WHAT DO FINANCIAL MARKET DATA TELL US ABOUT MONETARY POLICY TRANSPARENCY?

Jonathan Coppel and Ellis Connolly

Abstract

This paper attempts to discern from financial market data the impact of greater monetary policy transparency over the period since the late 1980s. We examine whether interest rate variability has changed, the degree to which financial markets anticipate policy moves and movements in the yield curve at the time of changes in monetary policy. Where possible, we compare the results for Australia with other countries. We find that interest rate volatility at the short end has fallen dramatically since the late 1980s. The extent to which market participants anticipate changes in the policy rate has gradually risen, as has the speed of reaction to interest rate announcements. Since the late 1990s, bill futures contract prices have responded to the Reserve Bank of Australia's (RBA) commentaries on the economy. These results are consistent with an increase in the efficiency with which the market digests economic news. The results are quite similar across countries, and it is difficult to isolate from cross-country data any specific preferred model of monetary policy transparency.

Table of Contents

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1. Introduction

During the past 10 to 15 years, central banks around the world have taken a number of steps to improve the effectiveness of their communication about monetary policy decisions and their rationale. In Australia there were a number of important changes including the introduction of announcements for changes to the target cash rate from January 1990, the subsequent adoption of an inflation target and the formalisation of the targeting framework in the Statement on the Conduct of Monetary Policy in 1996. These changes had the effect of making explicit the Reserve Bank's framework of instruments and objectives for monetary policy. In addition, there has been a significant expansion in the Bank's published commentary and analysis relating to the economy and monetary policy in recent years. This has taken place through a number of devices including the quarterly *Statement on Monetary Policy*, *Bulletin* articles, public addresses and reporting by the Governor to the House of Representatives Standing Committee on Economics, Finance and Public Administration.

These developments, often referred to under the general heading of increased transparency, might be expected to have resulted in financial markets being better informed and therefore better able to anticipate policy decisions and respond more efficiently to economic data than was formerly the case. This paper attempts to discern from financial market data the extent to which this has occurred in Australia and, where possible, to provide comparisons with results in similar countries. We find that: (i) interest rate volatility at the short end of the yield curve has fallen dramatically since the late 1980s; (ii) the extent to which market participants anticipate changes in the policy rate has gradually risen; (iii) the speed of reaction to interest rate announcements has increased; and (iv) bill futures contract prices appear to respond to RBA commentaries on the economy. These results are consistent with an increase in the efficiency with which the market

digests economic news. However, it is difficult to isolate from cross-country data any specific preferred model of monetary policy transparency.

2. Financial Market Consequences of Increased Monetary Policy Transparency

The empirical work presented in this section focuses on two key issues: whether increased transparency over the years has been associated with higher or lower interest rate volatility; and second, whether this has helped financial markets to better predict future interest rate outcomes. On the first issue, a simple method is to examine various measures of volatility of financial market prices. The second issue is more complicated to evaluate. One approach is to examine whether the degree to which markets have anticipated policy changes has risen. We also conduct event-study analyses to evaluate the impact of policy announcements and other economic information from the RBA on short-term interest rates. In addition we examine movements in the yield curve at the time of monetary policy changes; improved understanding of the monetary policy framework and stronger anchoring of inflation expectations would be likely to show up in smaller surprise movements in short maturity interest rates and a dampened impact of policy rate movements at the long end of the yield curve.

Before examining these effects, some descriptive statistics of cash rate moves are presented in Table 1. Three time periods are shown which broadly correspond to different stages of monetary policy communication arrangements at the RBA. This might give the impression that the moves towards greater transparency were characterised by distinct shifts. This would be an oversimplification, but for the purposes of the following analysis it is instructive to attempt to identify separate periods. The first period is from 1986 to 1989, which corresponds to the time before a cash rate target was announced. The second period is from 1990 to July 1996. This can be thought of as a transitional period during which there were a number of important initiatives including the first articulation of the inflation target. The third period runs from August 1996 until the present.[1] The start date of the third period corresponds to the release of the Statement on the Conduct of Monetary Policy, which formalised the inflation-targeting framework.

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[1] In Section 2.4, we allow this breakpoint to vary and analyse the results.

Several characteristics from Table 1 are noteworthy. The average size of moves in the cash rate target has significantly declined. Between 1986 and 1989 the average absolute movement was 129 basis points, whereas since mid 1996 it has been 35 basis points. Since policy changes were announced, and reflecting a more stable macroeconomic context, there has also been an increase in the average number of trading days between moves. Despite a longer time span, over the last two time periods the number of sign changes (i.e., moves that reverse the direction of the previous move) has fallen from 5 to 3. Finally, reflecting the growing tendency to announce cash rate changes at a set time on the day following Board meetings, the proportion of cash rate moves occurring on that schedule has risen sharply to over 80 per cent on average since August 1996, and to 100 per cent since December 1998.

Table 1: Descriptive Statistics of Moves in the Target Cash Rate					
	Number of cash rate moves	**Proportion of moves scheduled[a]** Per cent	**Mean absolute cash rate move** Bps	**Average number of trading days between moves**	**Number of sign changes**
January 1986 to December 1989[b]	19	11	129	53	5
January 1990 to July 1996	19	37	87	87	3
August 1996 to December 2002	18	83	35	89	3

Notes: (a) The proportion of rate moves on the day following Board meetings.
(b) During this period where there was no official target cash rate, policy changes were identified based on the midpoint of the informal band used by the RBA's domestic trading desk.

2.1 Impact on Interest Rate Volatility

There is no single model of monetary policy transparency, and communication arrangements differ across countries in various respects depending partly on the governance and accountability structures in place in each country.[2] Nonetheless, as noted above, there has been a general trend towards increased transparency in most central banks over the past 10 to 15 years. The effect of this trend on the volatility of financial markets could in theory be quite complex. An improvement in the flow

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[2] See Mahadeva and Sterne (2000) and Schich and Seitz (2000) for a cross-country discussion of monetary policy frameworks.

of information to markets should reduce uncertainty and more closely anchor key financial prices to their fundamental determinants, but it would also mean that prices respond more rapidly to news. Another complexity is that not all measures designed to increase transparency necessarily result in better use of available information by markets if the information is poorly managed or carries the risk of being misinterpreted. Notwithstanding these complexities, it seems plausible to think that the improved availability of information about monetary policy decision-making would have reduced interest rate volatility during the period under review.

Consistent with that interpretation, the volatility of short-term interest rates in Australia has declined dramatically over the past 15 years. This is evident in a range of measures, such as a rolling average of absolute daily changes in bank bill yields or a rolling standard deviation, and to a lesser extent in the coefficient of variation in bank bill yields. It is also illustrated by the measure in Figure 1 which indicates days when the 90-day bank bill rate moved by more than 10 basis points, the equivalent for Australia of about one standard deviation of the daily change in 90-day bank bill rates over the period shown. This measure, by focusing on relatively large movements, attempts to capture interest rate surprises and to abstract from any increase in volatility linked to a greater frequency of signals, which would be likely to result in an increased number of small daily moves. A substantial decline in this measure of volatility occurred after the RBA decided in 1990 to announce an operational target for the cash rate. While there was a brief period of greater volatility around 1994, there have subsequently been only a small number of days when bill yields moved by more than 10 basis points.

