RESEARCH DISCUSSION PAPER

AN EMPIRICAL MODEL OF AUSTRALIAN INTEREST RATES, EXCHANGE RATES AND MONETARY POLICY.

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RDP 9009

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Research Discussion Paper
9009

November 1990

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Reserve Bank of Australia

We are grateful to colleagues at the RBA for helpful comments. Any errors are ours alone. The views expressed herein are those of the authors and do not necessarily reflect the views of the Reserve Bank of Australia.

ABSTRACT

In this paper we use daily data to examine the relationships between the unofficial cash rate, the $A/$US exchange rate and other interest rates. In particular, we investigate whether any change in these relationships occurred after October 1987. Amongst other results, we find that in the period January 1985 to October 1987, shocks to the exchange rate and expected inflation led to a significant monetary policy reaction, but that in the period October 1987 to January 1990 this reaction was much less prominent. The response of the exchange rate to shocks in expected inflation also appears to have significantly changed in the later period, being far more responsive than was earlier the case.

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AN EMPIRICAL MODEL OF AUSTRALIAN INTEREST RATES, EXCHANGE RATES AND MONETARY POLICY.

Jerome Fahrer and Lynne-Ellen Shori

1. INTRODUCTION

Ever since the collapse of the Bretton Woods regime of quasi-fixed exchange rates in the early 1970's, the relationship between interest rates and exchange rates has been subject to a great deal of theoretical and empirical scrutiny. While the literature is now voluminous, one general theme has emerged: single equation structural models of exchange rate determination, which include interest rates as exogenous regressors, are abysmal failures when confronted with the data.[1]

Irrational (i.e. not profit-maximizing) behaviour by participants in the foreign exchange market, non-linearities in the structural relationships, and the existence of amorphous risk premia have all been advanced as potential reasons to account for these failures. As significant as these explanations might be, we believe that a more fundamental influence is at work, viz. the policy reaction of the monetary authorities.

For example, while a simple portfolio balance model predicts that a decrease in domestic interest rates will depreciate the exchange rate, such a depreciation might also elicit a tightening of monetary policy, which will increase interest rates. In other words, the

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[1] See Macdonald (1988) and Meese (1990) for a review of the theory and evidence on floating exchange rates.

relationship between interest rates and exchange rates is simultaneous, and single equation estimation of the parameters in an exchange rate equation is likely to result in biased and inconsistent estimates. A further complication arises from the fact that the direction of the relationship running from interest rates to exchange rates depends on the source of the change in the interest rates. For example, if nominal interest rates increase because inflation is expected to increase, the exchange rate will probably depreciate, contrary to the predictions of the portfolio balance model.

There are several approaches that researchers can take in response to these problems. One is to attempt to build structural models in which exchange rates and interest rates (including policy instruments) are determined endogenously.[2] Another is to eschew structural models, and to estimate reduced forms. We choose the latter method of investigation in this paper.

Specifically, we estimate a five-equation vector autoregression using the following variables: the $A/$US exchange rate, the unofficial cash rate, the Australian 10 year bond rate, the United States federal funds rate, and the United States 10 year bond rate. The U.S. variables are included because the international mobility of capital means that domestic interest rates are linked, in theory, to foreign interest rates, as is the exchange rate. (The extent and nature of those linkages are, of course, empirical questions.)

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[2] One subset of this approach is the voluminous literature on money supply announcements, which attempts to model the reaction of the financial markets in response to the latest information on the money supply, conditional on an expected policy response to that information. For a recent contribution, see Strongin and Tarhin (1990).

Using this model, we can then examine the effects of unanticipated shocks to each of these variables on the exchange rate and interest rates. The advantage of using a reduced form model is that we can do so without having to specify any structural relationships.

The rest of the paper is organized as follows: Section 2 presents some stylized facts; Section 3 discusses the VAR methodology and its application to this problem. Section 4 contains the results and Section 5 contains some concluding remarks.

2. SOME STYLIZED FACTS

Figures 1a to 1d show bivariate relationships for five variables over the period January 1985 through January 1990. The data are monthly averages of the daily data that we use in the formal analysis in this paper.

Figure 1a shows the exchange rate and the unofficial cash rate. The exchange rate is defined as the number of Australian dollars per U.S. dollar, so an increase in the exchange rate is a depreciation of the Australian currency. The unofficial cash rate is the instrument of monetary policy. When monetary policy is being tightened, for example, the Reserve Bank sells a quantity of government securities in the money market sufficient to let rates on overnight cash reach their new, higher, desired level. These higher rates are soon transmitted to yields on financial instruments of longer maturities.[3]

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[3] The unofficial cash rate is preferred in this context to the official cash rate since the latter can be affected by banks' PAR requirement, which is unrelated to monetary policy.

