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Long-term Interest Rates under Inflation Targeting: The New Zealand Experience

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ABSTRACT

One advantage cited for formal inflation targeting is that by anchoring inflationary expectations such a policy framework would aid in the pricing of long-term securities. Long -term interest rates would become less sensitive to temporary shocks to the economy including policy induced changes in short-term interest rates. This paper examines the experience in this regard of New Zealand, an early and strict inflation targeting country. As a frame of reference we compare the experience of New Zealand with those of Australia, a country with a more flexible inflation targeting regime, and the United States, which has not adopted inflation targeting.

JEL classification: E43; E52; E58
Key words: Inflation targeting; Monetary policy; Long-term interest rate.

1. INTRODUCTION

On December 19, 2008, the Reserve Bank of New Zealand announced its Policy Targets Agreement which set as the Bank's objective "to promote a growing, open and competitive economy." Price stability was to play "an important part in supporting this objective." The relegation of price stability to a supporting role marked either the end or a period of abeyance for the strict inflation targeting regime the Reserve Bank had followed since the Reserve Bank of New Zealand Act of 1989. The current world financial crisis and widespread economic downturn is likely to lead other central banks to reassess the advantages and disadvantages of inflation targeting.

One often-cited advantage of inflation targeting is that "with long-term inflationary expectations more firmly anchored, long-term interest rates might jump around a bit less, and businesses and investors might find it easier to draw up long-term contracts."[1] One reason for decreased volatility would be that with long-term inflationary expectations anchored by a credible inflation targeting regime, long-term rates would respond by less to monetary policy induced changes in short-term rates. This paper examines the experience of New Zealand to assess the effect of inflation targeting on the volatility of long-term interest rates and on the relationship between long-term interest rates and monetary policy.

The link between the response of long-term interest rates to changes in monetary policy and the anchoring of inflationary expectations has been an element in the debate in the United States over the desirability of moving to an inflation targeting framework. Ben Bernanke has argued that, "the apparently high sensitivity of long-term nominal interest rates to Fed actions suggests some uncertainty about the Fed's long-run inflation target."[2] Bernanke's statement is tied to Gurkaynak, Sack and Swanson's (2005) empirical results

[1] Rogoff, Kenneth, "A Case for Inflation Transparency," *Financial Times*, April 23, 2005, p. 13.
[2] Bernanke (2004), p. 166.

(which Bernanke cites) indicating that under current Federal Reserve procedures, "private agents' views of long-run inflation are not strongly anchored (p. 425)."

The study of the effects of policy-induced changes in short-term interest rates on long-term rates is then of interest for the question of whether inflation targeting *matters*. The evidence on this issue is mixed. Studies such as Ball and Sheridan (2005), Mishkin and Schmidt-Hebbel (2007), Dueker and Fischer (2006), and Levin, Natalucci and Piger (2004) suggest answers ranging between: "IT (inflation targeting) has played a role in anchoring inflationary expectations and in reducing inflation persistence [Levin, Natalucci and Piger (2004)]"; or "Thus on the heels of a decade of low global inflation, it has been hard to argue that formal inflation targets have led to any divergence between targeters and non-targeters in terms of inflation performance [Dueker and Fischer (2006)]." We consider a narrowly focused examination of one proposed advantage of inflation targeting.

2. THREE TYPES OF EVIDENCE

We begin with an examination of descriptive statistics on the behavior of interest rates in New Zealand prior to and after the adoption of inflation targeting in the Reserve Bank of New Zealand Act which was effective from the beginning of February 1990. In most OECD countries inflation moderated in the post-1990 period relative to the 1970s and 1980s. Thus a simple comparison of nominal interest rates pre- and post- the Reserve Bank Act is not informative. For this reason we compare the New Zealand experience with that of the United States, a country that did not adopt formal inflation targeting.

For descriptive statistics and some other measures considered, we also compare New Zealand with Australia. Australia is an economy with more in common with New

Zealand than the United States and while Australia has become an inflation targeting country it is viewed as having, as Dueker and Fischer (2006) term it, "a more nebulous charge to keep inflation at levels comparable with those of its major trading partners (p. 440-441)." Or as Bernanke *et.al.* (1999, p. 223) make the comparison, "In sharp contrast to New Zealand's targeting framework … the Reserve Bank of Australia emphasized flexibility in all aspects of its operations, from the definition of target to the recognition of its discretion in responding to shocks."[3]

Second, we estimate VARs using monthly data for New Zealand pre- and post-adoption of inflation targeting. These VARs contain the policy rate, a longer term market rate, the exchange rate, and a commodity price measure. Here we look directly at the impact of innovations in the policy rate on longer-term rates. We compare results with VAR estimates for the United States.

Third, we use data from the days on which the Reserve Bank changed its policy rate to assess the effects on longer-term market interest rates. One expects that only the unanticipated component of the change in the policy rate will have an effect on longer-term rates. The surprise component (or shock) in the change is measured by the change in the 30-day bill rate from just before to just after the change in the policy rate. The third line of inquiry is limited to the period beginning in April 1999 when the Reserve Bank began to closely target the overnight cash rate. While limiting the period of analysis, this line of inquiry has the advantage that results can be compared to many previous studies for the United States. We conduct a comparable study for Australia.

[3] There has been some convergence in the interpretation of inflation targeting in New Zealand and Australia in recent years. By 2002 the Reserve Bank's Policy Targets Agreement specified the inflation target range as "1 percent to 3 percent over the medium term."