A large part of the overall fall in volatility has been a global phenomenon due to a lower general level of nominal rates, as inflation levels have fallen, and greater macroeconomic stability. Nonetheless, it is worth noting that volatility of Australian 90-day bank bills is similar to, or lower than, the other countries shown in Figure 1. Prominent reductions in volatility occurred in Canada in 1996 and New Zealand in 1999, when these central banks moved to announcing official overnight rate targets, and in Sweden after 1992, when the peg with the ECU was abandoned. Apart from these instances, it is difficult to isolate particular transparency measures that have noticeably reduced volatility of short-term rates in different countries. In the past three years, volatility appears to have been quite

similar in all the countries examined, regardless of the exact arrangements in each country.[3]

Figure 1: Volatility of 3-month Interest Rate
Daily moves larger than 10 basis points
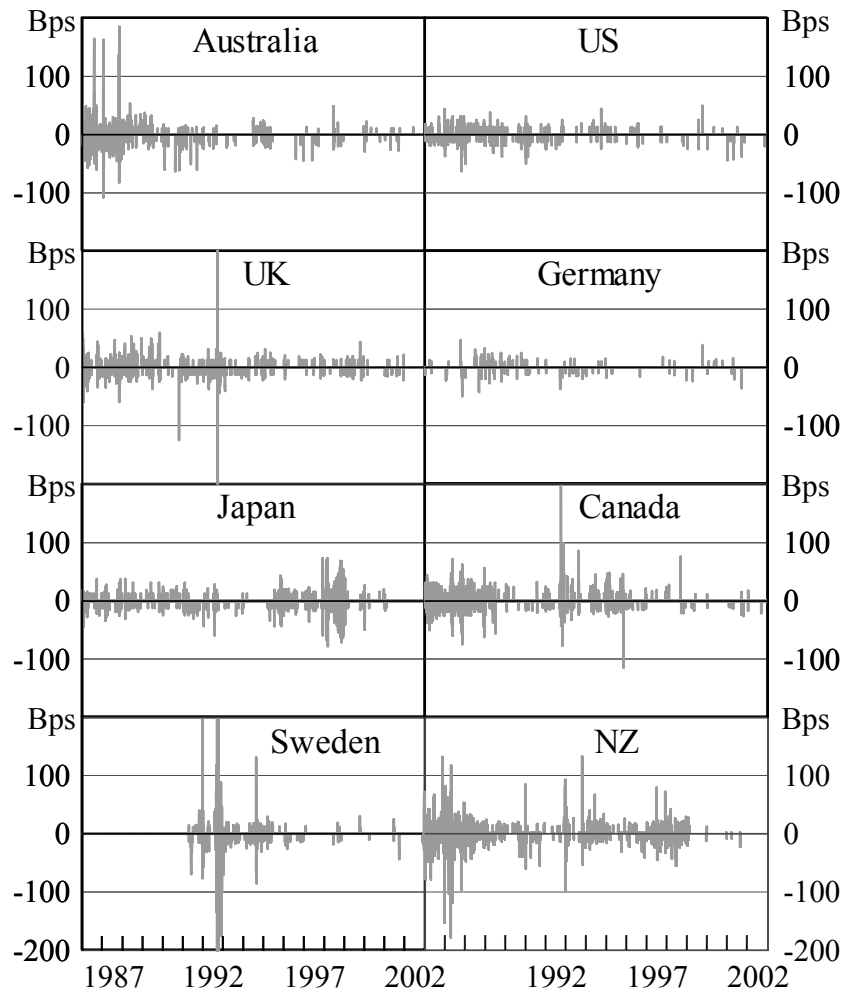
Notes: Some moves are larger than 200 basis points, mainly associated with periods of stress on the European Monetary System in the early 1990s. Swedish data are not available before March 1991.

Sources: Bloomberg; Federal Reserve; RBA; RBNZ; Thomson Financial Datastream

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[3] The standard deviation of the daily change in 3-month paper for all countries was between 2.8 and 4.5 basis points over the period 1999–2002, with the standard deviation of Australian 90-day bank bills at 3.5 basis points.

## 2.2   Impact on Market Responses to Cash Rate Moves

The response of market interest rates to announced changes in monetary policy provides a measure of the extent to which market participants were surprised by the action and whether they were induced to revise their outlook about the future path of interest rates.[4] Thus, the magnitude of the movement depends on the predictability of policy and the ability of investors to read future policy intent from current information. *A priori*, one would expect that the more transparent the central bank, the higher the degree to which the financial markets anticipate policy moves, implying a more muted response in the short-term interest rate market on the day of the announcement.

One aspect of this concerns the distinction between scheduled and unscheduled policy announcements. Scheduled announcements are likely to be easier for financial markets to anticipate and consistent with that, the data in Figure 2 show that these have generally been associated with smaller reactions in interest rate markets to cash rate moves. The average size of the response for 30- and 90-day bank bills is at least halved when the change in the target cash rate occurred on a day following a scheduled meeting of the RBA Board. In fact, when the rate moves occurred the day after Board meetings, the market movement was often as low as the average daily change in market interest rates during the previous four weeks. Hence, an increase in the relative prevalence of scheduled versus unscheduled announcements would be one factor contributing to a reduced average impact of policy announcements on market interest rates.

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[4] For example, Hardy (1998) estimates the reaction of market interest rates to both the anticipated and unanticipated components of Bundesbank monetary policy moves from 1985–1995. On the day of rate moves, the response to the anticipated change is not significantly different from zero, with only the unanticipated component having a systematic effect on market rates. This supports our assumption that the change in market interest rates on the day of rate moves is a measure of the unanticipated, or surprise component, of a policy move.

Figure 2: Market Response to Monetary Policy Moves

Average absolute change in bank bill rates relative to size of policy move
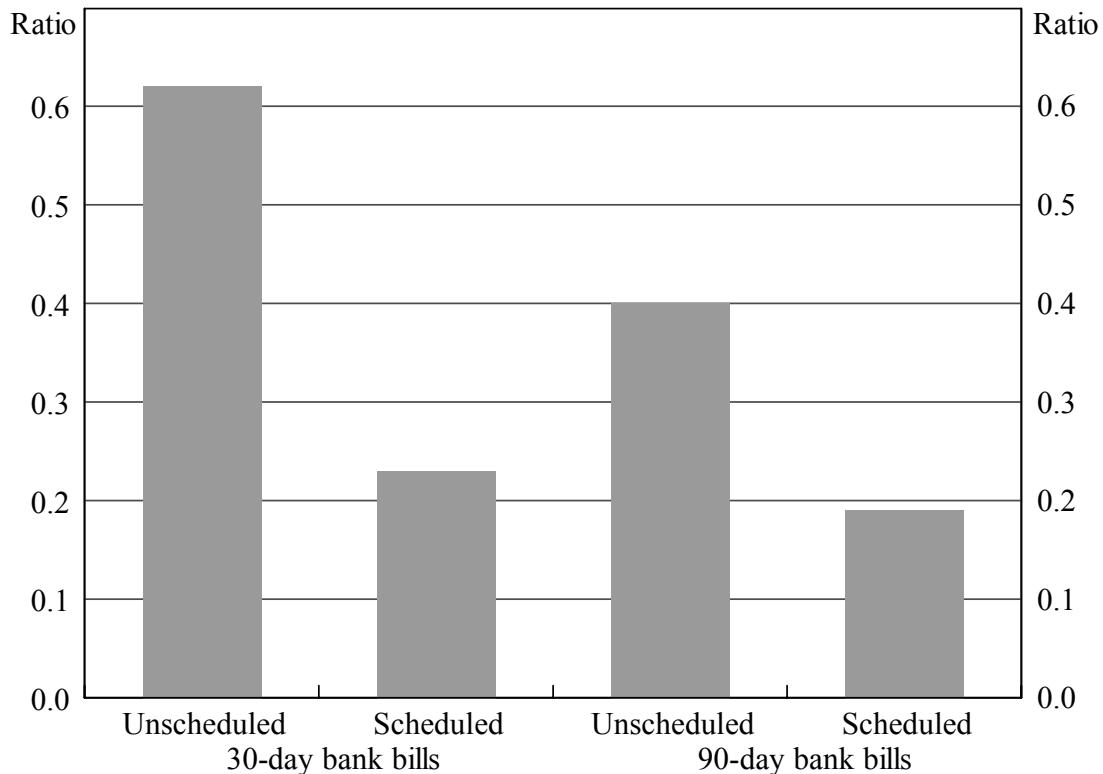
Note: Averages calculated over the period 1990–2002 on days when the cash rate was changed.