Figure 1a
The $A/$US and the Australian Unofficial Cash Rate

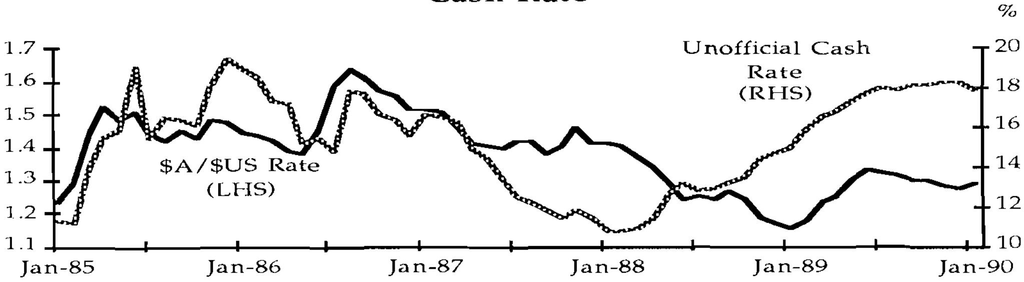

Figure 1b
The Federal Funds Rate and the Australian Unofficial Cash Rate

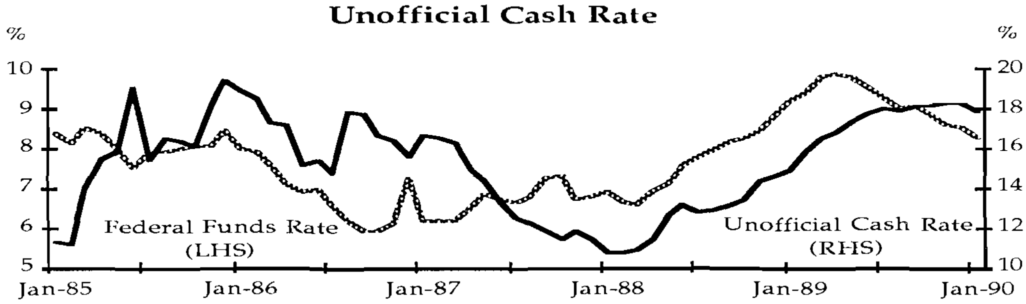

Figure 1c
The Australian Bond Rate and the U.S. Bond Rate

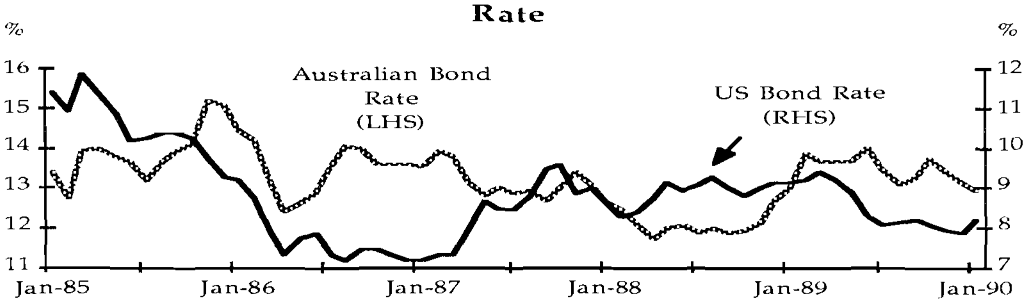

Figure 1d
The $A/$US and the Australian Bond Rate

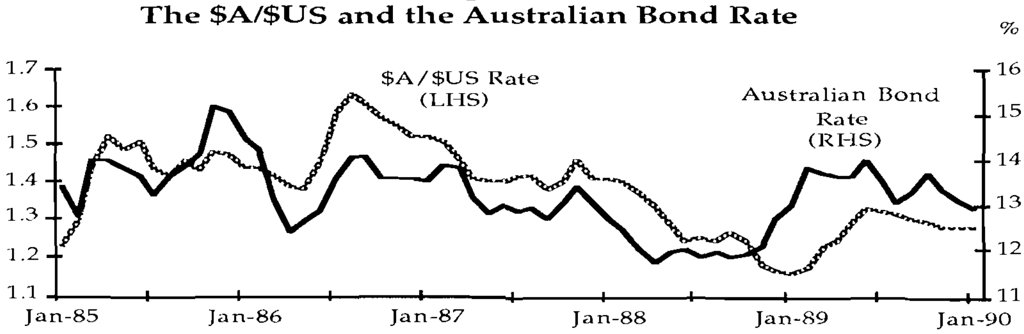

Figure 1a indicates that up to about October 1987, a depreciation (appreciation) of the exchange rate was clearly associated with a tightening (easing) of monetary policy. This correlation might be reasonably interpreted as reflecting the reaction of monetary policy to developments in the foreign exchange market, possibly due to the inflationary implications of currency depreciation. After October 1987, however, this relationship becomes much more tenuous, indicating, perhaps, that monetary policy was not so tightly focused on the exchange rate.[4]

Figure 1b compares the cash rate with the principal instrument of monetary policy in the United States, the federal funds rate. The ability of each country to select its own inflation rate, via an appropriate monetary policy, has long been cited as one of the major advantages of a flexible exchange rate system. However, the conditions under which complete independence occurs (no international capital mobility) are inapplicable to modern economies. While it is clear that a flexible exchange rate affords more independence than a fixed rate, the extent of that independence is an empirical issue. Figure 1b shows that the cash rate and federal funds rate have demonstrated a general tendency to move together. The seems to be particularly the case since the end of October 1987. This does not mean, of course, that changes to the stance of monetary policy in Australia have been caused by corresponding changes in the United States; the coincidental changes in policy might simply reflect simultaneous responses to similar pressures.

At the other end of the yield curve, Figure 1c compares the

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[4] This change has been noted by other commentators e.g. Macfarlane and Tease (1989).

Australian 10 year bond rate with the U.S. 10 year bond rate. We interpret these variables as proxies for the expected rate of inflation in each country; an increase in expected inflation is reflected in a higher bond rate. As figure 1c shows, the relationship between the two bond rates is ambiguous. At times they move together, possibly reflecting the transmission of inflationary expectations from the United States to Australia; at other times the relationship is weak, indicating that different factors are dominant in determining expectations of future inflation in Australia.

One such factor could be the stance of monetary policy. Figure 1d shows that depreciations in the exchange rate appear to be clearly associated with increases in the bond rate, and vice versa. Tighter monetary policy, for instance, might well decrease expected inflation and appreciate the exchange rate.

Figures 1a-1d suggest some interesting hypotheses, but such descriptive material has obvious limitations as an analytical tool. The remainder of the paper is devoted to a more rigorous statistical examination of the data and the hypotheses outlined in this Section.

3. THE VAR METHOD

A vector autoregression (VAR) is a dynamic system of reduced form equations. VARs were popularized by Sims (1980), as a reaction to what he saw as the "incredible" restrictions necessary to identify structural models. The intended purpose of VARs was to provide a framework to study the historical dynamics of an economy, without imposing any prior structure on the problem at hand. The two principal tools for analysing these dynamics are impulse responses and variance decompositions. These are based on the moving average representation of the VAR.

Consider the following vector autoregressive representation[5]

$$y_t = b(L)y_t + u_t \tag{1}$$

where y_t is a stationary stochastic process and L is the lag operator. Under suitable regularity conditions (1) can be written as a vector moving average representation

$$y_t = a(L)u_tE(u_t) \tag{2}$$

where the coefficients of the matrix a(L) are functions of the estimated autoregressive parameters b(L). a(L) at lag 0 is the identity matrix. u_t is the forecast error (innovation) of the autoregression given information at t - 1.

The impulse response is the dynamic effect on the system of a particular shock. For example, given a shock to the federal funds rate we can then trace, over time, the effects on the other variables in the system. The variance decomposition of the k-step ahead forecast is the proportion of the total forecast variance of one component of y_{t+k} associated with shocks to the moving average representation of another variable.

While a VAR is a set of reduced form equations, the early view that it is a mere atheoretical representation of the data is now known to be incorrect. Since, in general, the innovations u_t are correlated with each other, the effects on the system of a

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[5] This exposition is based on Runkle (1987).

particular shock are difficult to interpret. The innovations therefore need to be orthogonalized; however, this orthogonolization imposes structure on the model. The model is then no longer atheoretical, and so the impulse responses stemming from the model are conditional on the structure that has been imposed.[6]

Typically, orthogonalization is achieved via the Choleski decomposition, which (implicitly) places a recursive structure on the model. An n variable model has n! possible recursive structures. Valid use of the Choleski procedure therefore obligates us to make an explicit judgement about which of these structures is most appropriate. We choose the following - the variables are placed in the order: federal funds rate, U.S. 10 year bond rate, exchange rate, cash rate, Australian 10 year bond rate.