These are the broad lines of our study. Details are given as each is pursued in the following three sections. A final section summarizes results.

3. DESCRIPTIVE STATISTICS

Table 1 displays summary statistics for New Zealand interest rates for sample periods pre- and post-adoption of inflation targeting. The first period is pre-inflation targeting, April 1985 – January 1990. The New Zealand dollar was floated in April 1985. We begin our sample at that point to avoid the fixed exchange rate period. A period of transition to inflation targeting is to be expected, so we start the inflation targeting sample with January 1992. In addition, the period April 1999 to the January 2008 is considered separately; this reflects the move of the Reserve Bank from an operating target of cash settlement balances (a bank reserve measure) to explicit control of the overnight interbank cash rate. A reason for considering this period separately is that the change in operating procedures might have affected the functioning of inflation targeting. Specifically, direct control of the overnight interbank rate seems likely to have increased the transparency of monetary policy. Control of cash settlement balances via statements intended to influence changes in their demand - - what were referred to as "open-month operations" appears to have caused confusion and to have introduced an additional source of noise in the determination of overnight interest rates.[4] Table 2 shows descriptive statistics for comparable U. S. interest rates for the same time periods.

The statistics shown are mean, variance, and the coefficient of variation. The tables also show the minimum and maximum values each rate took on in each time period. Table 1 shows the high degree of volatility in both short-and long-term interest rates in the pre-IT

[4] On the operation of Reserve Bank Policy in the pre-2000 period of inflation targeting, see Guthrie and Wright (2000).

period. This volatility reflects, among other things, the high and variable inflation rate in New Zealand. Inflation reached peaks of 16-19 percent at three points in the 1980s. The economic environment in the United States was much more stable. Nominal interest rates in the United States are lower and less volatile.

During the period of inflation targeting (1992-2008) both short- and long-term interest rates in New Zealand were lower and less volatile than in the pre-inflation targeting period. The move to inflation targeting was a factor in these developments though there were no doubt others. In comparison to the United States, the policy rate and 90-day rate in New Zealand were higher though not more volatile. In the case of the long-term (10-year) rate, the New Zealand rate was higher on average but had a somewhat lower variance and coefficient of variation.

In the post-1999 period, the New Zealand policy rate (or 90-day) is higher than in the United States but less volatile. The same is true for the 10-year rate. The ratios of the variance of the 10-year rate in New Zealand to that in the United States is 0.38; the ratio of the coefficients of variation is 0.46. It is in this later period of inflation targeting that there is most support for Rogoff's view that long-term interest rates would "jump around a bit less" under inflation targeting. Further evidence that inflationary expectations in New Zealand became more anchored post-1999 comes from the comparison of the yields on nominal versus inflation-indexed 10-year government securities as shown in Figure 1. These rates and the spread which can be taken as a measure of long-term expected inflation appear more stable post-1999.

Table 3 shows representative Australian interest rates. Because the time periods for adoption of inflation targeting are different, we make comparisons for several time periods.

If we compare our IT period for New Zealand (January 1992-January 2008) with the same time period for Australia then longer-term interest rates are much less volatile in New Zealand. The variance of the 10-year rate in New Zealand is, for example, 0.86 compared to 2.37 in Australia. Because the mean 10-year rates do not differ by much the coefficient of variation is also quite a bit lower in New Zealand than in Australia. Australia, however, did not adopt inflation targeting until September of 1994. If we allow for an adjustment period and start Australia's IT period at January 1996, there seems to be little difference in the volatility of the two countries interest rates (see Panel 4 of Table 3). A comparison of panels 3 and 4 of the table shows that during Australia's less stringent IT regime both the level and volatility of interest rates did fall markedly.

If we compare the two countries' interest rates for the April 1999-January 2008 period when both were inflation targeters and both used overnight interest rates as operating targets, there seems to be little difference in the volatility of their longer-term interest rates. The variance of the 10-year rate for this period was 0.20 for New Zealand; 0.26 for Australia.

4. IMPLICATION OF VAR ESTIMATES

The second line of inquiry we pursue is to examine the effects on longer-term interest rates resulting from innovations in the New Zealand overnight cash rate. We measure the effects by calculating impulse response functions from VARs. The logic of this line of analysis is that if inflation targeting anchors long-term inflationary expectations, innovations in the overnight cash rate should have little effect on the average of expected future short rates and thus on long-term rates. The summary statistics in the previous

section indicate that under inflation targeting uncertainty about long-term average inflation declined in New Zealand. So we compare VAR estimates for New Zealand with comparable ones from the United States to see if inflationary expectations were more firmly anchored by New Zealand's formal inflation targeting regime.

Details of the VARs:

The VARs for New Zealand contain four variables: the overnight cash rate; a longer-term interest rate (1-year or 10-year); the exchange rate (value of the New Zealand dollar measured in U.S. cents); and the ANZ index of New Zealand Commodity Prices, measured in New Zealand dollars (July 1986 = 100). The interest rate variables are measured as percents. The exchange rate and commodity price variables are entered into the VARs as logarithmic first differences. All observations are monthly.