Source: RBA

More generally, when the rationale for monetary policy decisions is better understood, it could be expected that markets would be more able to interpret the implications of new information, and thus better able to anticipate policy decisions. This in turn would mean a smaller market response at the time a policy announcement is made. The regression analysis reported in Table 2 supports that there has been a reduction over time in the degree to which short-maturity debt markets react to policy announcements. The response of 1-month paper to monetary policy moves is estimated using OLS. In Equation (1) we regress the daily change in 1-month paper Δi_{jt}, for country j on a constant α_{0j}, and changes in the policy target rate Δp_{jt}.[5] Dummy variables D_k are used to divide the sample

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5   One-month paper is preferred to 3-month paper since it allows us to focus on the surprise element of the move itself, rather than the forward-looking information that may accompany the move.

into the periods used in Table 1. $D_1 = 1$ prior to January 1990, $D_2 = 1$ between January 1990 and July 1996, and $D_3 = 1$ from August 1996 to December 2002; each dummy equals 0 otherwise.

$$\Delta i_{jt} = \alpha_{0j} + \sum_{k=1}^{3} \alpha_{kj} D_k \Delta p_{jt} + \varepsilon_{jt} \qquad (1)$$

The equation is also estimated over the period January 1999 to December 2002 (without dummies) so New Zealand[6] and the euro area can be included in our analysis. The estimated constants are not significantly different from zero. The estimated coefficients on the policy changes are presented in Table 2.

In the late 1980s, the market response to rate moves was smaller for Australia since rate moves were not announced to the market. In the early 1990s, the financial markets responded to policy moves by the RBA to a similar extent as policy moves by the Federal Reserve and the Bank of England. When responses are compared across countries since 1996, they are quite similar, with the market on average responding by between 22 and 48 per cent of a rate move. A statistical test cannot reject that the responses to rate moves in these countries since 1996 are equal.[7] The range is even narrower since 1999 and once again we cannot reject that the responses are equal. The general convergence of these responses is likely to be partly reflective of the more stable economic outcomes in recent years, but may also reflect similarities in key aspects of central bank communication strategies, with all banks examined having adopted a policy of announcing and explaining all rate moves. It also suggests that the areas of divergence in transparency arrangements do not significantly influence the ability of the market to predict moves.

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[6] The Reserve Bank of New Zealand introduced an Official Cash Rate in March 1999.

[7] We estimate $\Delta i_{jt} = \alpha_{0j} + \alpha_{1j} \Delta p_{jt} \, \varepsilon_{jt}$ for each country over August 1996 to December 2002 and test the null hypothesis that α_{1j} for each country is equal using a Wald test. The null was not rejected at the 10 per cent level of significance.

Table 2: Market Response to Monetary Policy Moves[a]			
	January 1986 to December 1989	January 1990 to July 1996	August 1996 to December 2002	January 1999 to December 2002[b]
Australia	0.08***	0.41***	0.37***	0.15**
	(0.03)	(0.09)	(0.10)	(0.06)
US	0.24***	0.39***	0.22**	0.20*
	(0.05)	(0.07)	(0.10)	(0.11)
UK	0.30***	0.41***	0.25***	0.22***
	(0.07)	(0.09)	(0.04)	(0.06)
Japan	–0.02	0.28**	0.48**	0.25**
	(0.12)	(0.12)	(0.22)	(0.10)
Germany/ECB[c]	0.22***	0.16***	0.35***	0.30***
	(0.05)	(0.04)	(0.09)	(0.10)
Canada[d]	–	–	0.37***	0.18***
			(0.11)	(0.06)
Sweden[e]	–	–	0.31***	0.27***
			(0.07)	(0.08)
New Zealand[f]	–	–	–	0.19**
				(0.08)

Notes: (a) Numbers in parentheses are Newey-West heteroskedasticity and autocorrelation-consistent standard errors. ***, ** and * represent significance at the 1, 5 and 10 per cent levels.

(b) January 1999 to December 2002 results for each country are estimated separately from the results in the other time periods.

(c) The policy rate is calculated as the average of the Deutsche Bundesbank lombard and discount rates prior to April 1996 consistent with Hardy (1998). Since variable rate repos were also used as a monetary policy instrument during this period, this measure of surprises may be an underestimate.

(d) The Bank of Canada adopted an operating band for the overnight rate in 1994, with the bank rate tied to the upper end of the operating band from February 1996 (Muller and Zelmer 1999).

(e) Data for Swedish 1-month paper are available from 1991.

(f) Data are from 17 March 1999 when the Reserve Bank of New Zealand introduced an Official Cash Rate.

Another way of measuring the extent to which financial markets anticipate monetary policy changes is to examine how much of the actual change is already factored in over the two-week period leading up to the policy announcement. If we assume that market anticipation of a rate move does not enter into the central bank's reaction function, we can test whether the anticipation and pass-through of monetary policy moves by the market has changed over time, and whether it

differs across countries.[8] Using OLS, we estimate the daily difference between the 1-month paper rate i_{jt} and the policy rate p_{jt} for country j as a function of a constant β_{0j}, and the change in the target policy rate Δp_{jt}, led by 10, 5 and 1 business days, and lagged by five business days:

$$i_{jt} - p_{jt} = \beta_{0j} + \beta_{1j}\Delta p_{jt+10} + \beta_{2j}\Delta p_{jt+5} + \beta_{3j}\Delta p_{jt+1} + \beta_{4j}\Delta p_{jt-5} + \varepsilon_{jt} \qquad (2)$$

The results are presented in Table 3 for Australia from January 1986 to December 2002, and for other countries in our sample from August 1996 to December 2002. The coefficients β_{1j}, β_{2j} and β_{3j} are estimates of market anticipation of monetary policy changes over the two weeks leading up to a move, with a value of zero indicating that a rate move was unanticipated over a 1-month horizon. β_{3j} may be interpreted as the proportion of a policy move that was anticipated. However, β_{1j} and β_{2j} should be interpreted more cautiously. One to two weeks prior to a rate move, 1-month paper can be interpreted as an average of expectations of an unchanged policy rate prior to a policy move, and a higher or lower rate afterwards over the remaining maturity of the paper. Therefore, these coefficients will be an underestimate of the proportion of a policy move that was anticipated one to two weeks prior to the move. If β_{4j} is equal to zero, this indicates that the policy move has been fully passed through within a week of the move, while a positive coefficient suggests the market is pricing in the possibility of a subsequent rate move. The constant, β_{0j}, controls for the existence of an average premium of the market rate over the policy rate, and is between 0 and 16 basis points for all the countries in our sample over August 1996 to December 2002.[9] The R^2 coefficients are quite small, but this is not surprising given that the regressions do not include variables to explain the variation on other days.

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[8] If this assumption is invalid, then the regression that we estimate may suffer from endogeneity, which could bias the coefficients.

[9] The constant could include a risk premium along with any average expectation of rate rises or cuts over the estimation period. One way to reduce the size of the latter effect would be to include more leads and lags of the change in the target policy rate. However, including 20 leads and 10 lags does not significantly alter the coefficient estimates in Table 3.

Table 3: Market Anticipation and Pass-through of Monetary Policy Moves

	2-week anticipation	1-week anticipation	1-day anticipation	1-week pass-through	R^2	Number of moves
	β_{1j}	β_{2j}	β_{3j}	β_{4j}		
Australia						
January 1986 to December 1989	0.12 (0.09)	0.17*** (0.06)	0.22** (0.10)	–0.39* (0.23)	0.02	19
January 1990 to July 1996	0.23*** (0.04)	0.37*** (0.07)	0.52*** (0.09)	–0.02 (0.02)	0.15	19
August 1996 to December 2002	0.35*** (0.06)	0.49*** (0.07)	0.74*** (0.11)	0.11*** (0.02)	0.09	18
US						
August 1996 to December 2002	0.31*** (0.06)	0.57*** (0.08)	0.85*** (0.10)	0.10** (0.05)	0.08	22
UK						
August 1996 to December 2002	0.22*** (0.07)	0.33*** (0.10)	0.63*** (0.08)	0.03 (0.09)	0.06	25
Japan						
August 1996 to December 2002	0.00 (0.14)	0.18 (0.21)	0.25 (0.20)	–0.38** (0.15)	0.00	5
Germany/ECB						
August 1996 to December 2002	0.32*** (0.05)	0.43*** (0.08)	0.59*** (0.10)	0.00 (0.07)	0.07	16
Canada						
August 1996 to December 2002	0.38*** (0.06)	0.47*** (0.08)	0.71*** (0.11)	0.17*** (0.06)	0.15	35
Sweden						
August 1996 to December 2002	0.30*** (0.06)	0.49*** (0.07)	0.63*** (0.10)	0.09* (0.05)	0.09	25

Note: Numbers in parentheses are Newey-West heteroskedasticity and autocorrelation-consistent standard errors. ***, ** and * represent significance at the 1, 5 and 10 per cent levels.

