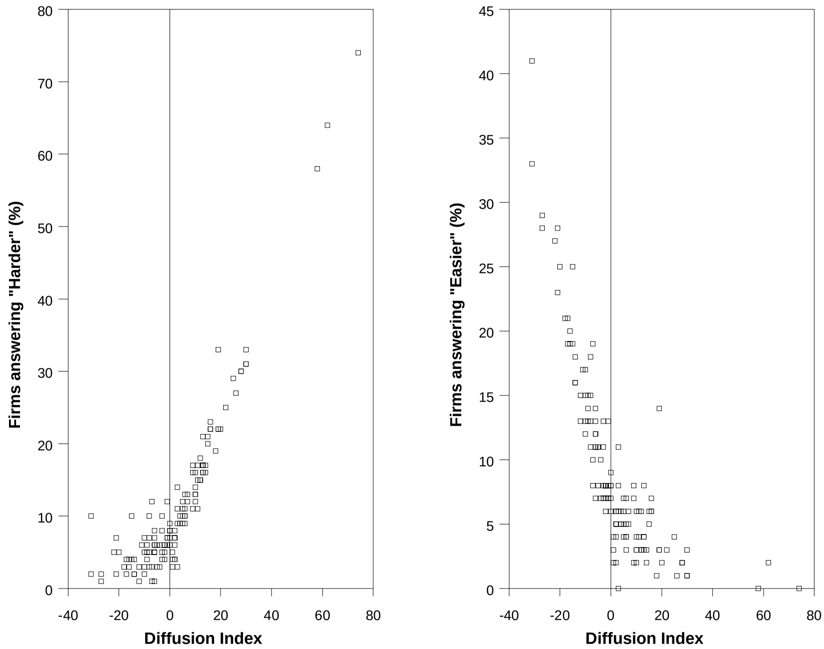

Figure 6: Diffusion Index and its Components

Sample: 1966:Q2 - 2000:Q4

B Robustness Check

For the purpose of checking robustness, the system of equations (1) is estimated by changing the ordering of the variables. Figures 7 to 14 show the simulation results from the unrestricted model estimated by reordering the variables. In estimation for Figure 7, the cash rate, which is the policy instrument of the RBA, is the first variable. This implies the assumption that the RBA determines the level of the cash rate without utilising any contemporaneous information from the variables in the system. Despite the unrealistic assumption, however, the simulation results are essentially same as those in Figure 2. The quantity and price of bank loans increase in response to an unanticipated hike of the cash

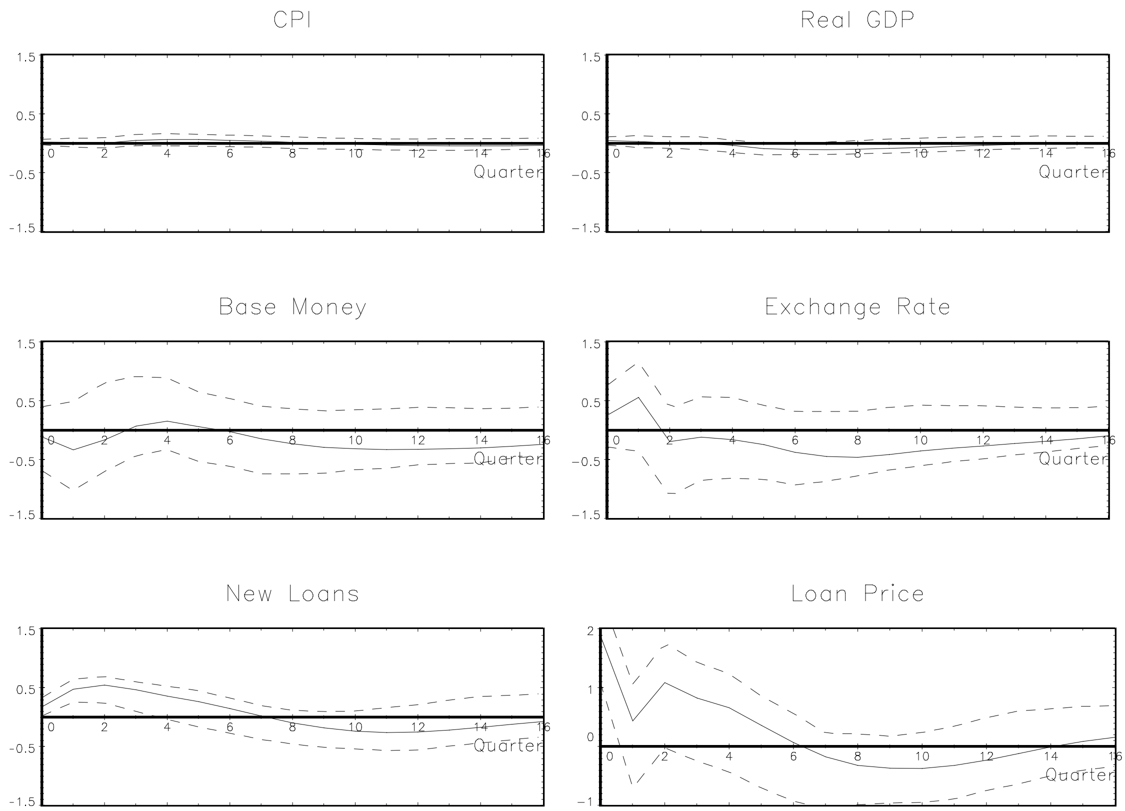

Figure 7: Robustness Check 1 (the Unrestricted Model).
R is the first variable.

rate.