Representative impulse response functions from VAR estimates for the IT period (1992-2008) are shown in Figures 2 and 3. These are generalized impulse response functions computed using the method of Pesaran and Shin (1998). In Figure 2 the longer-term interest rate is the 1-year rate and in Figure 3 it is the 10-year rate. For the VARs from which these impulse response functions are calculated the lag length chosen by the Bayesian information criterion is one. The impulse responses are to a one-percentage point change in the level of an interest rate or one percent change on the exchange rate or commodity price index.[5]

Impulse Response Functions:

[5] Confidence bands at the 90% level for the estimated impulse responses are calculated using a bootstrap method of 2000 draws to compute the standard errors.

Our interest in the impulse response functions is primarily in the response of the longer-term interest rates to the policy rate (OCR) - - the row 2-column 1 cell of the panel. Thus for other sample periods and maturities we show only that panel. Some comments on the complete set of impulse response functions as shown in Tables 2 and 3 still seem merited. The effects of a one percentage point shock in OCR on the exchange rate (ER) and commodity price (CP) measures are fleeting. This is probably because these variables are expressed as log first differences while the interest rates are levels. In the case of the exchange rate, the effect of OCR is negative but insignificant. This appears to be in the "wrong" direction unless one considers it to reflect overshooting. The commodity price index responds positively but briefly and with marginal significance.[6] With respect to the main variable of interest, Figure 2 shows that the 1-year interest rate rises initially in response to a 1 percentage point increase in OCR. The response is significant for 9 months. The 10-year rate also rises in response to a rise in OCR. The response is significant for approximately 3 months but is markedly smaller.

The magnitude of the responses of the longer-term rates to innovations in the policy rate can be examined more clearly in Figure 4 which also shows these responses for two other time periods: pre-inflation targeting (April 1985-January 1990) and the OCR targeting years (April 1999-January 2008). In Figure 3 all the variables were scaled such that one standard deviation equaled one-percentage point. In Figure 4 only the OCR variable is scaled in the manner. In Figure 4 the response of market rates are then in all panels the response of those rates in percentage points to a one percentage-point increase in

[6] The effect on the commodity price index for a small country such as New Zealand would be expected to be only via the effect on the exchange rate. The positive effect is consistent with the negative effect on the exchange rate. Still, both effects are counter intuitive. Both reflect the "exchange rate puzzle" as discussed in Kim and Roubini (2000) and Chen and Rogoff (2002).

OCR. A series for the 1-year rate is not available back to 1985. Therefore we also examine the response of the 2-year rate over the three time periods.

If we look at the panels for the 2-year and 10-year rates, the pattern across the time periods is consistent. The response of the longer-term rate to the policy rate (OCR) falls by more than one half from the (1985-90) to the (1992-2008) period. The response for the (1999-2008) period is also considerably smaller than for the inflation targeting period as a whole. This latter finding also holds for the response of the 1-year rate to OCR.

Comparisons with the United States:

There are a number of VAR studies of the relationship between the federal funds rate and longer-term market interest rates for the United States that form a basis for comparison with the New Zealand results in Figures 2-4. A statement that summarizes the implications of these studies is the following from Evans and Marshall (1998), "A contractionary policy shock induces a pronounced but short-lived response of short-term rates. The response declines monotonically with maturity; long-term rates are virtually unaffected."

An additional finding from VAR analysis of U.S. data is that the response of longer-term market interest rates to innovations in the federal funds rate is lower in the post-1987 period relative to pre-1979 periods (Berument and Froyen (2006)). These responses decline even more if only the post-1994 period is considered (Berument and Froyen (2009)). The Federal Reserve's greater emphasis on their inflation goal post-1979 and thus greater anchoring of inflationary expectations is a possible reason for this decline.

A different though related explanation is that decline in the estimated effect on longer-term interest rates from innovations is the federal funds rate reflects the greater transparency of Federal Reserve policy post-1987 and even more post-1994. Lange, Sack and Whitesell (2003) provide evidence that beginning in the late 1980s markets came to anticipate Federal Reserve actions to a greater extent. Poole (2005) documents changes in Federal Reserve procedures since 1990 that further increased the predictability of Federal Reserve actions. Many sources of information, including the Federal Reserve's own guidance to markets would not be incorporated in VARs. Innovations from estimated VARs may have become less successful in measuring the surprise component of Federal Reserve policy changes.

The move to inflation targeting in New Zealand, by anchoring long-term inflationary expectations, seems to be a likely cause of the decline in the response of longer-term interest rates to innovations in the policy rate in the post-1992 period. The further decline in these responses post-1999 may be the result of a further anchoring of inflationary expectations as public confidence in the IT regime grew over time. The comparison with the United States results suggests that the change in the operating regime to direct control of the overnight cash rate led to greater transparency in the monetary policy process that contributed to the decline in the effect of innovations. Results in the next section bear on this issue.

The overall conclusion we draw from a comparison with the VAR studies for the United States is that the results for New Zealand in Tables 2-4 fit within the range of those for U.S. data.

5. EFFECTS OF POLICY RATE SURPRISES

The third type of evidence we examine is the effects that *unanticipated* changes in the policy rate (OCR) have on longer-term market rates. The results in the previous section (Figure 4) show that innovations in OCR from VARs have effects on longer-term market interest rates that are diminished in the inflation targeting regime. This may reflect a greater anchoring of inflationary expectations due to the change in the monetary policy regime. But the smaller response of market rates to changes in the policy rate may also result from policy becoming more transparent. Thus, market participants may have additional sources of information, including signaling from policymakers, that make innovations from VARs poorer measures of "surprise" changes in the policy rate.

