The implementation of monetary policy in Australia

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Introduction

Over the past decade, the monetary policy framework in Australia has changed substantially, with the most significant change being the adoption of an inflation target in the early 1990s.[2] There have also been changes at the operational level. Many of these changes were part of an evolutionary process following the deregulation of financial markets in the first half of the 1980s, but a major change occurred in January 1990 when the Reserve Bank began to announce changes to the stance of monetary policy, as reflected in the level of overnight interest rates. Prior to that, it simply operated in the market and left market participants to draw their own conclusions about policy changes. One consequence of this move to announcements was that interest rate changes are now implemented as discrete, and fairly large, steps.

This paper discusses some of the thinking behind these changes in operating procedures and the effects that they have had on financial markets and the transmission mechanism. The paper is structured as follows. Section 1 describes the main features of current operating procedures. Section 2 discusses the reasons why the Bank adopted these arrangements. Section 3 then examines the impact of the changed procedures on financial markets, including the effects on interest rate volatility, market turnover, and the speed with which financial institutions adjust their deposit and lending rates. Finally, Section 4 makes some concluding comments, and foreshadows possible changes to market operations that will result from the move to real-time gross settlement next year.

1. The Australian framework for implementing monetary policy

1.1 Current operating procedures

Domestic market operations became the main mechanism for implementing monetary policy in Australia in the mid 1980s, as part of the general trend towards deregulation. The immediate objective of these operations is the overnight interest rate (also known as the "cash" rate), which is the instrument of monetary policy. Since 1990, the Bank has announced an operational target for the cash rate (expressed as a single figure) each time monetary policy is changed.

Market operations influence the cash rate by changing the availability of banks' "settlement" balances – that is, the funds used by banks to settle their payments obligations. These settlement balances are held in banks' Exchange Settlement Accounts at the Reserve Bank, and do not count towards reserves held for the purpose of meeting reserve ratios.[3] Interest is paid on settlement balances at a rate 10 basis points below the Bank's target for the cash rate.

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[1] We would like to thank Eleanor Lewis and Tim Rocks for invaluable research assistance.

[2] The Bank's inflation objective is to achieve an average rate of inflation of between 2 and 3% over the course of the business cycle. This objective has been formally endorsed by the Federal Government.

[3] The reserve ratio on banks is set at 1% of liabilities. The reserve requirement is determined each month in relation to the previous month's average liabilities. This reserve ratio currently has no monetary policy significance, but effectively acts as a tax on banks (they are paid a rate of interest 5 percentage points below the market rate).

Exchange Settlement Accounts must be in credit at all times, so banks seek to maintain sufficient funds in these accounts to meet their daily settlement needs – i.e. the demand for these reserves is essentially a transactions demand, and is quite well defined. Any tendency for reserves to move away from the level that banks regard as desirable quickly results in pressure on the cash rate as banks attempt to restore their holdings to the desired level. The fact that banks earn a rate of return on their settlement balances which is only a small margin below the overnight rate means that downward pressure on rates is limited.

The Bank's market operations are conducted in Commonwealth Government securities (the securities issued by the Federal Government). They involve both outright trading and repurchase agreements, though the latter account for about 90% of transactions. At times, the Bank supplements these operations with foreign currency swaps.

Any participant in the wholesale market for government securities is eligible to deal with the Bank.[4]

Inter-bank settlement is on a net, deferred (next-day) basis.[5] This means that the "exogenous" factors which affect the banks' cash position are largely known at the start of each day. The Bank publishes this estimate of the cash position at 9.30 am each day, together with its dealing intentions for the day (whether it will buy or sell, though not the amounts). Announcements of monetary policy changes are also made at this time. Dealing operations are conducted later in the morning, around 10.30 am. Because the market cash position is known at the start of the day, the Bank usually needs to engage in only one round of dealing each day to maintain the required degree of reserve pressure.

Should, for some reason, banks wish to obtain additional reserves to those supplied by the Bank in its morning dealing round, they (and any other market participant) may rediscount Treasury notes at the Reserve Bank at their discretion. A substantial penalty applies to rediscounts (75 basis points over market yields) and, given that the cash rate rarely diverges from the target by this margin, the rediscount facility is used very infrequently.[6]

1.2 History of policy announcements

Prior to January 1990, the Bank did not announce its monetary policy stance when changes were implemented; instead, market participants assessed the stance of policy from the Bank's actions in money markets and from changes in the overnight interest rate. Under this arrangement, changes to policy were not always immediately obvious to the market due to noise in the overnight rate.

This method of operation was common to a number of countries at that time. After the difficulties experienced with administered interest rates in the 1970s, central banks saw advantages in implementing monetary policy through market operations and in having some volatility in short-term interest rates; in particular, this was seen as providing some flexibility in policy implementation – e.g. there was scope to start "snugging" rates higher, and then reverse, if subsequent data did not support the move. This arrangement was seen as allowing central banks to take timely action, particularly in raising rates, as it avoided the risk of having to announce reversals of policy which could be damaging to credibility. To the extent that volatility in interest rates encouraged a public perception that markets

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4 Prior to June 1996, the Bank's dealing counterparties were restricted to a group of authorised money market dealers (discount houses).