From August 1996 to December 2002 over 70 per cent of an RBA cash rate move was on average factored in to 30-day bill yields by the day before an announcement. This compares with around 50 per cent factored in the day before policy changes over the period January 1990 to July 1996, though this is not a statistically significant difference.[10] The most striking contrast is with the period over the second half of the 1980s. About 20 per cent of a move was factored in the day preceding a change in the cash rate, significantly lower than in the period since 1990.[11]

Furthermore, the 30-day bill yield in the late 1980s period only changed gradually following a policy move, and two weeks later had not fully adjusted to the new target cash rate. This can also be illustrated by calculating the average absolute difference between the 30-day bank bill rate and the cash rate over the two weeks preceding and following a rate move (Figure 3). The result is hardly surprising, since cash rate moves were not publicly announced over this period. In contrast, over the August 1996 to December 2002 period, rate moves were fully passed through quickly, and after a week the market was on average beginning to price in a subsequent rate move.

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[10] Using a *t*-test, it is not possible to reject at the 10 per cent level of significance that the anticipation of a policy move the day before was equal in the January 1990 to July 1996 period and the August 1996 to December 2002 period.

[11] Using a *t*-test, it is possible to reject at the 5 per cent level of significance that the anticipation of a policy move the day before was equal in the January 1986 to December 1989 period and the subsequent period.

Figure 3: Anticipation and Pass-through of Monetary Policy Moves
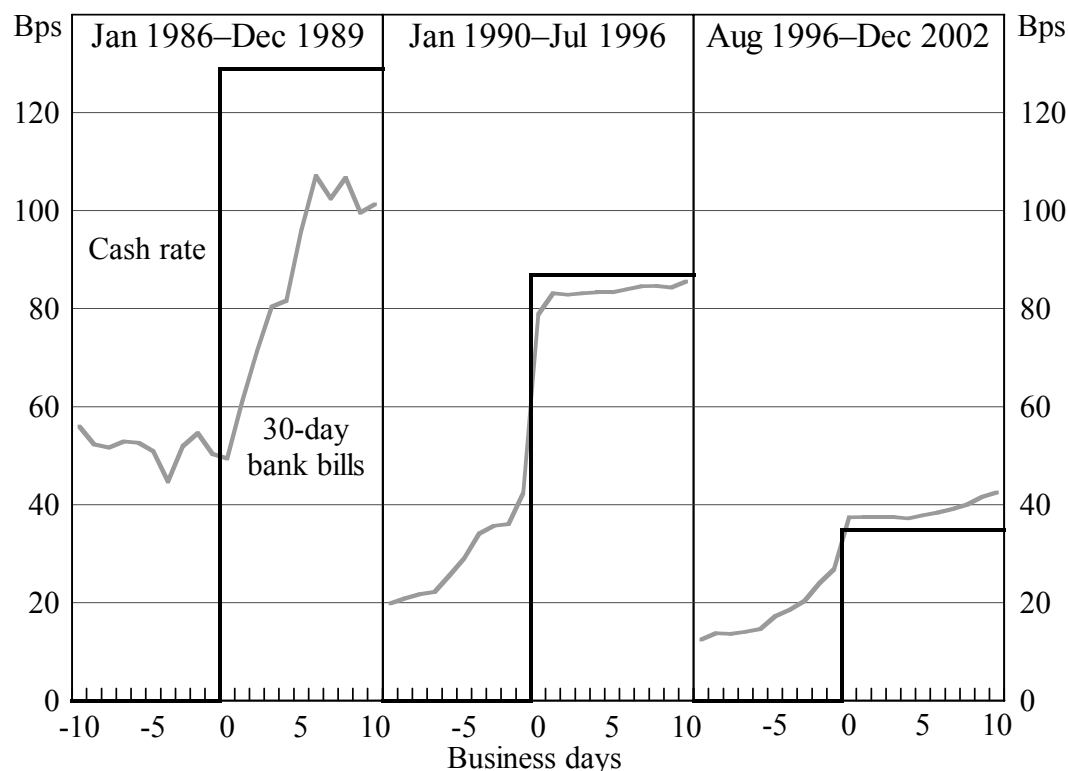
Notes: The 30-day bank bill line for the 10 business days before and after a policy move is the average absolute difference between the 30-day bank bill rate on each day and the cash rate the day before the move. The cash rate line is calculated on the same basis. No adjustment is made for risk premiums.

Source: RBA

Excluding Japan, for which there are only five rate moves between August 1996 and December 2002, there is remarkably little difference in the extent to which markets anticipate monetary policy moves across the countries in our sample (Figure 4). At the 2-week, 1-week and 1-day horizon, it is not possible to reject the hypothesis that the level of anticipation by the markets of a rate move in each country is equal.[12] Excluding Japan, the pass-through of rate moves was complete across the sample of countries after a week, with markets beginning to significantly price in subsequent moves on average in Australia, the US, Canada and Sweden.

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[12] When Equation (2) is estimated for each country over August 1996 to December 2002, using a Wald test it is not possible to reject the null hypothesis that the level of anticipation of a rate move at the 2-week, 1-week and 1-day horizon is equal at the 10 per cent level of significance.

14

Figure 4: Average Response to Monetary Policy Moves

August 1996 to December 2002
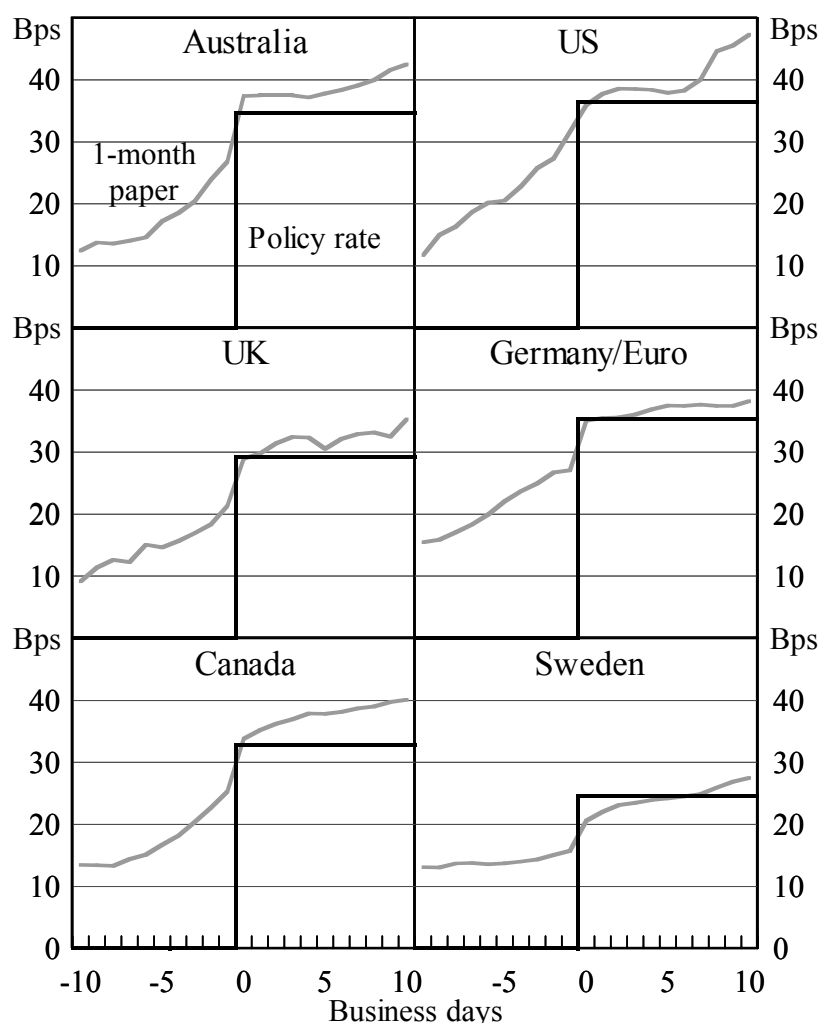
Notes: The 1-month paper line for the 10 business days before and after a policy move is the average absolute difference between the 1-month paper rate on each day and the cash rate the day before the move. The policy rate line is calculated on the same basis. No adjustment is made for risk premiums.