For the United States, a number of studies [Kuttner (2001), Gurkaynak, Sack and Swanson (2005), Ellingsen, Soderstrom and Masseng (2004)] have found that even in the recent regime where the Federal Reserve has placed greater emphasis on the goal of price stability, long rates have responded with what has been termed "excess sensitivity" to unanticipated changes in the Federal Reserve's target federal funds rate. This has been taken as evidence that inflationary expectations are not well-anchored by Federal Reserve strategy [Gurkaynak, Sack and Swanson (2005, p. 425)]. In contrast Gurkaynak, Levin and Swanson (2005) find that in the United Kingdom surprise changes in the policy rate have not produced this excess sensitivity in longer-term market rates during the post-1997 formal inflation targeting period.[7]

Estimates for New Zealand:

[7] Both papers examine the effects of policy actions on forward rates not long-term yields.

Anticipated and unanticipated changes in the policy rate will have different effects on longer-term market rates. Some method is needed to distinguish between the two types of policy actions. In studies of U.S. monetary policy a variety of methods have been used. Kuttner (2001) used data from the federal funds futures market to measure market anticipations of policy actions. The equivalent of a federal funds futures market does not exist for New Zealand and thus this method of decomposing anticipated and unanticipated policy actions cannot be used. Cochrane and Piazzesi (2002) and Ellingsen, Soderstrom and Masseng (2004) measure the unanticipated (or surprise) component of a policy action as the change in a one-month eurodollar rate from just before to just after the change in the policy rate. We follow this approach for New Zealand and Australia.

In New Zealand policy actions are typically announced in the morning before financial markets open.[8] Therefore we measure the surprise component of a change in the Reserve Bank's official cash rate by same day effect on the 30-day resulting from the policy change.[9] We then regress longer-term market rates on this measure of the policy surprise. The results are given in column 1 of Table 4. The sample period is April 1999 to November 2008, the period where the official cash rate was the operating target.

The results indicate that an unanticipated one-percentage point change in OCR changes longer-term rates by an amount that declines monotonically with term to maturity ranging from 0.940 percentage points for the 90 day rate, to 0.697 percentage points for the 2-year rate, to 0.218 percentage points for the 10-year rate.

Comparison to Australia and United States:

[8] See Guender and Rimer (2008) for a detailed description of the Reserve Bank's procedures.
[9] Note that the policy variable here is the official cash rate rather than the actual overnight cash rate. Discrete policy changes are changes in that rate.

How does this compare to Australia and the United States? Results for Australia are given the second column of Table 4. At each maturity the response of longer-term market interest rates in Australia is smaller than in New Zealand - - the opposite of what would be expected of inflationary expectations were better anchored by New Zealand's stricter IT regime. The results in Table 4 for Australia encompass the whole inflation targeting period for that country. If the sample is restricted to the shorter period covered by the New Zealand estimates, the estimated responses of longer-term market rates to surprise changes in the policy rate are slightly smaller than those in column 2 of the table.

The New Zealand results in the first column of Table 1 can also be compared to estimates for the United States. In column 3 of the table we show Kuttner's (2001) estimates of the effect on longer-term market rates resulting from an unanticipated increase of 1 percentage point in the federal funds rate. As previously noted, Kuttner's estimates are based on measures of market anticipations of Federal Reserve actions inferred from the federal funds futures market. A comparison of columns 1 and 3 of Table 4 indicates that New Zealand market rates for maturities up to 2 years are more responsive to changes in the policy rate than those in the United States. For 5-year and 10-year rates the opposite is true. Two difficulties with this comparison are that the sample period used by Kuttner (June 1989 – February 2000) differs from that used for the New Zealand estimates in Table 4 (April 1999 – November 2008) and that the method of measuring policy surprises is different.

Swiston (2007) updates Kuttner's estimates for the sample period March 2000 – June 2006. He finds that the magnitude of the surprise component of Federal Reserve target rate changes declines markedly in this later period. The response of market rates also

declined. Swiston's (2007; Table 1) estimates indicate smaller responses of market rates to changes in the policy rate in the United States relative to the New Zealand estimates at all maturities. In fact he finds no significant response of market rates at the 5-year and 10-year maturity in the United States. Poole, Rasche and Thornton (2002) also study the responses of longer-term rates to unanticipated changes in the federal funds target rate using a measure derived from the federal funds futures market. When they consider a subperiod of Kuttner's sample period (1994-2001), they find no significant effects of such surprise changes in the target rate for maturities of 2 years or longer.

The method of measuring surprise changes in the policy rate also differs between the estimates for New Zealand (or Australia) and the United States in Table 4. The estimated coefficients for New Zealand (βs) can be expressed conceptually as

1. $\beta = dRL/dR30$

Where RL is the longer-term market rate in each row of Table 4 and R30 is the 30-day rate. We want to measure

2. $\beta' = dRL/dRP^u$

Where RP^u is the surprise component in the policy rate. The assumption that the coefficients (βs) represent the response to policy surprises rests on the assumption that $dR30/dRP^u = 1$. This is reasonable as long as policy changes are persistent past 30-days. In New Zealand the average duration of changes in OCR was 91 days over March 1999-June 2005 thus this assumption seems reasonable.[10]

Estimates for the United States using the changes in the 30-day rate on the day of changes in the federal funds target rate as measures of policy surprises by Ellingsen,

[10] For Australia the average duration was 142 days so there too the assumption that a policy change would last for 30 days is reasonable.