5 Australia is scheduled to move to a real-time gross settlement payments system at the end of 1997.

6 For more detail on the history of the Bank's domestic market operation, see Rankin (1992 and 1995) and Battellino (1990).

set financial prices, it was consistent with the then prevailing view that central banks should focus on quantities rather than setting financial prices.

In January 1990, the Bank decided to ease policy after a prolonged period of very tight monetary conditions in the late 1980s. There were concerns about how this would be received in financial markets. For one thing, the change marked a reversal of a process of policy tightening that had been going on for about two years. The decision was also somewhat pre-emptive, and therefore ahead of a clear consensus in the market about the need for an easing. The situation was further complicated by the fact that a federal election was imminent, and there was a risk that in the circumstances the easing could have been interpreted as being politically motivated. For these reasons, it was felt that the Bank should make a public explanation of the policy change.

This initial announcement was made mid morning, at the end of the Bank's dealing session for that day and as market interest rates began to fall. The announcement was successful and a similar approach was followed in the subsequent easing. The practice of announcing each policy change has continued since, with the timing being brought forward to the start of the day – i.e. ahead of the Bank operating in the market.

The decision to make announcements brought with it the need to make explicit the size of the change in interest rates. Initially, the Bank gave a range for the cash target, on the grounds that it was not sufficiently confident that it could immediately achieve a precise target. In the event, however, the Bank soon found that its control over the cash rate had increased under the new arrangements, and it therefore began to announce a single target rate. As time went on, market dynamics changed further, with the cash rate moving quickly to the new target on the announcement – i.e. ahead of the Bank operating in the market for the day.

The effect of the change in operating procedures on the speed of adjustment of the actual cash rate to changes in the target rate has been estimated using the following error-correction model:

$$\Delta r_t = \alpha + \sum_{i=1}^{K} \beta_i \Delta r_{t-i} + \sum_{i=0}^{L} \gamma_i \Delta \bar{r}_{t-i} + \lambda r_{t-1} + \phi \bar{r}_{t-1} + \varepsilon_t$$

where r_t is the actual cash rate and $\bar{r}_t$ is the target cash rate.[7] The equation was estimated using daily data and over two time periods: the first running from 1st July 1985 to 22nd January 1990 (the day before the first announcement) and the second from 23rd January 1990 to 2nd September 1996. In estimating the equations we initially included seven lags of the changes in both the actual and target cash rate and then used the general-to-specific methodology to obtain a more parsimonious specification. The estimation results are reported in Appendix 1.

As expected, the estimates for both periods indicate that eventually changes in the target cash rate are fully reflected in the actual cash rate. There are, however, important differences in the two sets of results. First, in the earlier period the absolute daily changes in the cash rate were much larger and much less well explained by movements in the "target rate". Second, in the period in which announcements have been made, the actual cash rate has adjusted more quickly to the target rate. By the day after the change in the target rate, the adjustment is complete with the vast bulk of the adjustment occurring on the day of the policy change.[8] In contrast, in the earlier period the point estimates suggest that if the "target rate" was changed by 100 basis points, the actual rate would move

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7 In the period prior to January 1990 when there was no official target for the cash rate, we have used the midpoint of the informal band that guided the operations of the Bank's domestic trading desk.

8 Prior to the Reserve Bank paying interest on settlement balances, there were opportunities for banks to earn a small profit around the time of the change in policy by attempting to adjust their level of float; i.e. the net obligations arising from unsettled cheques. Because the interest rate paid on the float was based on the average cash rate for the week, a change in policy late in that week meant that banks had some scope to arbitrage between the overnight rate and the float rate, which could slow down the adjustment of the overnight rate to the new target.

by only 26 basis points on the day of the change; after one week the actual rate would have moved by around 50 basis points, and after one month, by around 90 basis points.

2. The thinking underlying current arrangements

2.1 The case for announcements

Looking back, the Bank's view is that there have been significant net benefits arising from the practice of making announcements. Essentially these rest on the now well documented arguments for central bank accountability. Among the specific benefits:

- The discipline of having to explain to the public the reasons for policy changes has led to greater rigour in the Bank's internal policy debates, and a clearer focus on the objective of the policy change.
- Clear statements of the reasons for policy changes have led to greater community acceptance of monetary policy decisions, and a better understanding in the community of the Bank's objectives. As a by-product, it has enhanced perceptions of the Bank's independence, as the community now more fully appreciates the Bank's responsibilities for monetary policy decisions.
- There are some signs that it has improved the transmission of monetary policy. There appears to be a more direct psychological impact on households and businesses, and the pass-through to bank interest rates is noticeably faster, particularly when monetary policy is being tightened. The reasons here are two-fold. First, recognition lags – i.e. the time it takes the market to discern a change in policy – have been eliminated. Second, there is more pressure on banks to respond to a publicly announced change in policy than was the case when policy changes were discernible only to professional market participants.[9]

The process of announcing changes to the cash rate target has some of the same characteristics as a system of administered interest rates, and there was therefore some concern, when the Bank decided to make policy announcements, that it would reduce flexibility. In particular, it could lead to greater reticence in implementing policy changes and thereby increase response lags. In the event, however, this concern has proved unfounded.