Sources: Bank of Canada; Bank of England; ECB; Federal Reserve; RBA; Sveriges Riksbank; Thomson Financial Datastream

The analysis summarised in Table 3 and Figure 4 relates only to the market response to changes in the policy rate, but does not provide any insight into situations where the market anticipated a monetary policy action that did not materialise. In Australia, some large daily changes in 30-day bank bill yields have also occurred on days following a Board meeting where it was decided not to move interest rates (Figure 5). In recent years, three 'no move' decisions surprised the

market by around 10 basis points, a similar result to that which followed a number of the rate moves during the same period. Surprises of this magnitude tend to occur at times close to turning points in the rate cycle, suggesting that markets may correctly anticipate a move, but may be uncertain as to the timing.

Figure 5: Market Response to Monetary Policy Meetings

Daily changes in 30-day bank bills
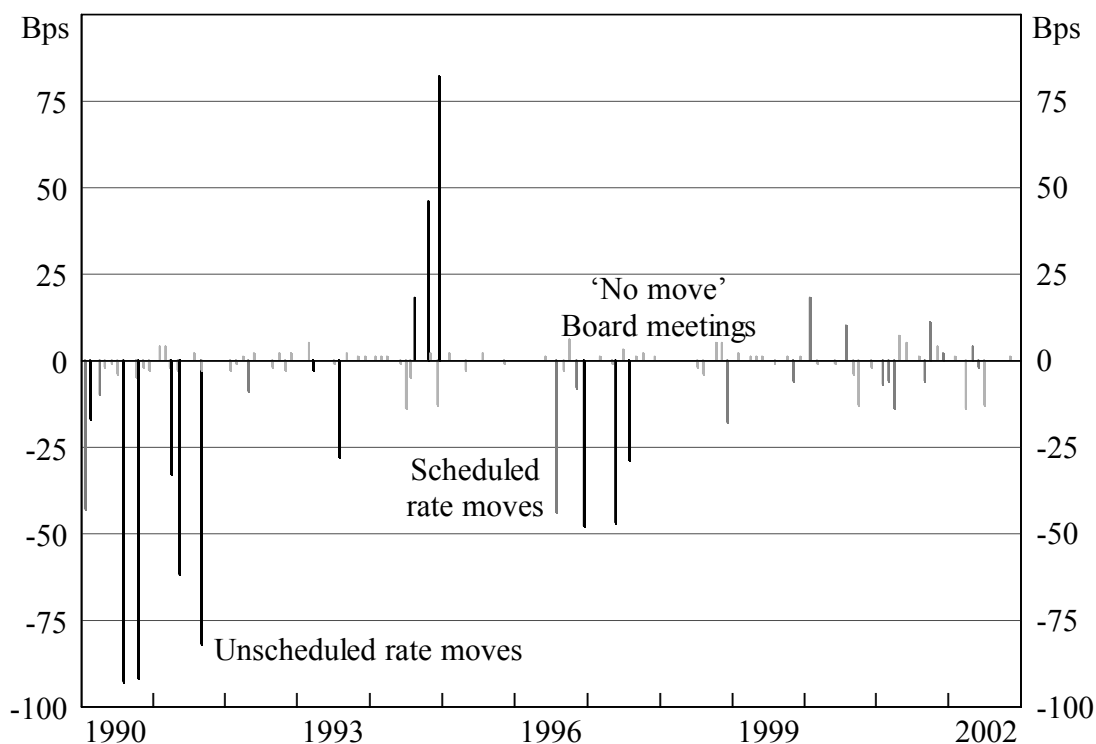
Source: RBA

However, compared with other central banks, the average magnitude of the market reaction following 'no move' decisions by the RBA is not large (Table 4). Moreover, the mean response of 3 basis points is about the same as the general background volatility in interest rates, and is much lower than the response to rate moves. Also noteworthy is a relatively low maximum response to 'no move' monetary policy decisions.

16

Table 4: Response of 1-month Paper to Monetary Policy Decisions
January 1999 to December 2002 – absolute change, basis points

	Response to unscheduled rate moves		Response to scheduled rate moves		Response to 'no move' monetary policy decisions		Mean daily change, all days	Share of 'no move' decisions Per cent
	Maximum	Mean	Maximum	Mean	Maximum	Mean		
Australia	–	–	18	7	14	3	2	70
US	53	35	22	5	10	2	2	53
UK	25	25	19	5	19	3	3	69
Japan	–	–	13	6	8	1	2	94
ECB	42	42	27	9	18	2	1	84
Canada[a]	19	9	26	7	21	4	1	21
Sweden	–	–	24	9	16	2	1	75
NZ	–	–	31	8	8	1	2	53

Note: (a) Fixed announcement dates began in November 2000.

2.3 Impact on Expectations of Future Monetary Policy

The impact of policy announcements on interest rate expectations over a longer horizon can be examined using interest rate futures prices. Figure 6 plots for Australia and the US the average of the absolute change of the 1- and 3-month paper and each 3-month futures contract out to the eighth contract (expectations of rate moves in just over two years' time) on the day of a policy move relative to the size of the policy move, for the periods 1990 to 1992, 1993 to July 1996 and from August 1996 to December 2002.[13] As before, relatively small average responses would indicate that markets significantly anticipate policy announcements and that the information content of announcements is already, to a large extent, reflected in market prices. If markets are becoming better informed, the curve describing these responses should thus shift downward over time.

[13] Futures data are unavailable for Australia for the 1986–1989 period. A factor in interpreting the results for the futures contracts may be the low liquidity of contracts further out. However, low liquidity is likely to have more of an effect on the level of implied futures rates rather than the change in implied futures rates.

**Figure 6: Futures Market Response to Monetary Policy Moves**

Average absolute change relative to size of policy move
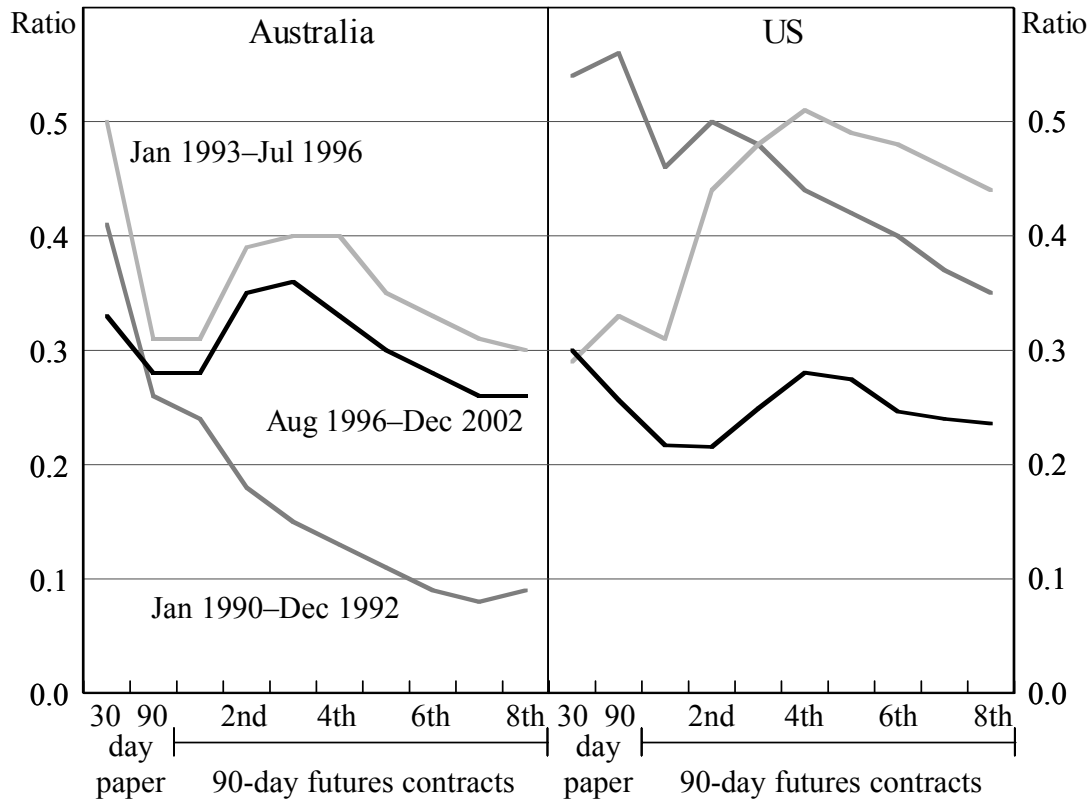
Sources: Bloomberg; RBA