Soderstrom and Masseng (2004) are very close the Kuttner's estimates in column 3 of Table 4. Cochrane and Piazzesi (2002) have similar estimates at shorter maturities but find a much higher response of the 10-year rate to an unanticipated one-percentage point change in the federal funds rate (52 basis points) than the other studies.[11]

Comparisons of the estimated effects of unanticipated changes in the policy rate on longer-term rates in New Zealand and the United States are inconclusive. The estimated effects in New Zealand fall well within the range of estimated effects for the United States. A comparison between Australia and New Zealand is more clear cut. The estimated effects of unanticipated changes in the policy rate are smaller for Australia which has had what is widely viewed as a less strict inflation targeting framework.

6. CONCLUSION

This paper has examined several types of evidence on the question of whether, by anchoring long-term inflation expectations, inflation targeting reduces the volatility of long-term interest rates. In New Zealand, we find that the volatility of longer-term market interest rates declined sharply after the move to inflation targeting in 1990. The impulse response functions in Section 4 indicate that the response of longer-term interest rates to innovations in the New Zealand policy rate (OCR) declined following the introduction of inflation targeting, another indication that long-term inflation expectations were more firmly anchored under the IT regime.

Longer-term interest rates in the United States and Australia also exhibit lower volatility in the post-1990 period relative to the 1980s. The policy regime in the United

[11] A summary of these estimates and those from several other studies can be found in Berument and Froyen (2009; Table 1).

States has been characterized [Mishkin (2007)] as one with an "implicit nominal anchor." A comparison of the data for longer-term interest rates in the United States and New Zealand indicates somewhat less volatility for New Zealand especially in the post-1999 period. An examination of the effects on longer-term interest rates from innovations in the policy rate as measured by impulse response functions does not provide evidence that inflationary expectations are more firmly anchored in New Zealand relative to the United States. The same is true for our estimated effects of unanticipated changes in the policy target rate from daily data for the two countries (Table 4).

Our comparisons between Australia and New Zealand do not provide evidence that the stricter version of inflation targeting in the latter country has been more successful in reducing the volatility of long-term interest rates. Simple measures of the volatility of 5-year and 10-year rates over comparable periods show little difference between the two countries. Estimated effects on longer-term rates as a result of unanticipated changes in the policy rate show that these effects are *smaller* in Australia, an indication of better-anchored long-term inflationary expectations.

A comparison of our results for Australia and the United States indicate somewhat lower volatility of longer-term interest rates in Australia, as well as better anchored long-term inflationary expectations. The former is indicated by a comparison of the data in Tables 2 and 3, if we consider only the IT period for Australia (post-1996). The latter by the estimated effects on 5-year and 10-year rates as a result of unanticipated changes in the policy rate for the two countries (columns 2 and 3 of Table 4). Bernanke *et. al.* (1999, p. 22) describe inflation targeting as a "framework for policy within which 'constrained discretion' can be exercised." The comparison of our results for Australia versus the United

States indicates an advantage, along the dimension we consider, to inflation targeting as adopted by Australia.

Figure 1
New Zealand Indexed and Nominal 10-year Government Bond Yields

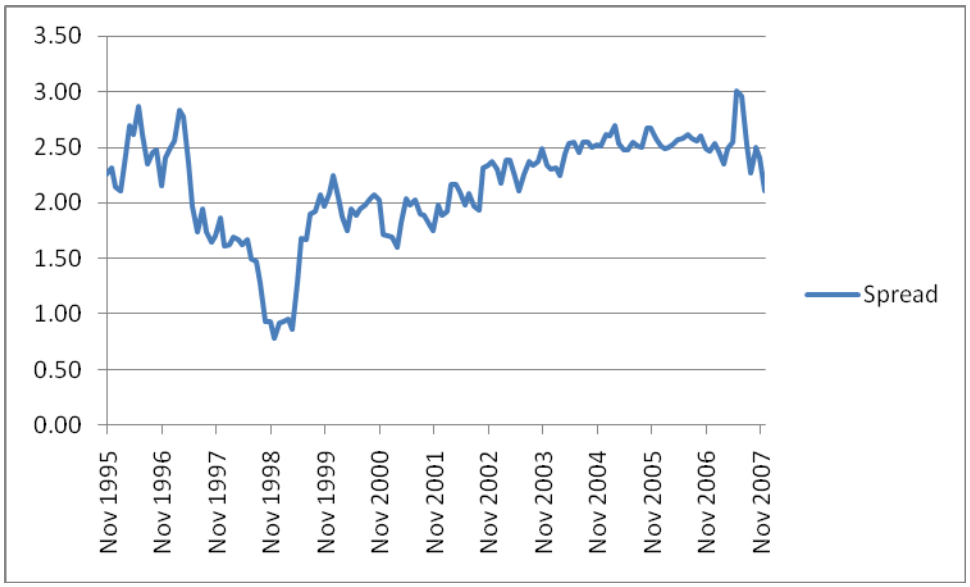


Figure 2: Impulse Response Functions 1-Year Rate: 1992-2008.