In estimation for Figures 8 to 11, the short-term interest rate is similarly placed after a part or all of the overseas variables. This implies the assumption that the RBA utilises information from the variables placed before R when it determines the level of the short-term interest rate. As is clearly shown, the results are not sensitive to those change in the ordering of the variables.

In Figures 12 to 14, the short-term interest rate is placed after a part or all of the domestic variables except for those in the bank loan market. These changes do not qualitatively affect the simulation results, and hence the conclusion is robust.

For further robustness check, the same system of equations is re-estimated by changing the lag structure. In the estimation, the short-term interest rate is assumed to be the eighth

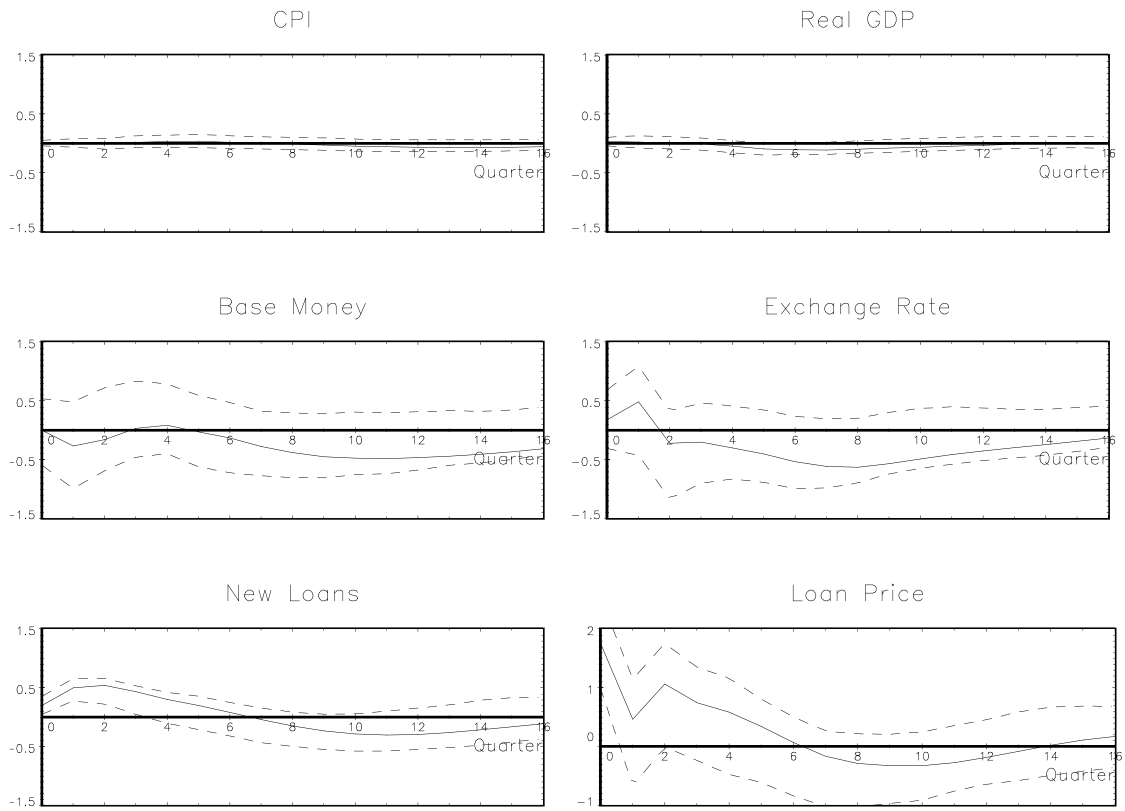

Figure 8: Robustness Check 2 (the Unrestricted Model)

R is the second variable.

variable. Figures 15 to 17 display the simulation results. As is clear from these figures, the results are essentially robust to the selection of the lag structure.