In other words, we take it to be (approximately) the case that the federal funds rate and the U.S. 10 year bond rate affect Australian interest rates and the $A/$US exchange rate contemporaneously, but not *vice versa*. This seems to us to be a reasonable assumption. The ordering of the variables within each country bloc is more problematic, and there is no fully satisfactory way to resolve this difficulty.[7] In any case, with high frequency data, the issue of which variables are contemporaneously exogenous to each

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[6] Cooley and Leroy (1985) provide an extensive discussion of this and related issues.

[7] This dilemma has led to the development of structural VARs e.g. Blanchard (1989) which resolve the issue by specifying explicit structural models in innovations of variables, and avoiding the Choleski method altogether. However, Keating (1990) argues that the exclusion restrictions used to identify structural VARs can yield inconsistent parameter estimates.

other is probably of only minor importance.

We use daily data with the exchange rate measured as an average of buy and sell rates at 4 p.m., Eastern Australian time. Domestic interest rates are recorded at 11 a.m., the federal funds rate and U.S. bond rate are recorded at the close of trading in the previous day in the United States. Deleted from the sample were days when there was no trading in Australia. The data come from the Reserve Bank of Australia's database, and are available from the authors on request.

4. RESULTS

a. Testing for a Structural Break

The first task was to confirm that a structural break did in fact take place around October 1987. This required us to choose a day in that month as our postulated break point. Quite arbitrarily, we chose October 20, giving 710 and 575 observations in the first and second periods, respectively.[8] We tested for structural stability by estimating unrestricted and restricted VAR systems, the restrictions being that the parameter values in the VAR did not change at this break point.

The unrestricted VAR takes the form $Y = (B + AD)X$, where D is

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[8] This, of course, was the date of the stock-market crash. We are emphatically *not* saying that the crash was the cause of any structural break, particularly in the monetary policy reaction function. What is likely, however, is that the post-crash depreciation of the exchange rate was the first occasion in which such a depreciation did not lead to a policy-induced increase in interest rates.

a matrix of dummy variables, $[d_{ij}] = 1$ from October 21 1987 onwards. Each equation contains 10 lags of each of the variables, plus a constant. The test of structural stability is the test that the coefficients a_{ij} are jointly equal to zero. The test was conducted by constructing the statistic

$$Z = T^{*}\ln(|\Sigma_1| / |\Sigma_2|) \tag{3}$$

where T is the number of observations in the full sample and $|\Sigma_1|$ and $|\Sigma_2|$ are the determinants, respectively, of the covariance matrices of the restricted and unrestricted VAR systems estimated over the entire sample period.

Z is distributed as Chi-square with degrees of freedom equal to the number of restrictions; in this case, with five equations, five variables and 10 lags, there are 255 restrictions. Our estimated value of Z is 1268, which exceeds the five percent critical value of 293, and so we reject the hypothesis of structural stability.

Given the existence of a structural break, we then estimated two VARs. The sample periods were January 2 1985 to October 20 1987 and October 21 1987 to January 30 1990, respectively. We do not report the parameter estimates since they are of no intrinsic interest. They are available on request.

b. Impulse Responses

Figures 2a to 4e show impulse response functions of the domestic variables in response to a one standard deviation shock to each of the variables. These are calculated over a 90 day horizon. Each figure contains two lines, the dashed line refers to the first period and the solid line refers to the second. The vertical axes show the responses of the variables to the various shocks, while the horizontal axes denote elapsed time, in days.[9] To facilitate comparisons, the impulse responses in each figure have been scaled so that they reflect shocks of the same size.

Consider first Figure 2c, which shows the response of the cash rate to an unexpected depreciation of the exchange rate. The impulse responses confirm the hypothesis made in Section 2. In the pre-October 1987 period, an upward shock to the exchange rate (remembering that such a shock is a depreciation of the currency) elicits a prolonged tightening of monetary policy; this policy response is absent in the latter period.

A tightening of U.S. monetary policy (Figure 2a) appears to lead to a tightening of domestic monetary policy, especially after October 1987. We do not, however, infer from this result that shocks to the federal funds rate caused changes in the cash rate, in a structural sense, since at no time during this period did the Reserve Bank's policy reaction for monetary policy ever include a "shadowing" of the federal funds rate. A more plausible explanation is that changes in U.S. monetary policy led to changes in other variables which, over time, led to changes in the cash rate.

This case highlights some of the potential pitfalls of this type of analysis. Notwithstanding the caveats we make in Section 3 (which we consider to be empirically unimportant) we should remember that the VARs are reduced forms, and so the impulse response functions reflect only causality of the Granger type, not

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[9] In the case of the exchange rate, the responses are for the natural logarithm of the exchange rate.

Cash rate responses to one standard deviation shocks

----Period one (2/1/85 - 20/10/87) ___Period two (21/10/87 - 30/1/90)

Figure 2a: A 0.0019 shock to the U.S. federal funds rate.

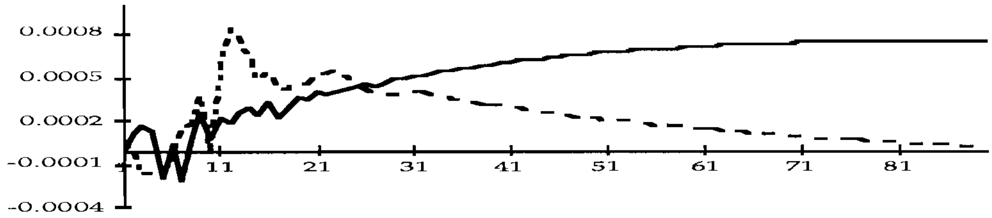


Figure 2b: A 0.0006 shock to the U.S. bond rate.

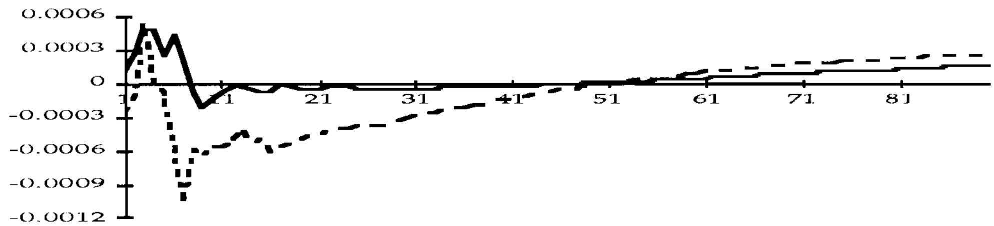


Figure 2c: A 0.0068 shock to the exchange rate.