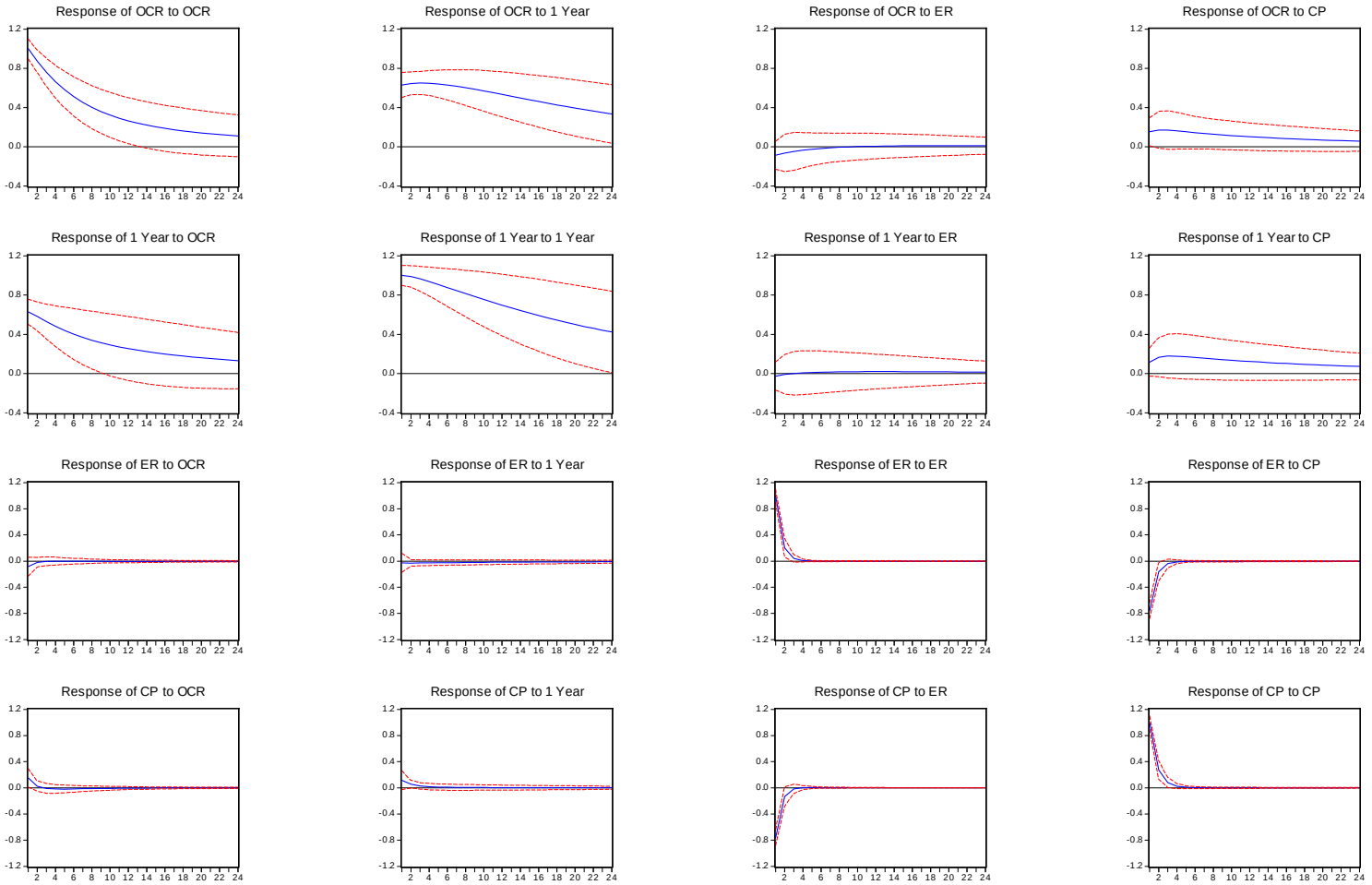


Figure 3: Impulse Response Functions 10-Year Rate: 1992-2008.