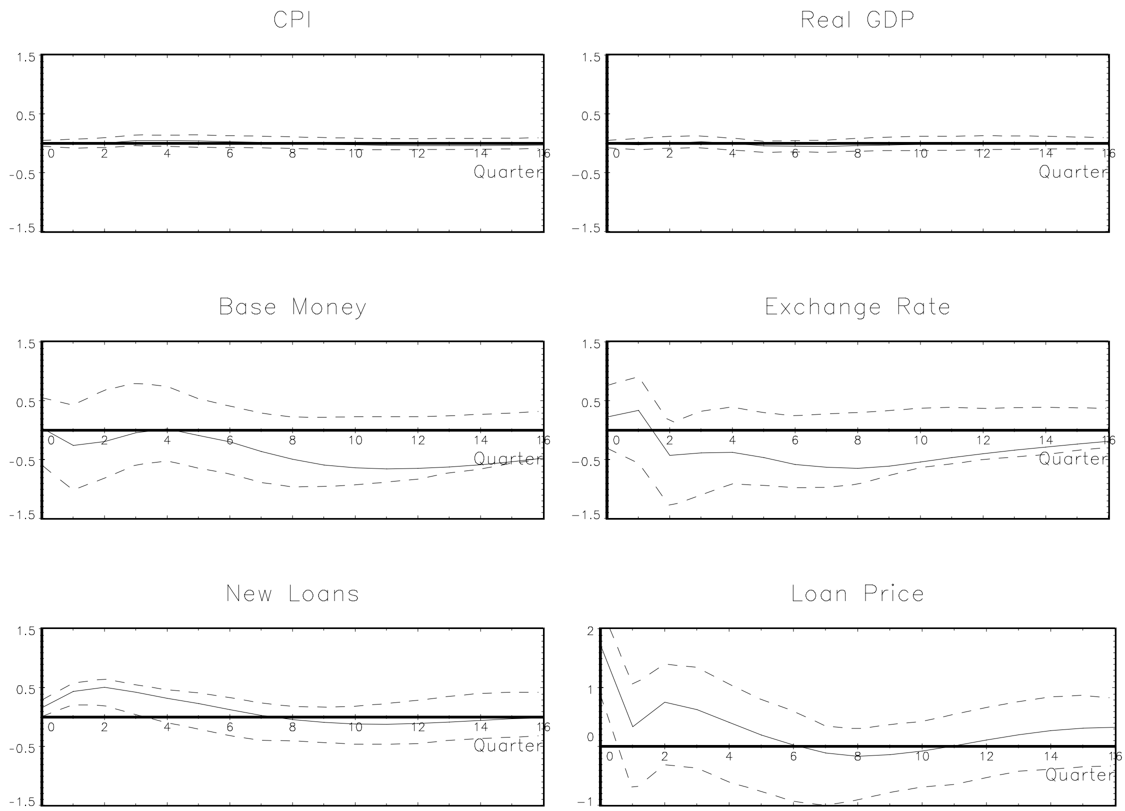

Figure 9: Robustness Check 3 (the Unrestricted Model).
R is the third variable.

References

[1] Berger, Allen N., Anil K. Kashyap, and Josehp M. Scalise. "The Transformation of the U.S. Banking Industry: What a Long, Strange Trip It's Been." *Brookings Papers on Economic Activity* 2 (1995), 55-201.

[2] Bernanke, Ben S. "Credit in the Macroeconomy." *Federal Reserve Bank of New York Quarterly Review* 18 (Spring 1993), 50-70.

[3] Bernanke, Ben S., and Alan S. Blinder. "Credit, Money, and Aggregate Demand." *American Economic Review* 78 (May 1988), 435-439.

[4] Bernanke, Ben S., and Alan S. Blinder. "The Federal Funds Rate and the Transmission of Monetary Policy." *American Economic Review* 82 (September 1992), 901-921.

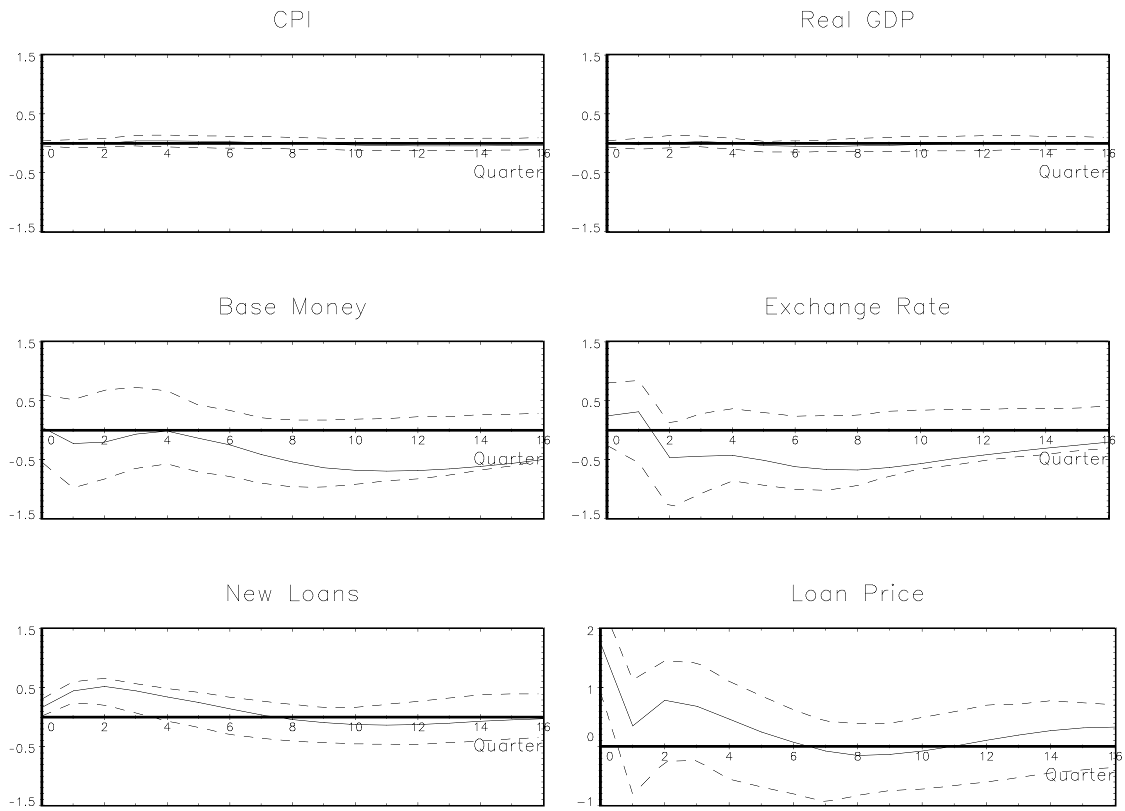

Figure 10: Robustness Check 4 (the Unrestricted Model).