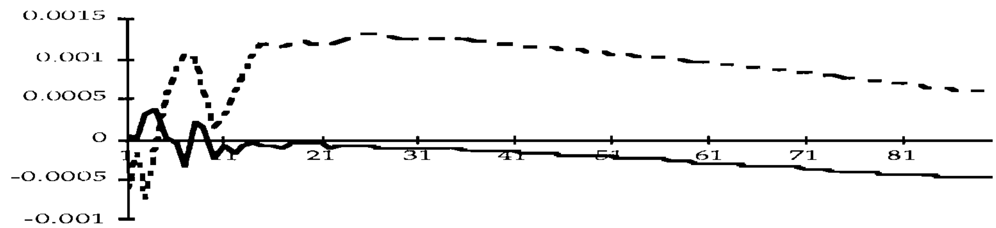


Figure 2d: A 0.0038 shock to the cash rate.

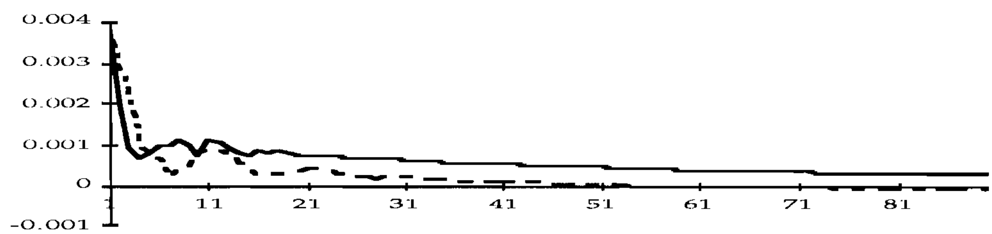
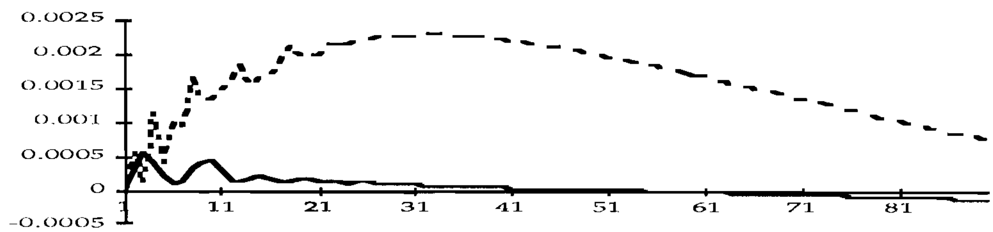


Figure 2e: A 0.0014 shock to the Australian bond rate.



Days after initial shock.

Exchange rate responses to one standard deviation shocks

----Period one (2/1/85 - 20/10/87)

___Period two (21/10/87 - 30/1/90)

Figure 3a: A 0.0019 shock to the U.S. federal funds rate.

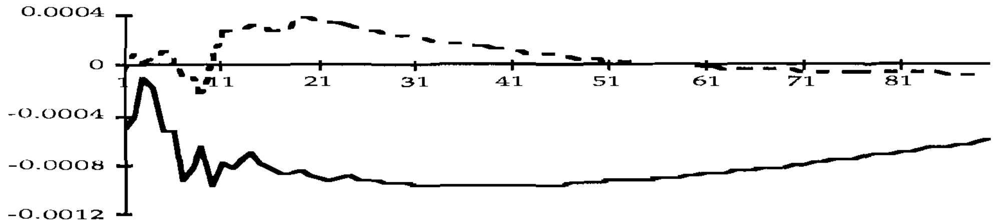


Figure 3b: A 0.0006 shock to the U.S. bond rate.

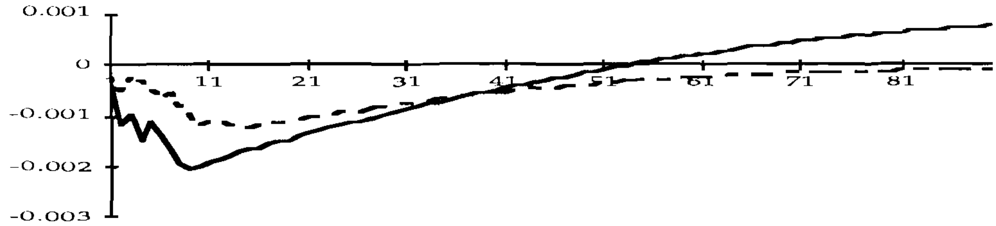


Figure 3c: A 0.0068 shock to the exchange rate.

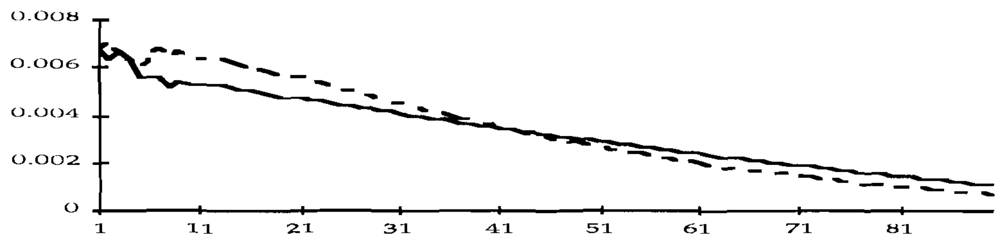


Figure 3d: A 0.0038 shock to the cash rate.

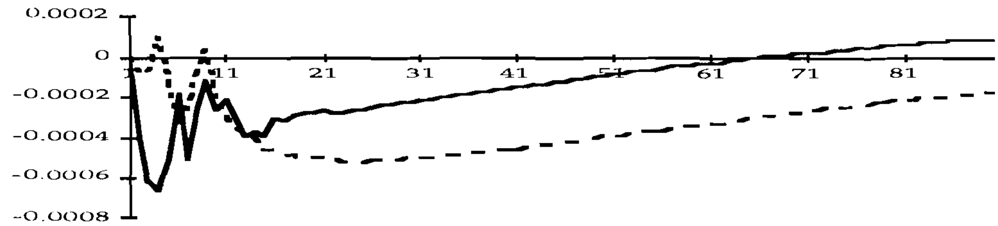
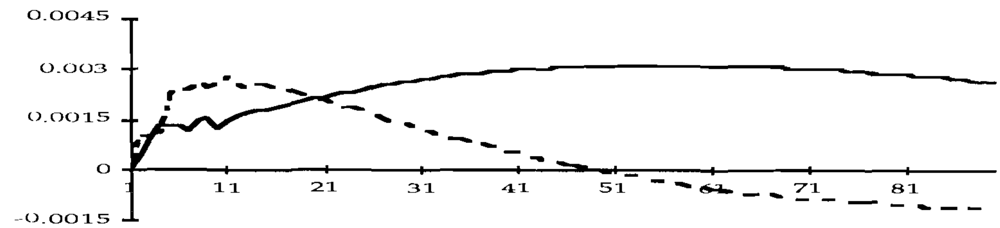


Figure 3e: A 0.0014 shock to the Australian bond rate.