Since 1996, the response of the Australian futures market to policy moves has fallen marginally relative to the 1993–1996 period. The response of US futures to policy also fell in the late 1990s relative to the 1993–1996 period, consistent with policy becoming more transparent. The data also suggest that the futures market surprise in Australia increased significantly from 1990–1992 to 1993–1996. The low response of futures during the 1990–1992 period may be an outlier, driven by the relative predictability of the easing cycle after the high interest rates of the late 1980s or the limited reaction of longer-maturity paper to policy announcements over this period. Figure 7 shows the same information over the period since 1999 for Australia and the US, as well as the euro area, the UK, Canada and New Zealand. The level of the response of interest rate futures in all countries shown is quite similar over this period.

Figure 7: Futures Market Response to Monetary Policy Moves

Average absolute change relative to size of policy move, 1999–2002
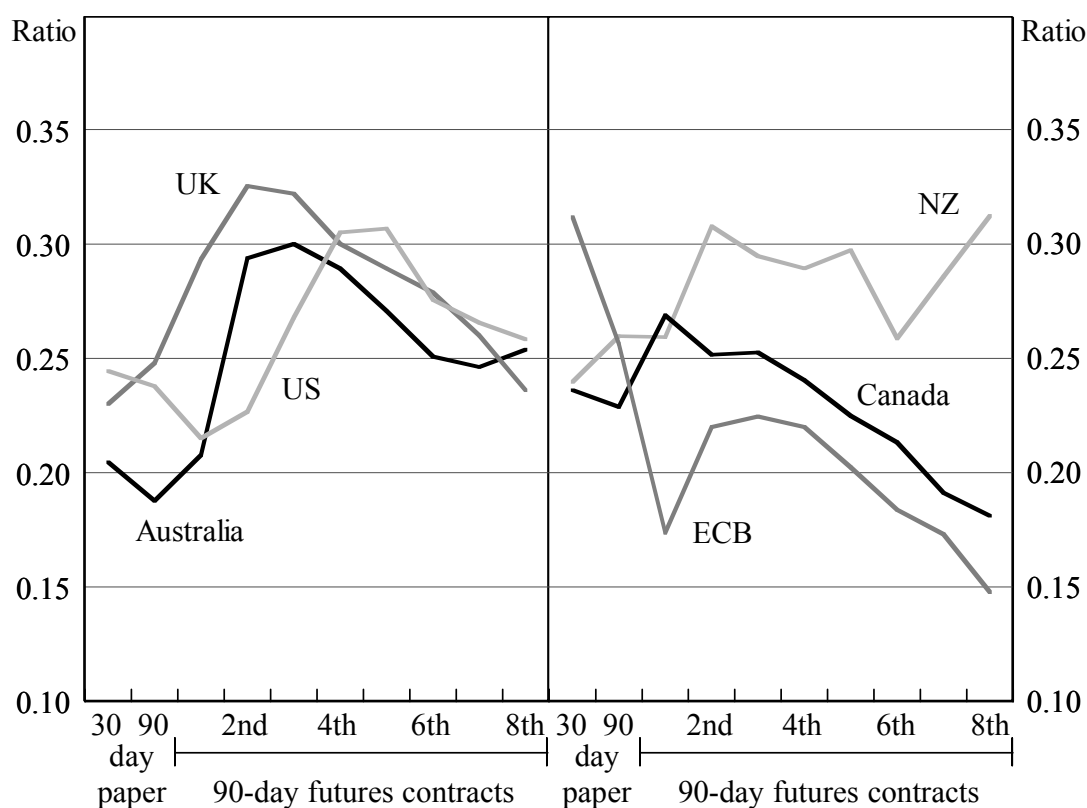
The shape of the futures market's response may also hold information. The largest surprise in Australia occurs on the second and third futures contracts, reflecting changing expectations of rates in roughly 9–12 months' time. This bulge is difficult to interpret because it may be affected by the liquidity of instruments, but possibly reflects the signalling value of rate changes (or the accompanying explanation of the change) over that horizon. A similar pattern occurs in the UK data and, to a lesser extent, in the US data.

We also examined the difference between the absolute responses of the bill futures markets when there is a policy move that changes the direction of interest rates, and those occurring with moves that continue a particular rate cycle. Short-term yields appear to respond similarly in the two cases. However, the information content of rate moves that change the direction of rates appears particularly high for expected rates in around a year's time (Figure 8). This effect does not appear to

be driving the hump noted in the previous paragraph, since if the episodes where policy rates change direction are excluded, the bulge remains in Figures 6 and 7.

Figure 8: Futures Market Response to Monetary Policy Moves

Average absolute change relative to size of policy move, 1990–2002
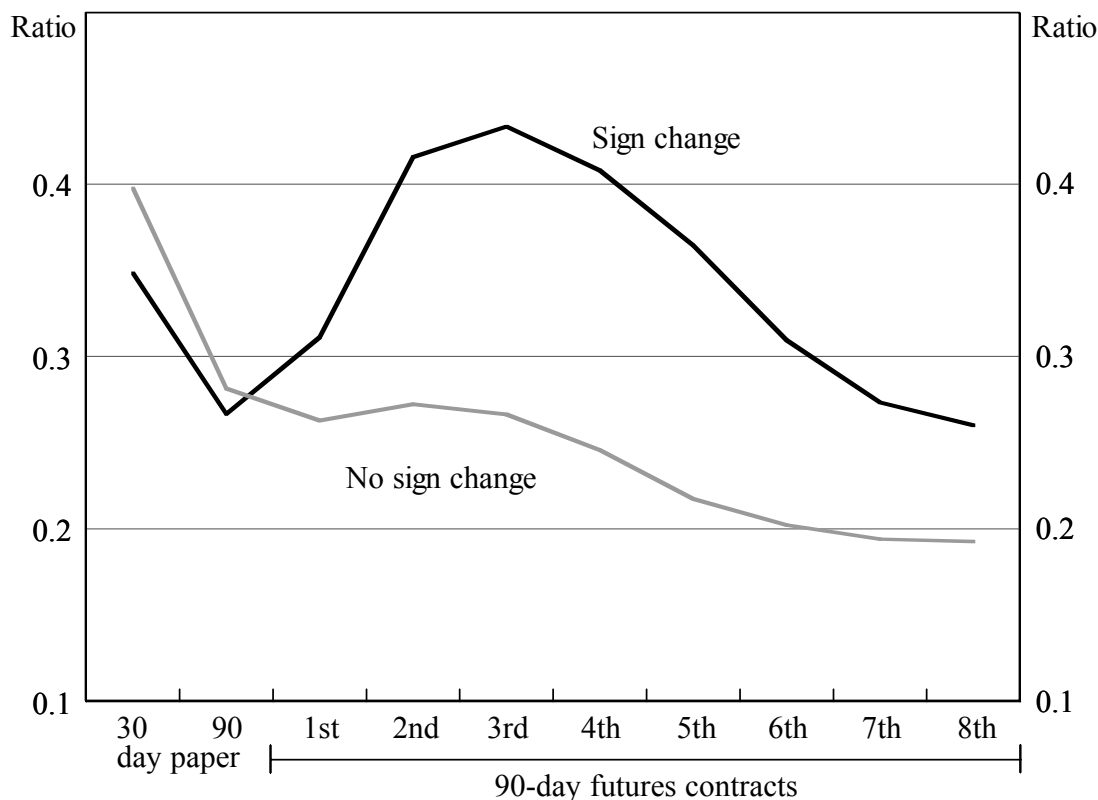
Sources: Bloomberg; RBA

Similar event-study exercises can be done to assess the financial market response to other information from the RBA. Figure 9 evaluates the response of 30-day and 90-day bank bills and 90-day bank bill futures to the release of the quarterly *Statement on Monetary Policy* (SMP) and the Governor's Statement to the House of Representatives Standing Committee on Economics, Finance and Public Administration. The response to rate moves and the change on other days are included for comparison. The average absolute size of market movements for virtually all contracts on days when the Governor's Statement is released is larger than the average absolute daily movements on other days, particularly around the second and third contracts, which suggests that the market is extracting useful information about expected rates in 9–12 months' time. The response to the

Statement on Monetary Policy has also been on average slightly higher than on other days around the second futures contract. However, the small number of observations makes it difficult to draw firm conclusions.