R is the fourth variable.

[5] Brischetto, Andrea, and Graham Voss. "A Structural Vector Autoregression Model of Monetary Policy in Australia." *Reserve Bank of Australia Research Discussion Paper* 1999-11 (December 1999).

[6] Cushman, David O., and Tao Zha. "Identifying Monetary Policy in a Small Open Economy under Flexible Exchange Rates." *Journal of Monetary Economics* 39 (August 1997), 433-448.

[7] Dungey, Mardi, and Renée Fry. "A Multi-Country Structural VAR Model." *Working Papers in Trade and Development* 2001/04 (November 2000), Research School of Pacific and Asian Studies, Australian National University.

[8] Dungey, Mardi, and Adrian Pagan. "A Structural VAR Model of the Australian

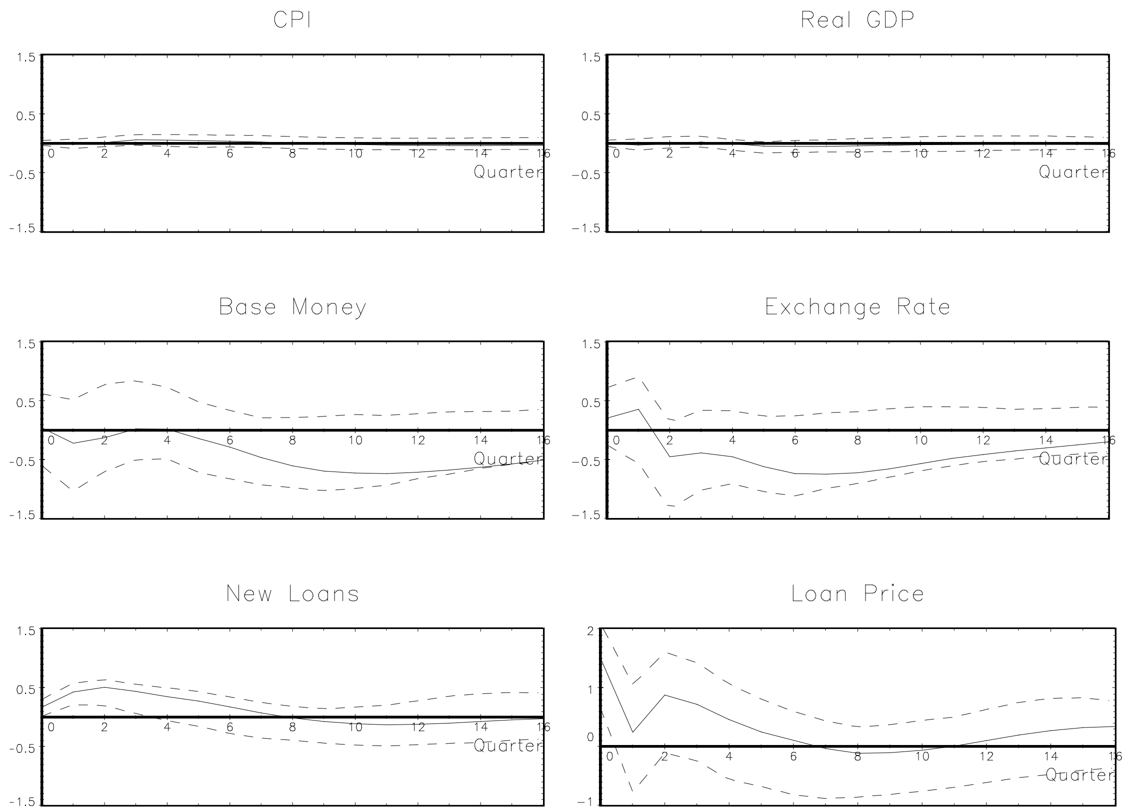

Figure 11: Robustness Check 5 (the Unrestricted Model).
R is the fifth variable.

Economy." *Economic Record* 76 (December 2000), 321-342.

[9] Eichenbaum, Martin. "Interpreting the Macroeconomic Time Series Facts: the Effects of Monetary Policy: Comments." *European Economic Review* 36 (June 1992), 1001-1011.

[10] Gertler, Mark, and Simon Gilchrist. "The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence." *Scandinavian Journal of Economics* 95 (1993), 43-64.

[11] Kashyap, Anil K., and Jeremy C. Stein. "Monetary Policy and Bank Lending." In *Monetary Policy,* edited by N. Gregory Mankiw, pp.221-256. Chicago: University of Chicago Press, 1994.