Days after initial shock.

Australian bond rate responses to one standard deviation shocks

----Period one (2/1/85 - 20/10/87)　　___Period two (21/10/87 - 30/1/90)

Figure 4a: A 0.0019 shock to the U.S. federal funds rate.

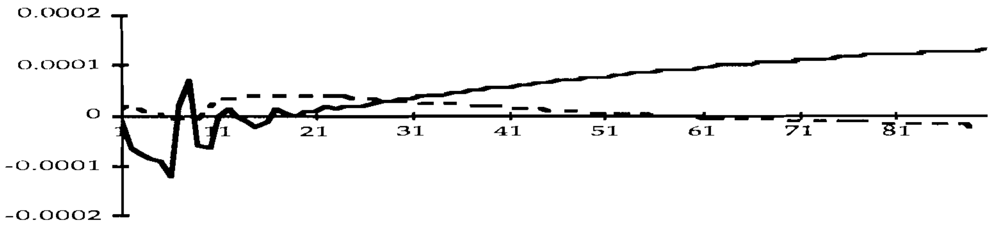


Figure 4b: A 0.0006 shock to the U.S. bond rate.

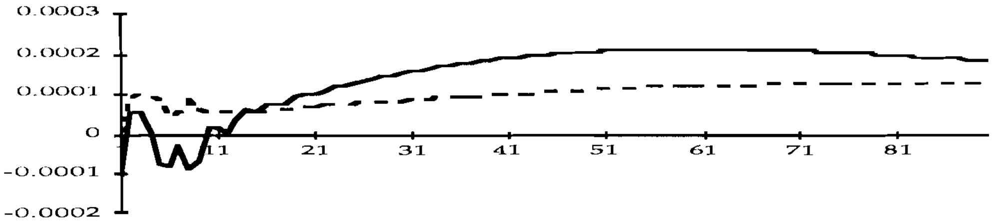


Figure 4c: A 0.0068 shock to the exchange rate.

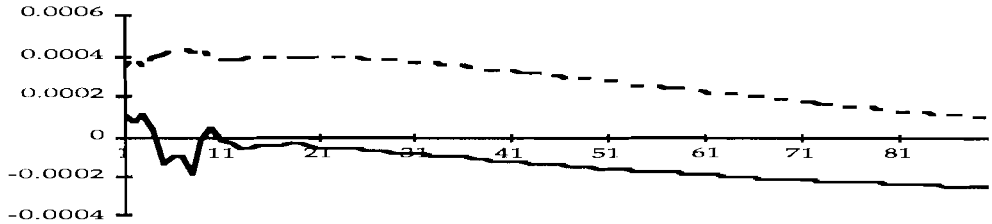


Figure 4d: A 0.0038 shock to the cash rate.

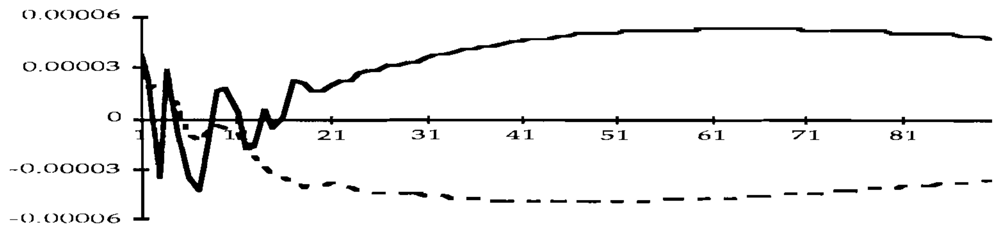
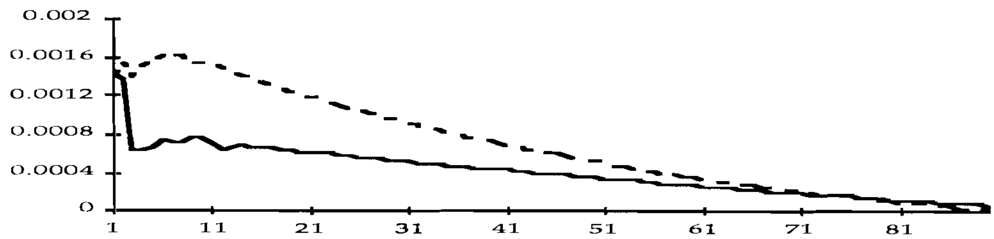


Figure 4e: A 0.0014 shock to the Australian bond rate.



Days after initial shock.

structural causality. Our results can, however, be interpreted as being consistent with a certain structural model, for which we might have some priors. For example, Figure 2c is certainly consistent with the notion that monetary policy did in fact react to developments in the foreign exchange rate in the earlier period. On the other hand, the causality that is apparent from the federal funds rate to the cash rate remains something of a structural puzzle.

Figure 2e shows that an upward shock to inflationary expectations (i.e. a rise in the Australian bond rate) resulted in a tightening of policy in the pre-October 1987 period, but not afterwards. (One reason for this might be the tendency of this shock to be more sustained in the first period; see Figure 4e.) This result can also be interpreted as indicating that downward shocks to inflationary expectations led to a more substantial easing of monetary policy in the first period than in the second. Shocks to inflationary expectations in the United States, on the other hand do not appear to have had much of an effect on Australian monetary policy.

To summarize, the nature of the Australian monetary policy reaction function appears to have changed in the following way after October 1987. Much less emphasis has been placed on innovations to inflationary expectations, and on developments in the foreign exchange market. Of course, this might simply reflect the fact that there have been no exchange rate "crises" since October 1987 which have necessitated a monetary policy reaction, and we do not rule out such a reaction in the future.

Figures 3a-3e show the impulse responses of the exchange rate. Shocks to U.S. monetary policy appear to have had negligible effects on the exchange rate in the first period; in the second period, the exchange rate appreciates in response to a tightening of policy in the United States, and can therefore be expected to depreciate to its equilibrium value of zero at some future time. This is consistent with the sustained increase in the cash rate that results from this shock since, due to the arbitrage of domestic and foreign asset returns, domestic interest rates will exceed foreign interest rates during this period of adjustment.