Figure 9: Futures Market Response to Monetary Policy News

Average absolute value change on day, August 1996 to December 2002
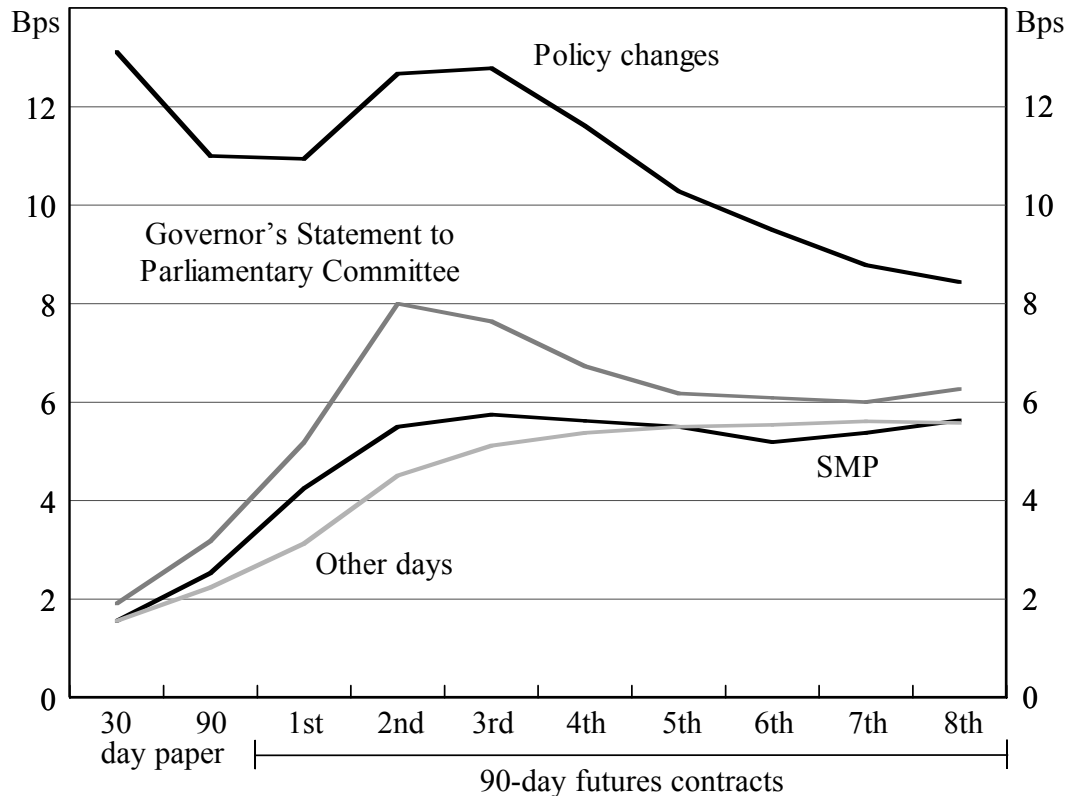
2.4   Impact on the Yield Curve

By appealing to the expectations theory of the term structure, another technique to assess the effects of greater transparency is to examine shifts in the yield curve at the time of monetary policy changes out to a 10-year horizon. Evidence that the yield curve responses have dampened would be consistent with greater transparency and credibility of the monetary policy framework and better anchoring of inflation expectations.

We examine this question using the methodology of Haldane and Read (2000) and regress the daily change in market interest rates of maturity m on a constant γ_{0m}, changes in the target cash rate Δp_t, changes in the US instrument of corresponding interest rate maturity the day before as a proxy for foreign developments Δi_{mt-1}^{US}, and a regime shift dummy variable M to capture the change in response.

$$\Delta i_{mt} = \gamma_{0m} + \gamma_{1m}\Delta p_t + \gamma_{2m}M\Delta p_t + \gamma_{3m}\Delta i_{mt-1}^{US} + \varepsilon_{mt} \tag{3}$$

The regressions are estimated on daily data using OLS for the 30-, 90- and 180-day bank bills, and 3-, 5- and 10-year bonds for the period January 1990 to June 2002. The γ_{1m} parameter gives the estimated response of different maturity interest rates to a cash rate move. The γ_{3m} parameter gives the estimated response to a change in the US interest rate of corresponding maturity. If the financial markets were unaffected by official interest rate changes, γ_{1m} would be zero for all maturities. The parameter γ_{2m} measures the effect of a more open monetary policy on average interest rate surprises. A zero coefficient for all maturities implies a rejection of any regime shift in interest rate surprises. The sum of the coefficients γ_{1m} and γ_{2m} measures the size of the average interest rate surprise along the yield curve during the new regime period. Equation (3) is very similar to Equation (1), with the addition of Δi_{mt-1}^{US}. This additional regressor does not significantly change the results for 30-day bank bills, but is an important explanator of movements at the long end of the yield curve, as discussed in Campbell and Lewis (1998). The estimated constants round to zero at the second decimal place.

The results are reported in Table 5, using August 1996 as the date for a regime shift, corresponding to the release of the Statement on the Conduct of Monetary Policy. The period covers 18 cash rate changes, compared with 19 cash rate changes between 1990 and July 1996. To test the sensitivity of the results to the exact dating of the regime change, we also report the coefficient on the regime shift dummy variable at the short end and the long end when the regime shift date is anywhere between January 1993 and December 2000 in Figure 10.

Maturity of interest rate instrument	Policy moves January 1990 to July 1996	Change over August 1996 to December 2002	US instrument of same maturity	R^2
	Table 5: Response of the Yield Curve to Monetary Policy Moves			
	γ_{1m}	γ_{2m}	γ_{3m}	
30-day	0.41***	−0.04	0.03**	0.27
	(0.09)	(0.14)	(0.01)	
90-day	0.23***	0.08	0.02	0.11
	(0.06)	(0.12)	(0.02)	
180-day	0.18***	0.12	0.02	0.07
	(0.06)	(0.11)	(0.02)	
3-year	0.04	0.18**	0.56***	0.18
	(0.04)	(0.09)	(0.03)	
5-year	0.01	0.17**	0.59***	0.17
	(0.03)	(0.07)	(0.03)	
10-year	−0.02	0.16***	0.69***	0.25
	(0.02)	(0.05)	(0.03)	

Note: Numbers in parentheses are Newey-West heteroskedasticity and autocorrelation-consistent standard errors. ***, ** and * represent significance at the 1, 5 and 10 per cent levels.

The main results are:

1. At the short end and the long end of the yield curve, around 25 per cent of the variation of interest rate changes is explained, and for maturities in between, it is about half as high.

2. As would be expected, yield curve responses to policy moves tend to be larger and more significant among short maturity debt instruments, with about 40 per cent of any change in the cash rate flowing through to 30-day bank bills. The effects on longer maturities are much smaller and less significant. US bond yields appear to be the main driving force behind movements in Australian long maturity yields.

3. The parameter designed to capture the effect of regime change γ_{2m} is insignificant at the short end of the yield curve when the regime shift is tested at August 1996 (Table 5). However, when the regime shift is tested after July 1997, the surprise to 30-day bank bills has fallen significantly, to around 25 per cent of a rate move (Figure 10). This points to a significant

fall in the response of short-term market rates to policy announcements in the late 1990s, implying increased anticipation of monetary policy decisions.