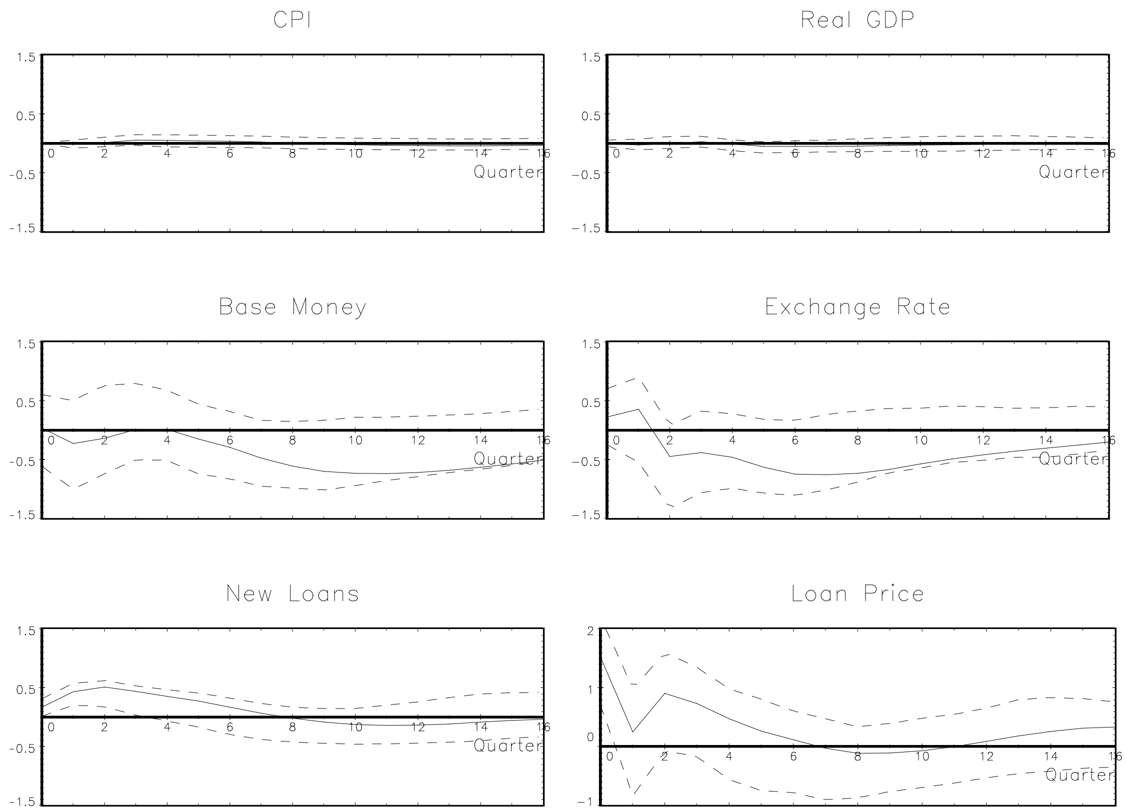

Figure 12: Robustness Check 6 (the Unrestricted Model).
R is the sixth variable.

[12] Kashyap, Anil K., and Jeremy C. Stein. "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy? " *American Economic Review* 90 (June 2000), 407-428.

[13] Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance." *American Economic Review* 83 (March 1993), 78-98.

[14] Kim, Soyoung, and Nouriel Roubini. "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR Approach." *Journal of Monetary Economics* 45 (June 2000), 561-586.

[15] MacFarlane, Ian J. "Australian Monetary Policy in the Last Quarter of the Twentieth