Shocks to U.S. inflationary expectations lead to an appreciation of the exchange rate, while tighter monetary policy in Australia leads to a sustained exchange rate appreciation in the pre-October 1987 period and to a somewhat less sustained appreciation in the later period. However, while a cash rate shock has the expected effects in terms of direction, the quantitative effect is very small. On the other hand, a shock to inflationary expectations has a very large effect on the exchange rate, especially post-October 1987.

As a matter of interpretation, we should emphasize that these results do not imply that monetary policy was less responsive, in some sense, to inflationary pressures after October 1987. In fact, the opposite conclusion is warranted. The results are consistent with the following interpretation of events: a downward shock to inflationary expectations is followed by a larger appreciation in the second period than in the first because, after October 1987, this shock did not lead to an easing of monetary policy.

The responses of the bond rate to the various shocks are shown in Figures 4a-4e. What stands out in these figures is the apparent insensitivity of the bond rate to innovations in the other variables. This suggests that inflationary expectations in Australia are deeply entrenched and not much affected - at least in the short term - by surprises in domestic monetary policy or developments in international financial markets.

Finally, we note that 95 per cent confidence intervals indicate that the responses, in each period, of the cash rate to shocks in the exchange rate and Australian bond rate are significantly different from each other. These are calculated using Monte Carlo integration with 1000 replications. For the thirteen other comparative responses, the confidence intervals indicate that the different responses in each period were not statistically different from each other. These confidence intervals are shown in the Appendix.

c. Variance Decompositions

The information contained in the impulse response functions can be equivalently represented by variance decompositions i.e. the proportion of the variance of the forecast of any variable that is caused by shocks to all of the variables in the system. Generally speaking, the forecast variance of a variable which is essentially exogenous will be largely explicable by the variance of its own innovations. Since there is little feedback to it from the other variables, its forecast variance will be little affected by innovations in the other variables.

Tables 1-3 contain the variance decompositions of the cash rate, the exchange rate and Australian 10 year bond rate, respectively. The information in the tables confirms the inferences that we made from the impulse responses.

Table 1 shows that innovations to the exchange rate and the Australian bond rate comprise a much larger proportion of the forecast variance of the cash rate in the pre-October 1987 period,

Table 1
Variance Decompositions

Percentage of Unofficial Cash Rate Explained by Shock to

Period 1 (2/1/85 - 20/10/87)

Day	FF	USB	E	UCR	AB
1	0.0	0.1	0.5	99.3	0.0
10	0.8	2.6	2.6	92.3	1.8
30	9.9	4.0	11.1	65.1	9.9
60	10.3	3.3	18.7	49.4	18.3
90	9.7	3.5	21.5	45.2	20.2
180	9.4	5.8	21.6	43.4	19.8

Period 2 (21/10/87 - 30/1/90)

Day	FF	USB	E	UCR	AB
1	0.0	0.1	0.0	99.9	0.0
10	0.8	3.4	1.6	90.4	3.8
30	6.7	2.3	1.5	86.2	3.5
60	22.9	1.6	3.0	70.1	2.4
90	34.9	1.5	7.6	53.9	2.0
180	40.2	2.2	23.3	27.1	7.2

FF = federal funds rate, USB = U.S 10 year bond rate, E = \$A/\$US exchange rate, UCR = unofficial cash rate, AB = Australian 10 year bond rate.

Table 2
Variance Decompositions

Percentage of Exchange Rate Explained by Shock to

Period 1 (2/1/85 - 20/10/87)

Day	FF	USB	E	UCR	AB
1	0.0	0.2	99.8	0.0	0.0
10	0.1	1.5	95.5	0.3	2.6
30	0.8	3.4	90.4	2.0	3.3
60	0.7	3.4	89.8	3.4	2.8
90	0.7	3.3	89.0	3.8	3.1
180	0.8	3.3	87.7	3.9	4.3

Period 2 (21/10/87 - 30/1/90)

Day	FF	USB	E	UCR	AB
1	0.5	0.2	99.3	0.0	0.0
10	1.0	5.9	89.2	0.4	3.5
30	1.9	6.4	80.4	0.3	10.9
60	2.9	4.3	68.8	0.3	23.7
90	3.2	4.0	60.3	0.2	32.3
180	3.1	6.2	53.1	0.2	37.4

FF = federal funds rate, USB = U.S 10 year bond rate, E = \$A/\$US exchange rate, UCR = unofficial cash rate, AB = Australian 10 year bond rate.

Table 3
Variance Decompositions

Percentage of Australian 10 y Bond Rate Explained by Shock to

Period 1 (2/1/85 - 20/10/87)

Day	FF	USB	E	UCR	AB
1	0.1	0.0	16.2	0.5	83.2
10	0.1	0.9	17.9	0.1	81.0
30	0.6	1.0	21.6	0.7	76.0
60	0.6	2.5	25.8	1.7	69.3
90	0.6	4.7	26.6	2.5	65.7
180	1.2	8.3	25.2	2.9	62.5

Period 2 (21/10/87 - 30/1/90)

Day	FF	USB	E	UCR	AB
1	0.0	0.8	0.6	0.1	98.6
10	0.7	0.6	1.3	0.1	97.3
30	0.4	1.6	1.1	0.1	96.7
60	0.9	6.3	3.7	0.4	88.7
90	2.3	10.0	9.1	0.6	78.0
180	6.5	10.2	20.8	0.7	61.7

FF = federal funds rate, USB = U.S 10 year bond rate, E = \$A/\$US exchange rate, UCR = unofficial cash rate, AB = Australian 10 year bond rate.

especially over shorter time horizons in the case of the exchange rate. After 180 days in the second period, however, the exchangerate accounts for nearly one quarter of the forecast variance in the cash rate, indicating that while short term changes in the exchange rate during this time were less relevant, longer term effects were still important.

Innovations to U.S. monetary policy appear to have become much more important in the later period; after 180 days, they explain 40 per cent of the forecast variation in the cash rate. However, it is interesting to note that, in the short run, the federal funds rate explains very little of the forecast variance in the cash rate, which is consistent with our prior view that no structural causality runs from the federal funds rate to the cash rate.

Table 2 confirms that unexpected changes in monetary policy appear to have had little effect, in either period, on the exchange rate. However, innovations to the Australian bond rate (inflationary expectations) do seem to have had a significant effect on the path of the exchange rate after October 1987, consistent with the result that such shocks have not had a particularly large effect on the cash rate during this time.