4. The response of bond yields has actually risen significantly relative to the early 1990s. This may reflect that the response of yields at the long end to monetary policy moves have changed sign rather than become larger. During the early 1990s, bond yields tended to move in the opposite direction to the policy rate on the day of a move, while in the second part of the sample, bond yields have generally moved in the same direction as the policy rate. This may reflect a stronger anchoring of inflation expectations, with the inflation expectations of market participants no longer increasing in response to rate cuts. If the regressions in Table 5 are estimated using absolute changes in market and policy rates, the absolute response of bond yields to rate moves has not increased.[14] This also suggests that the sign of the response at the long end to rate moves has changed, rather than the size of the response.

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[14] When the regression for changes in the 10-year bond yield is estimated using absolute values, the regime change coefficient is no longer significant, suggesting that the absolute size of the response of 10-year rates to monetary policy has not increased relative to the early 1990s.

$$\left|\Delta i_t\right| = 0.04 + 0.03\left|\Delta p_t\right| + 0.01M\left|\Delta p_t\right| + 0.48\left|\Delta i_{t\text{-}1}^{US}\right| + \varepsilon_t$$
$$(0.00)\ (0.01)\qquad (0.04)\qquad\quad (0.04)$$

This result is robust to moving the timing of the regime shift dummy between 1996 and 2000.

Figure 10: Moving the Timing of the Regime Shift Dummy Variable, *M*

Parameter γ_{2m}, change in response to a 1 per cent rate move
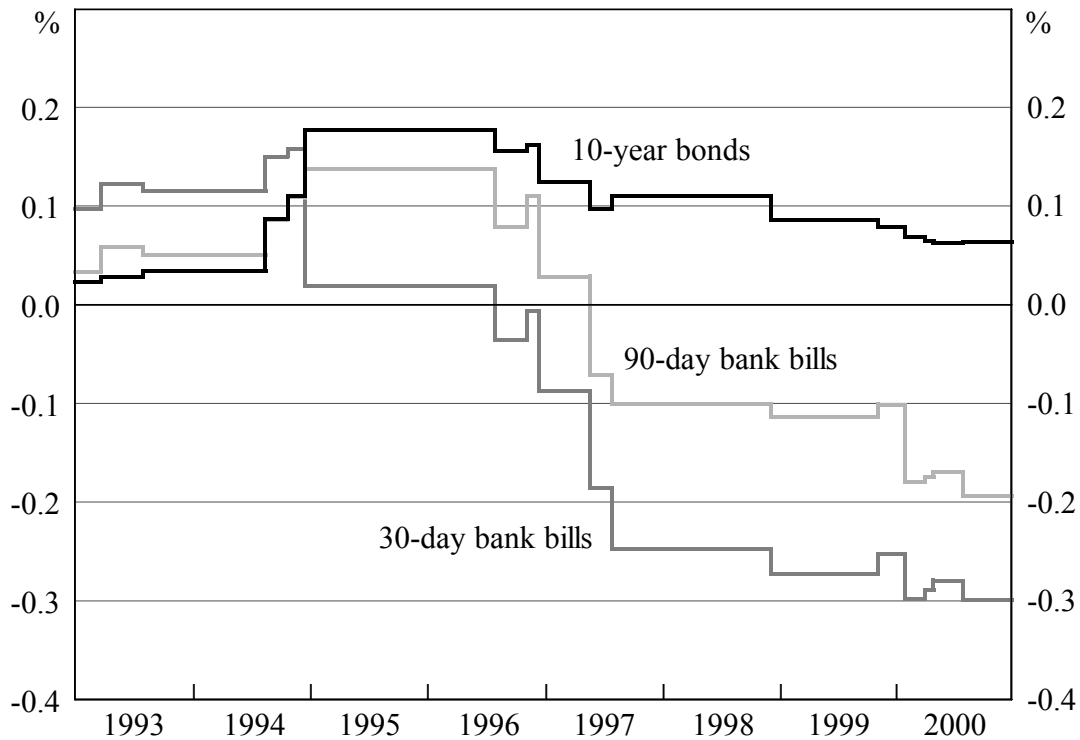
Source: RBA

In summary, time series analysis indicates a reduced response to policy moves at the short end from around mid 1997, consistent with the interpretation that markets have become better able to anticipate monetary policy decisions. This finding is similar to Haldane and Read (2000), who found that transparency innovations in the UK in 1992 significantly lowered the size of shocks to short-end interest rates. Muller and Zelmer (1999) found a similar result for Canada associated with transparency improvements in 1994. However, the result differs from Bomfim and Reinhart (2000), who found that the relationship between monetary policy moves and short-end interest rates in the US did not change as a result of disclosure reforms introduced in 1994.[15]

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[15] Ross (2002) also estimates interest rate surprise effects in the US, the UK and Germany/ECB, comparing the period 1991–1998 with the period 1999–2002 and finds that variability at the short end of the yield curve has fallen in the US and the UK, but has risen in the euro area. These cross-country results are consistent with the trends outlined in Table 2.

3. Conclusion

There is no single model of monetary policy transparency, and communication arrangements of central banks differ in various respects depending partly on the governance and accountability structures in place in each country. Nonetheless there has been a common trend towards increased transparency among central banks over the past 10–15 years, including in Australia. This paper has attempted to discern the impact of this trend on the behaviour of financial markets using data for Australia and, where possible, international comparisons. We find that interest rate volatility at the short end has fallen dramatically in Australia since the late 1980s, and the extent to which market participants anticipate changes in the policy rate has gradually risen. This is consistent with markets being better informed about the policy process and about the likely impact of newly available information on monetary policy. The results suggest that the performance of Australian financial markets in these respects has been quite similar to the experience of a range of other countries.

Appendix A: Data

Table A1: Interest Rate Data and Sources

	Policy rate	1-month[a]	3-month[a]	90-day futures[b]
Australia[c]	Cash rate: *Bulletin* Table A.2[d]	Bank bills: *Bulletin* Table F.1	Bank bills: *Bulletin* Table F.1	Bank Bills: IR1–IR8
US[e]	Fed funds target rate: Federal Reserve[f]	Eurodollar deposits:[g] Federal Reserve	Eurodollar deposits:[g] Federal Reserve	Eurodollar: ED1–ED8
UK	Base rates: Bank of England	LIBOR: LDNIB1M	LIBOR: LDNIB3M	LIBOR: L1–L8
Germany/ECB	Repo rate: ECB[h]	FIBOR:[g] FIBOR1M and GERMDRM pre-January 1999	FIBOR:[g] FIBOR3M and GERMDRQ pre-January 1999	EurIBOR: ER1–ER8
Japan	Target call rate: Bank of Japan	Euroyen: ECJAP1M	Euroyen: ECJAP3M	–
Sweden	Repo rate: Sveriges Riksbank	StIBOR: SIBOR1M	StIBOR: SIBOR3M and STIB3M <Index>[b] pre-December 1992	–
Canada	Target rate: Bank of Canada	Bankers acceptances: Bank of Canada	Bankers acceptances: Bank of Canada and ECCAD3M pre-January 1990	Bankers acceptances: BA1–BA8
NZ	Cash rate: RBNZ	Bank bills: RBNZ	Bank bills: RBNZ	Bank bills: ZB1–ZB8

Notes:
(a) Codes from Thomson Financial Datastream.
(b) Codes from Bloomberg.
(c) 180-day bank bills obtained from *Bulletin* Table F.1; 3-, 5- and 10-year bonds obtained from *Bulletin* Table F.2.
(d) RBA internal data prior to 1990.
(e) Six-month Eurodollar deposits, 3-, 5- and 10-year constant maturity bonds obtained from Federal Reserve website.
(f) Dungy and Hayward (2000) used prior to 1990.
(g) The response to policy moves is lagged one day since policy moves announced after market rate is measured.
(h) Deutsche Bundesbank repo rate used before 1999 from annual reports, with average of Lombard and discount rates used before April 1996, as in Hardy (1998).

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