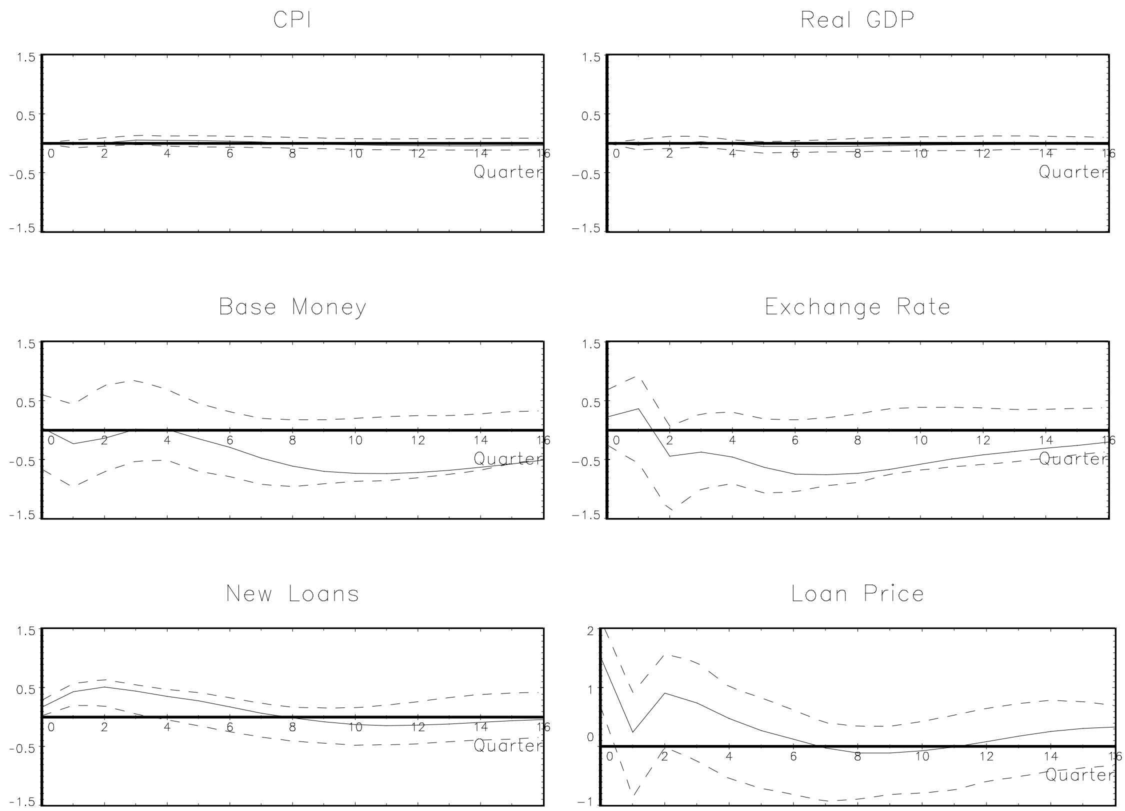

Figure 13: Robustness Check 7 (the Unrestricted Model).

R is the seventh variable.

Century." *Economic Record* 75 (September 1999), 213-224.

[16] Romer, Christina D., and David H. Romer. "New Evidence on the Monetary Transmission." *Brookings Papers on Economic Activity* 1 (1990), 149-213.

[17] Rudebusch, Glenn D. "Do Measures of Monetary Policy in a VAR Make Sense?" *International Economic Review* 39 (November 1998), 907-931.

[18] Runkle, David E. "Vector Autoregressions and Reality." *Journal of Business and Economic Statistics* 5 (October 1987), 437-449.

[19] Sims, Christopher A. "Interpreting the Macroeconomic Time Series Facts: the Effects of Monetary Policy." *European Economic Review* 36 (June 1992), 975-1000.

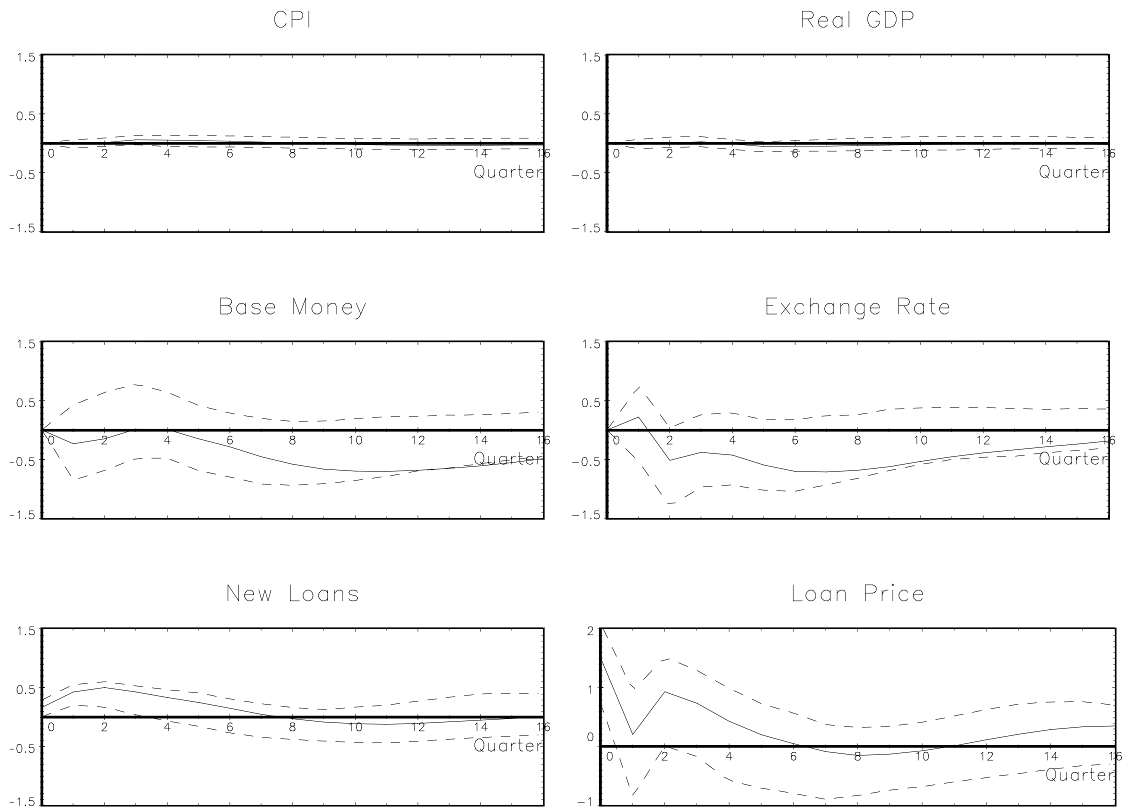

Figure 14: Robustness Check 8 (the Unrestricted Model).