Table 3 confirms our earlier conclusion that inflationary expectations in Australia seem to be very difficult to move. Even after 180 days (in both periods), over 60 percent of the forecast variance of the bond rate is explained by its own innovations. Innovations to the cash rate, however, have only a negligible effect. Exchange rate shocks appear to have had a significant effect on inflationary expectations the first period but not so much in the second period, except after 180 days. Innovations to inflationary expectations in the U.S. also seem to be of some significance, especially at longer time horizons.

5. CONCLUSIONS

Using a dynamic reduced form model, we have examined the relationships between Australian and U.S. interest rates, and the $A/$US exchange rate. On the basis of the evidence uncovered by this model, we make the following conclusions:

(i) In the period from January 1985 to October 1987, the principal reaction of domestic monetary policy was to unexpected changes in the exchange rate and expectations of future inflation. Subsequently, these influences became much less important.

(ii) unexpected changes in the expectations of future inflation have had a significant effect on the exchange rate, especially in the post October 1987 period. However, shocks to cash rates have had very little discernible effect on the exchange rate.

(iii) Consistent with (ii), inflationary expectations appear to be largely unaffected by innovations to monetary policy, even up to six months afterwards.

It is well-recognized that a monetary policy which is aimed at singularly reducing the rate of price inflation will be relatively costless only if inflationary expectations are reduced commensurately. Conclusion (iii) implies that, given the apparent stickiness of these expectations, the real costs of reducing the rate of inflation will be considerable, and will have to be factored into any benefit-cost calculus of such a policy.

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Appendix: Confidence Intervals

The following confidence intervals show 95 per cent confidence intervals for the difference between the period 1 (2/1/85 - 20/10/87) and period 2 (21/10/87 - 30/1/90) responses for each of the fifteen shocks reported in the paper. The solid line is the difference, while the distance between the dashed lines is the confidence interval, at each point in time.

95 % Confidence Intervals For the Difference Between the Cash Rate Responses

Figure A.1: Federal funds rate shock.

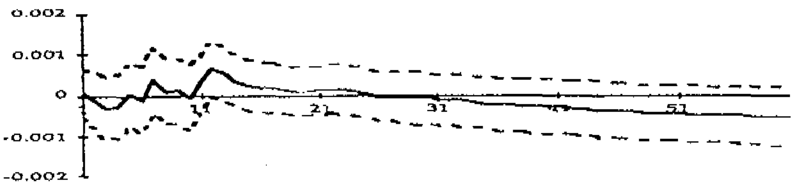


Figure A.2: U.S. bond rate shock.

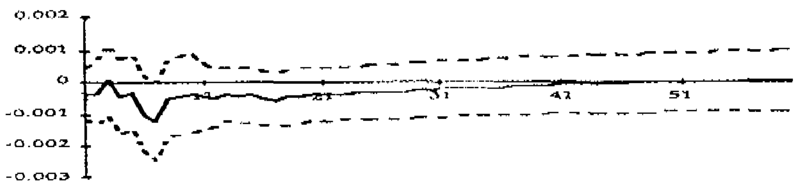


Figure A.3: Exchange rate shock.

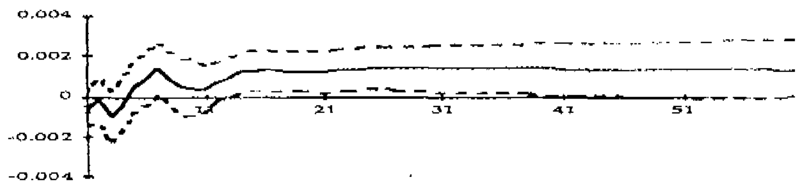


Figure A.4: Cash rate shock.

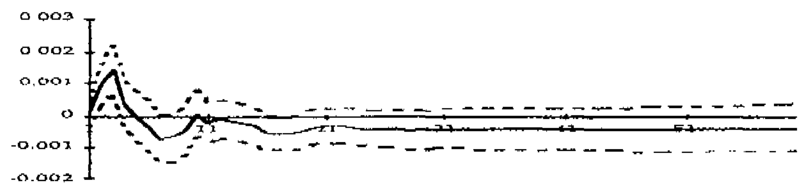
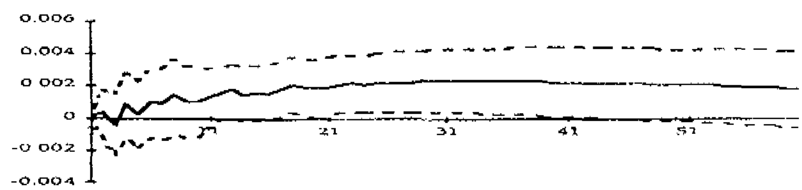


Figure A.5: Australian bond rate shock.



Days after initial shock.

95 % Confidence Intervals For the Difference Between the Exchange Rate Responses

Figure A.6: Federal funds rate shock.

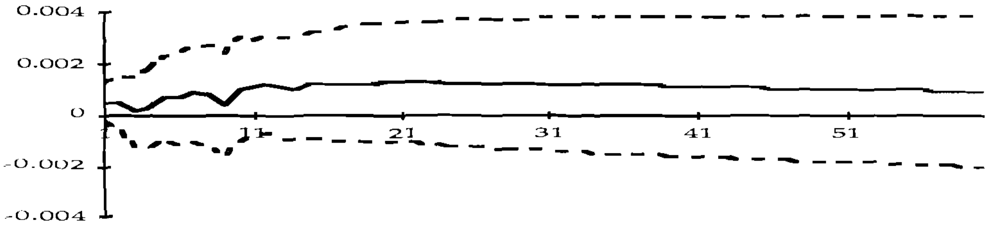


Figure A.7: U.S. bond rate shock.

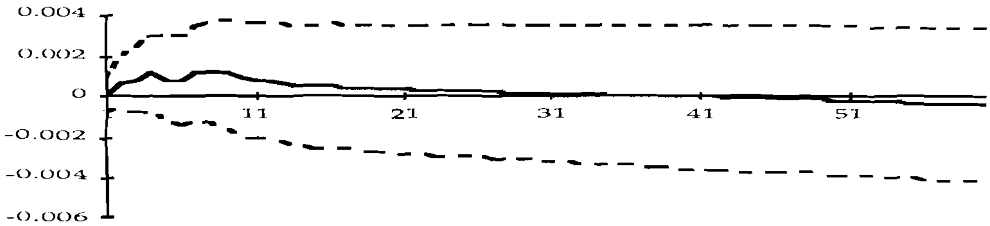


Figure A.8: Exchange rate shock.