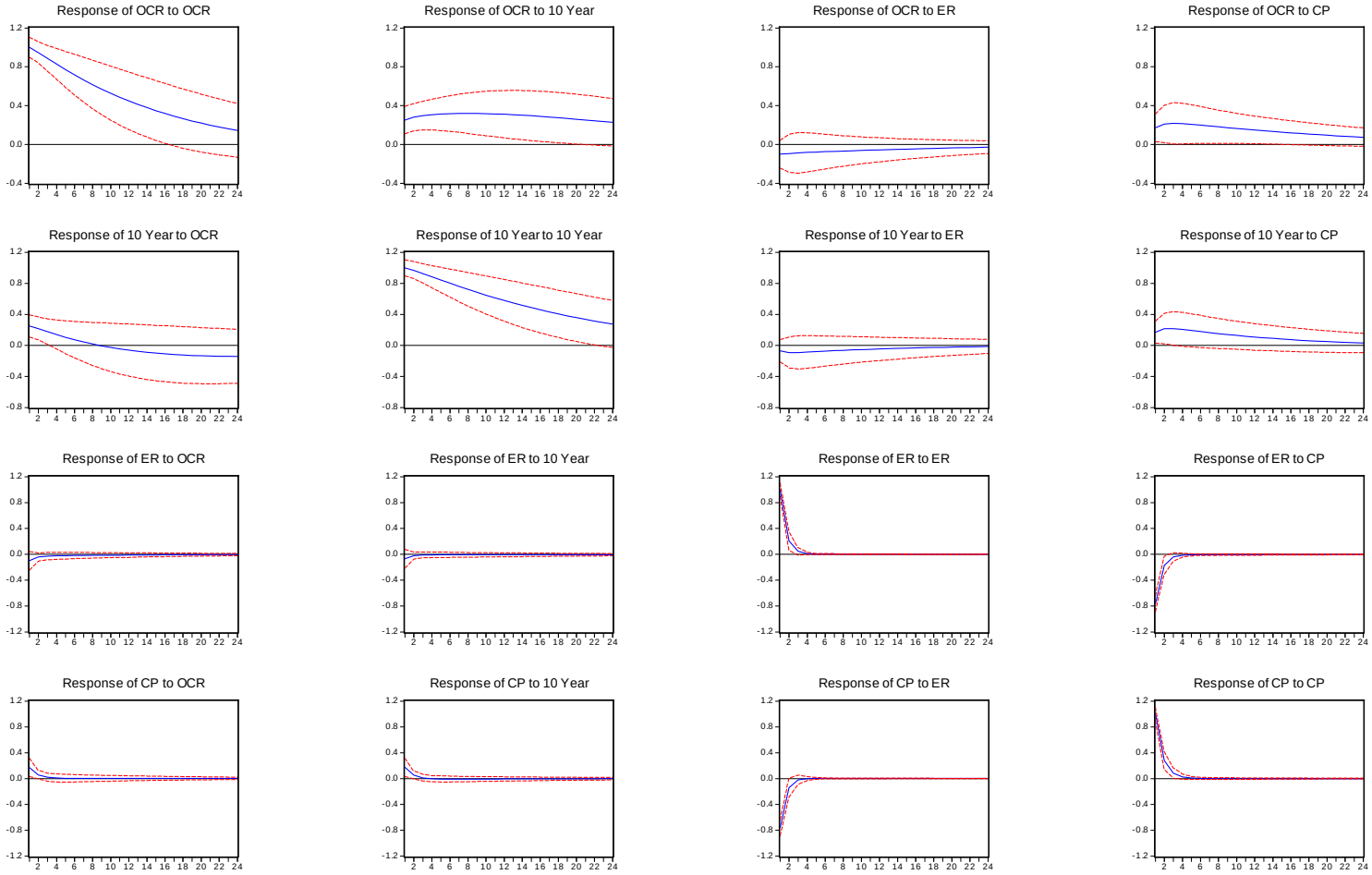


Figure 4: Impulse Response Functions: Market Rates to OCR: Selected Time Periods

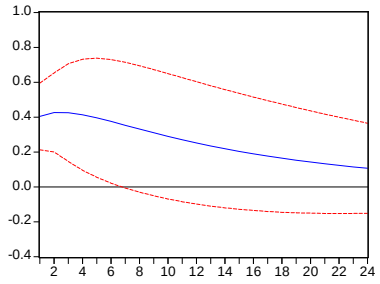
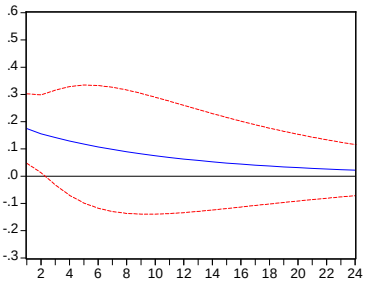
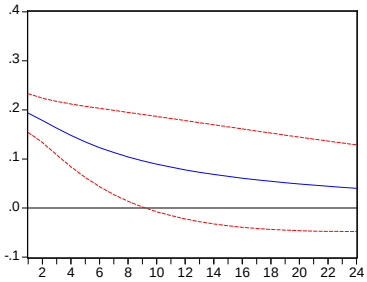
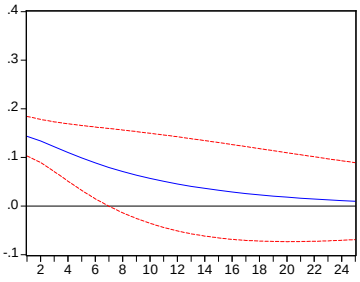
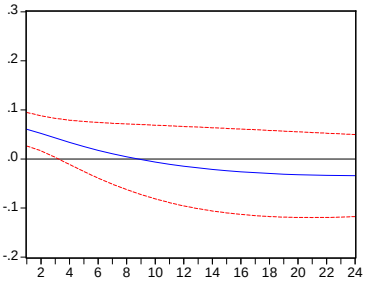
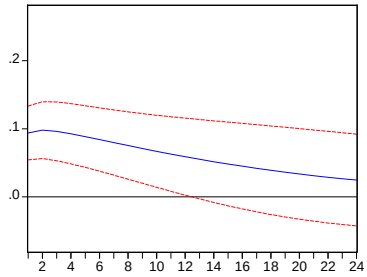
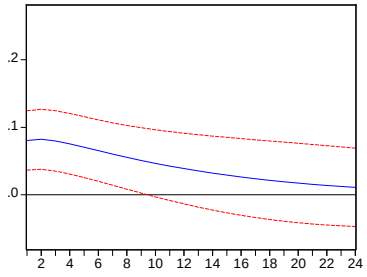
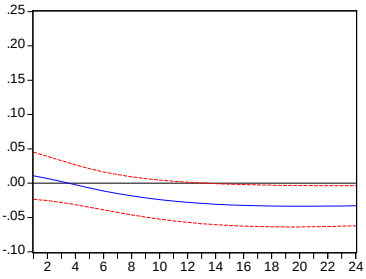
	1-year	2-year	10-Year
April 85-Jan 90			
Jan 92-Jan 2008			
April 99-Jan 2008			

Table 1[a]
Representative New Zealand Interest Rates, Selected Time Periods
Overnight Interbank