R is the ninth variable.

[20] Sims, Christopher A. "Do Measures of Monetary Policy in a VAR Make Sense?: Comment." *International Economic Review* 39 (November 1998), 933-941.

[21] Suzuki, Tomoya. "Is the Lending Channel of Monetary Policy Important in Australia? " *Working Papers in Economics and Econometrics* 400 (September 2001), School of Economics, Australian National University.

[22] Tallman, Ellis W., and Nargis Bharucha. "Credit Crunch or What? Australia Banks during the 1986-93 Credit Cycle. " *Economic Review* (Third Quarter 2000), Federal Reserve Bank of Atlanta, 13-33.

[23] Toda, Hiro Y., and Taku Yamamoto. "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes." *Journal of Econometrics* 66 (April 1995), 225-

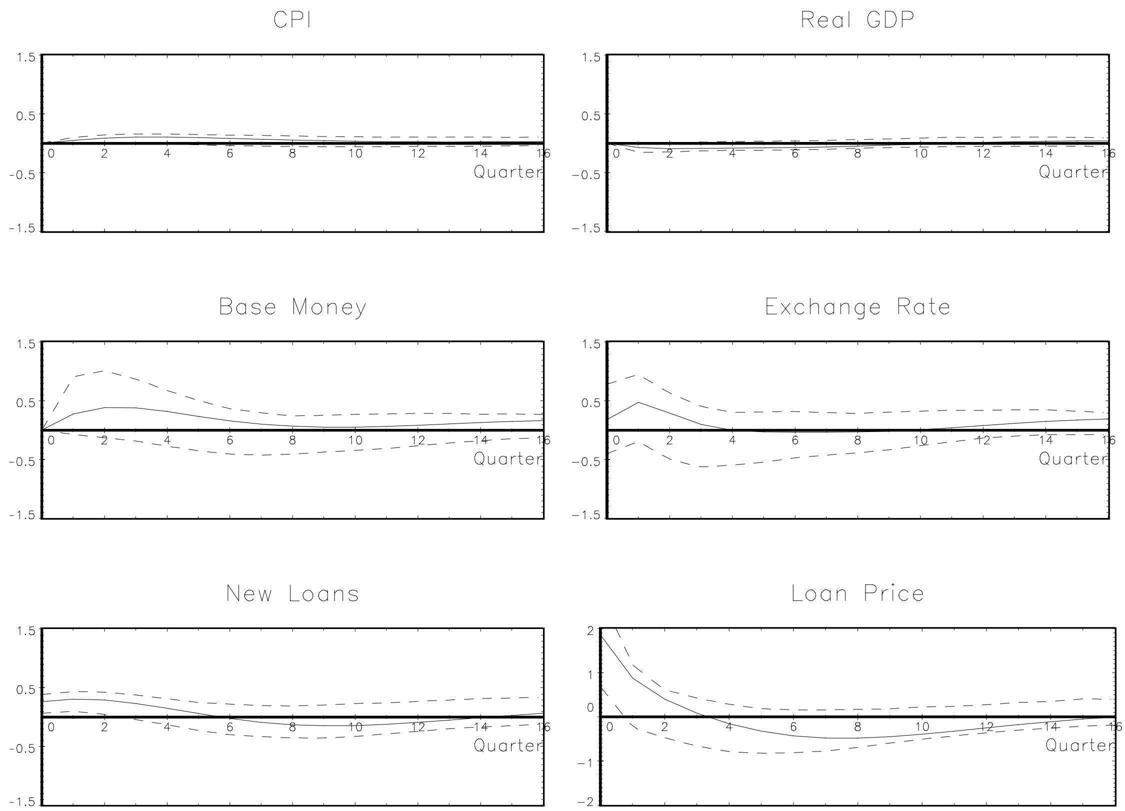

Figure 15: Robustness Check 9 (the Unrestricted Model).

The number of lags is 1.

250.

[24] Ueda, Kazuo. "A Comparative Perspective on Japanese Monetary Policy: Short-Run Monetary Control and the Transmission Mechanism." In *Japanese Monetary Policy,* edited by Kenneth J. Singleton, pp.7-29. Chicago: University of Chicago Press, 1993.