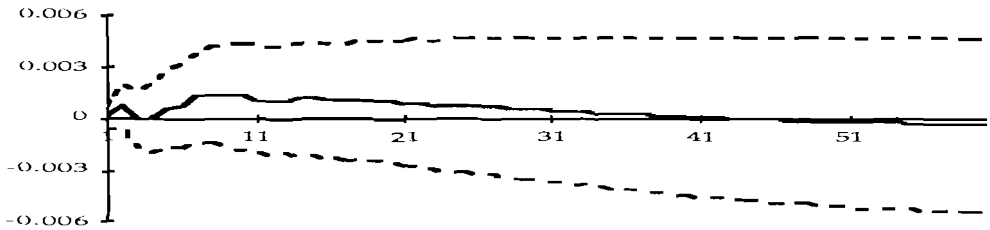


Figure A.9: Cash rate shock.

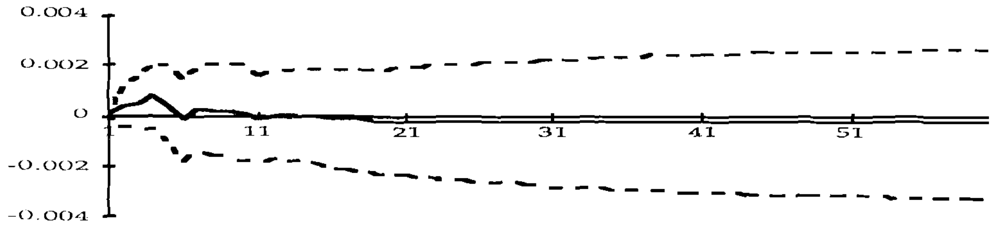
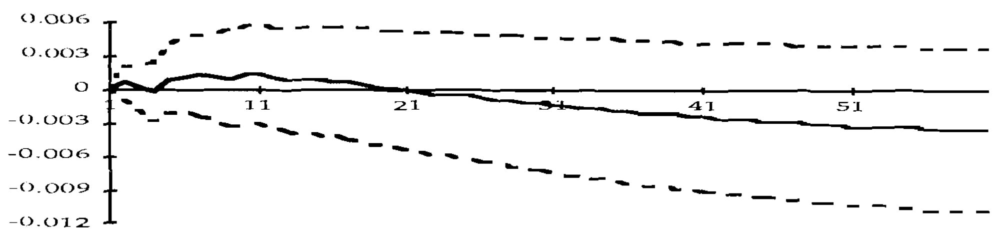


Figure A.10: Australian bond rate shock.



Days after initial shock.

95 % Confidence Intervals For the Difference Between the Australian Bond Rate Responses

Figure A.11: Federal funds rate shock.

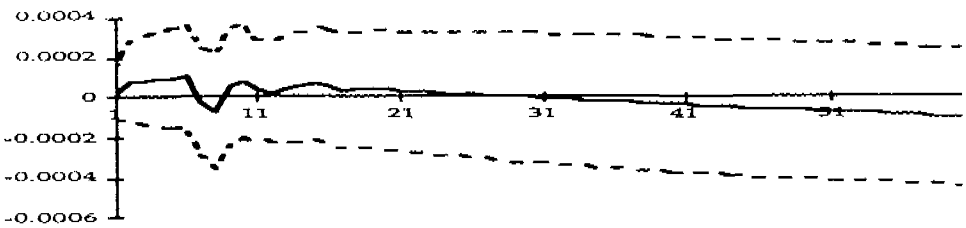


Figure A.12: U.S. bond rate shock.

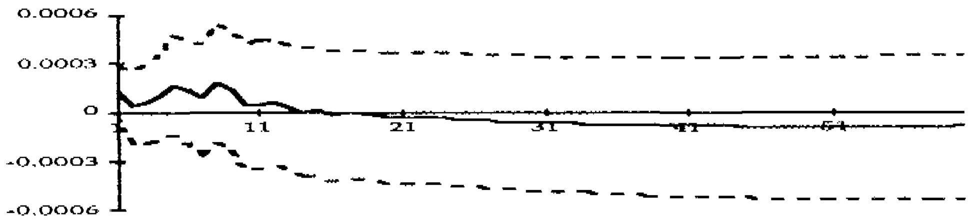


Figure A.13: Exchange rate shock.

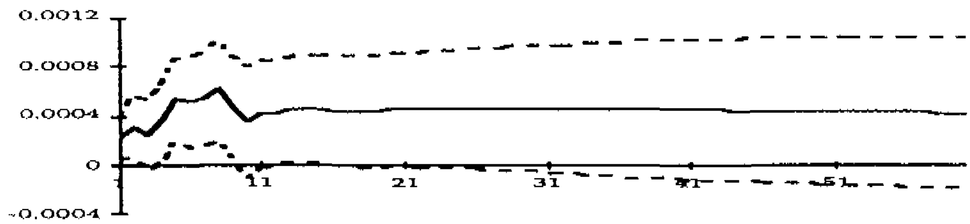


Figure A.14: Cash rate shock.

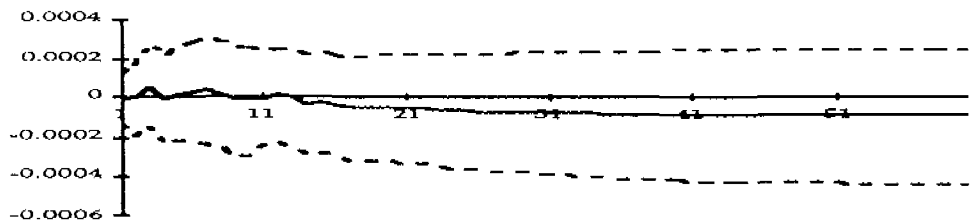
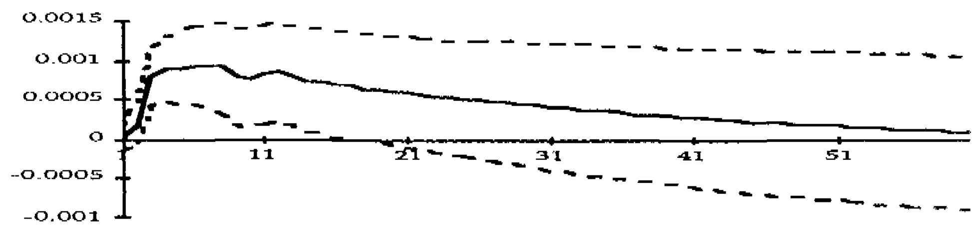


Figure A.15: Australian bond rate shock.



Days after initial shock.