	Cash Rate	90-days	1-year	2-year	10-year
			(April 1985 - Jan 1990)		
mean	17.59	18.26	14.96	16.62	14.99
variance	17.22	18.93	3.30	8.00	4.12
coefficient of variation	0.24	0.24	0.12	0.17	0.14
minimum	12.80	12.98	12.96	12.73	12.23
maximum	31.13	27.20	18.86	22.21	18.71
			(Jan 1992 - Jan 2008)		
mean	6.65	6.88	6.91	6.65	6.76
variance	2.29	2.12	2.06	1.56	0.86
coefficient of variation	0.23	0.21	0.21	0.19	0.14
minimum	3.30	4.13	4.30	4.13	5.23
maximum	10.07	10.12	10.12	9.58	9.32
			(April 1999 - Jan 2008)		
Mean	6.17	6.44	6.09	6.10	6.24
variance	1.12	1.23	0.69	0.45	0.20
coefficient of variation	0.17	0.17	0.14	0.11	0.07
Minimum	4.50	4.64	4.13	4.64	5.23
Maximum	8.33	8.90	7.81	7.60	7.48

a. The sources and descriptions for all data series used in the paper are given in Table 5.

Table 2
Representative U.S. Interest Rates, Selected Time Periods

	Effective Federal Funds Rate	3-Month	1-Year	2-Year	10-Year
		(April 1985-Jan 1990)			
mean	7.64	6.97	7.48	7.93	8.65
variance	1.20	1.15	1.02	0.94	1.01
coefficient of variation	0.14	0.15	0.13	0.12	0.12
minimum	5.85	5.32	5.72	6.23	7.08
maximum	9.85	9.14	9.57	10.09	11.43
		(Jan 1992-Jan 2008)			
mean	4.07	3.91	4.22	4.56	5.48
variance	2.68	2.41	2.39	2.18	1.14
coefficient of variation	0.40	0.40	0.37	0.32	0.19
minimum	0.98	0.90	1.01	1.23	3.33
maximum	6.54	6.36	7.14	7.59	7.96
		(April-1999-Jan 2008)			
Mean	3.57	3.39	3.61	3.87	4.80
variance	3.45	3.06	2.73	2.26	0.52
coefficient of variation	0.52	0.52	0.46	0.39	0.15
Minimum	0.98	0.90	1.01	1.23	3.33
Maximum	6.54	6.36	6.33	6.81	6.66

Table 3

Representative Australian Interest Rates, Selected Time Periods

	Interbank Cash Rate	90 days	3-year	5-year	10-year
		(Jan 1992-Jan 2008)			
Mean		5.76	6.38	6.67	6.97
variance		0.92	1.66	1.92	2.37
coefficient of variation		0.17	0.20	0.21	0.22
Minimum		4.25	4.44	4.76	5.00
Maximum		8.37	10.44	10.57	10.92
		(April-1999-Jan 2008)			
Mean	5.36	5.54	5.78	5.92	6.03
variance	0.42	0.50	0.40	0.33	0.26
coefficient of variation	0.12	0.13	0.11	0.10	0.08
minimum	4.23	4.25	4.44	4.76	5.00
maximum	6.75	7.29	7.28	7.31	7.49
		(April 1985-September 1994)			
Mean		11.93	10.51	12.01	12.15
variance		21.97	11.96	8.43	6.28
coefficient of variation		0.39	0.33	0.24	0.21
Minimum		4.78	5.70	6.14	6.64
Maximum		19.56	16.00	16.06	15.33
		(January 1996-January 2008)			
mean	5.32	5.60	5.90	6.09	6.29
variance	0.40	0.66	0.69	0.69	0.79
coefficient of variation	0.12	0.15	0.14	0.14	0.14
minimum	4.23	4.25	4.44	4.76	5.00
maximum	6.75	7.57	8.51	8.77	9.16

Table 4

Effect on Long-Term Rates of an Unexpected One Percentage Point Change in Policy Rate[a]

	New Zealand	Australia	United States[c]
90 days	0.940	0.607	0.79
	(16.99)[b]	(11.23)	(8.4)
1-year	0.839	--	0.72
	(6.76)	--	(8.5)
2-year	0.697	0.479	0.61
	(7.22)	(4.80)	(6.0)
5-year	0.421	0.277	0.48
	(5.21)	(3.85)	(4.3)
10-year	0.218	0.074	0.32
	(3.21)	(1.09)	(3.1)

a. As explained in the text the unexpected component of a change in policy rate is measured by its same day effect on the 30-day bill rate.

b. The t-statistic of the coefficient is in parenthesis.

c. Estimate from Kuttner (2001), Table 3.

Table 5

Data Sources: The sources and descriptions of the data series used in the paper are as follows:

Australia: Bond rates are secondary market government bond yields. The 90-day rate is the rate on Reserve Bank bills. The policy rate is the overnight interbank rate. All are taken from the Reserve Bank of Australia's data bank.

New Zealand: Bond rates are secondary market government bond yields. The 90-day rate is the rate on Reserve Bank bills. The policy rate is the overnight interbank cash rate. The exchange rate is the value of the New Zealand dollar in U.S. cents. All series are from the Reserve Bank of New Zealand. The commodity price measure is an index of New Zealand important export prices, measured in New Zealand dollars (1986-100). The source is ANZ Bank.

United States: Data for all Treasury securities are constant maturity rates. The policy rate is the effective federal funds rate. The data source is FRED, the data base of the Federal Reserve Bank of St. Louis.

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