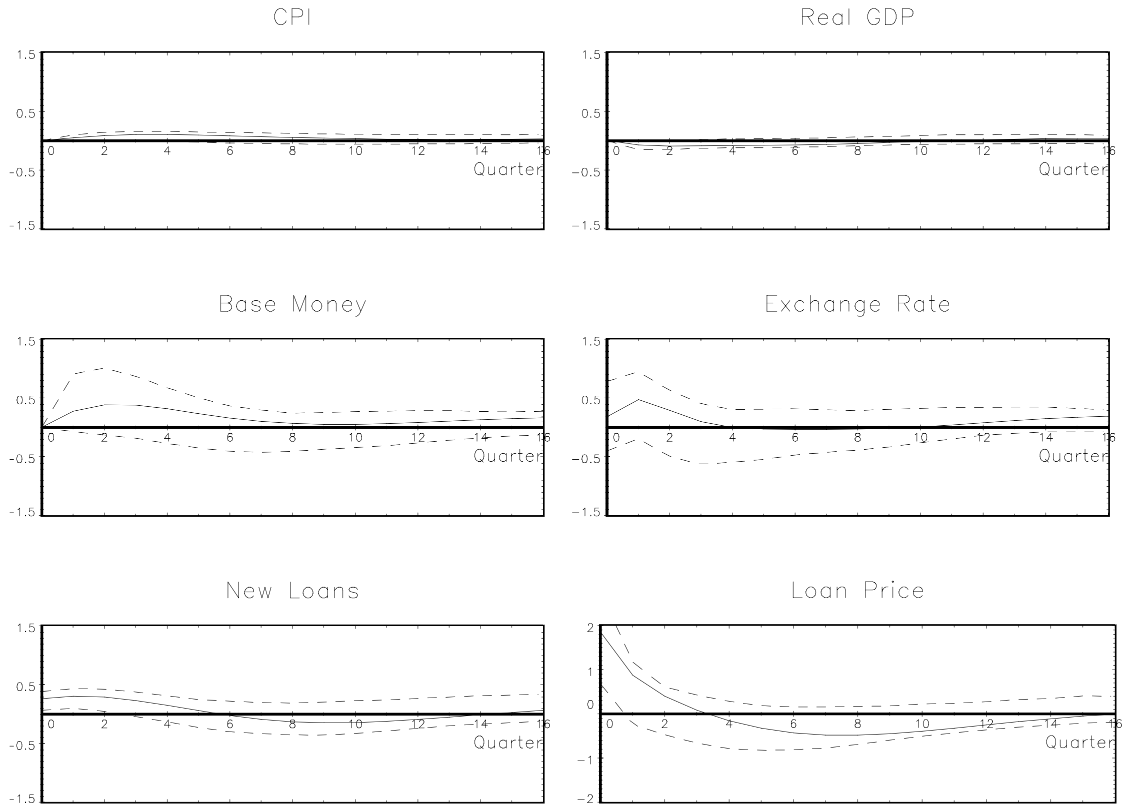

Figure 16: Robustness Check 10 (the Unrestricted Model).

The number of lags is 3.

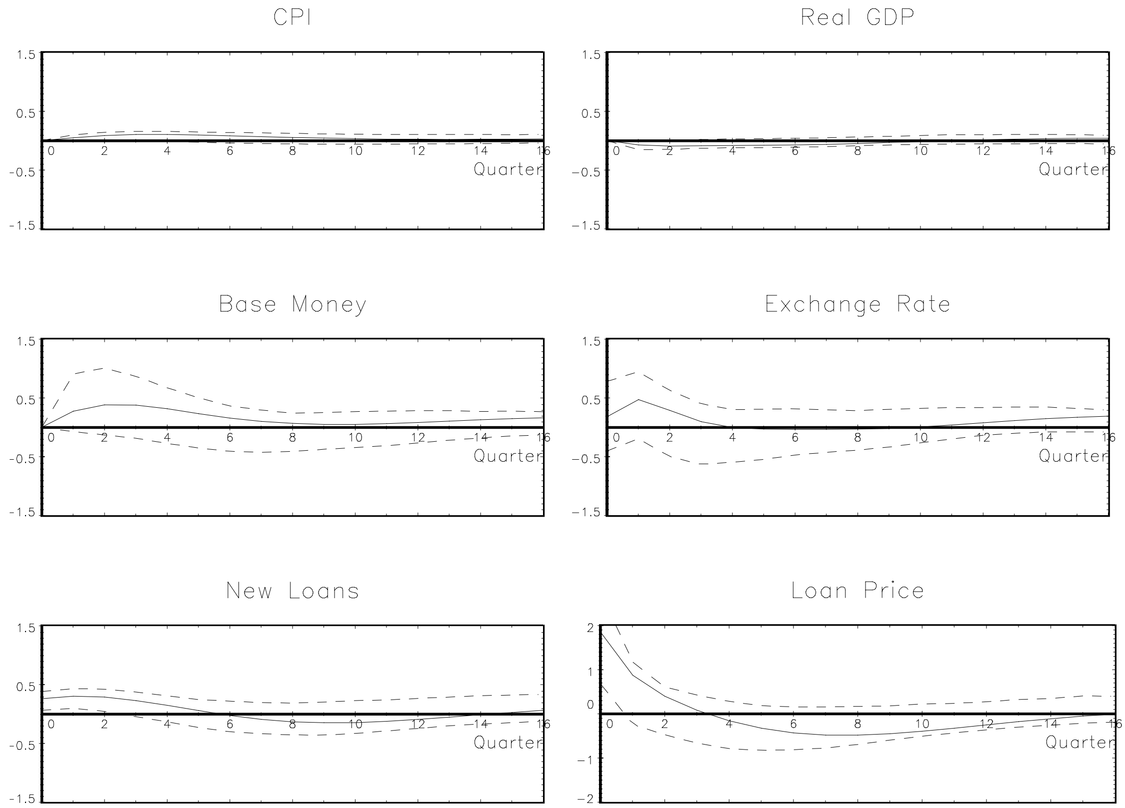

Figure 17: Robustness Check 11 (the Unrestricted Model).

The number of lags is 1.