Overall, the move by the Bank to announce and explain each policy change is seen, both in the Bank and in the community at large, as being a positive development and it would be difficult to envisage circumstances in which the Bank would now move away from this practice.

2.2 The pattern of interest rate changes

Since 1990, there have been 20 changes in monetary policy – fifteen easings between 1990 to 1993 as the overnight interest rate was reduced from 18 to 4.75 %; three tightenings in the second half of 1994; and two easings in the second half of 1996. Of these, one involved a change in the cash rate of 150 basis points; eleven involved a change of 100 points; two involved a change of 75 points; and six involved a change of 50 points.

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[9] Caplin and Leahy (1996) argue that a single large reduction in interest rates may be more effective than a sequence of small reductions, as small reductions lead investors to expect further cuts with the consequence that they delay their investment. They argue that "policy needs to be more aggressive than the reaction it seeks to elicit" (p. 699).

These changes in the overnight interest rate have generally been larger than is the case in many other developed countries; on average, the size of moves has tended to be about twice as large as those in other English-speaking countries (see Table 1).

Table 1
International comparison of changes in interest rates

Country	Latest tightening cycle (1994)			Latest easing cycle (1995-96)		
	Number of changes	Total change (basis points)	Average change (basis points)	Number of changes	Total change (basis points)	Average change (basis points)
Australia	3	275	92	2	100	50
United States	7	300	43	3	75	25
Canada	10	450	45	20	500	25
United Kingdom	3	150	50	4	100	25

Despite the larger size of moves, interest rates have typically been adjusted multiple times in the same direction before a move is made in the other direction, a pattern which is common to most countries.[10] The Australian experience is summarised in Table 2. Using data on the "target" cash rate, we characterise each interest rate change as a "continuation" or a "reversal", where a "continuation" is a movement of the target rate in the same direction as the previous change, while a "reversal" is a move in the opposite direction. The table shows that over the past decade the number of continuations is almost four times that of reversals. Over the period in which changes in the target rate have been announced, the ratio of continuations to reversals is even higher, reflecting the long series of reductions in interest rates in the early 1990s.

Table 2
Interest rate changes in Australia

	Number of changes	Average size (basis points)	Average number of days since previous change
January 1985 - November 1996			
- Continuations	38	94	72
- Reversals	9	122	185
- Total	**47**	**99**	**94**
January 1990 - November 1996			
- Continuations	17	87	88
- Reversals	3	75	372
- Total	**20**	**85**	**130**

[10] See, for example, Goodhart (1996) and Rudebusch (1995).

Table 2 also shows the average size of the movements in the cash rate and the average numbers of days between movements. There is no systematic difference in the average size of reversals and continuations, but as the time lengthens since the previous policy adjustment, the probability that the next move will be a reversal appears to increase.[11]

The relatively large number of continuations suggests that interest rate changes are positively autocorrelated. This positive correlation appears to be strongest for quarterly changes in interest rates – over the entire period from January 1985 to August 1996 the correlation between the quarterly change in the target cash rate and the change in the previous quarter is 0.53. In interpreting this correlation, it needs to be kept in mind that the period since the late 1980s was one in which Australia experienced a long-term decline in inflation, and hence also in interest rates, which would have contributed to the autocorrelated outcomes.

The positive autocorrelation of quarterly interest rate changes implies that changes are predictable, in the sense that the probability of an interest rate increase and the probability of a decrease are not always equal. Any predictability of changes in policy interest rate has been criticised by economists who argue that the authorities should set the interest rate so that the probability that the next move is up is equal to the probability that it is down. This argument is typically based on a model which sees a very restricted role for monetary policy. For example, Barro (1989) argues that the monetary authority's task is simply to move the nominal interest rate in line with the equilibrium real rate, which is constantly changing in an unpredictable fashion. As a result, changes in the nominal rate should also be unpredictable.

In contrast, if the equilibrium real rate is constant, or varies around some (constant) average, movements in policy interest rates will sometimes be predictable. Suppose, for example, that the central bank raises nominal (and real) interest rates to combat an inflation shock. At some point in the future, one would expect that interest rates would need to be lowered, otherwise the real interest rate would be permanently higher. Given such an expectation, it cannot be true that the interest rate is always set at the point where the expected change over any future period is zero. Put simply, if there is an equilibrium nominal interest rate and the current rate is not at the equilibrium, interest rate changes will, to some degree, be predictable.

This predictability implies that interest rate moves away from equilibrium will be followed by reversals; it does not imply multiple movements of the policy interest rate in the same direction. Interest rates could be moved up in response to a shock and then moved back down in a single step to their initial value. This is the pattern that Goodhart (1996) has in mind when he argues that an important explanation for the persistence of inflation is that central banks "do not vary interest rates sufficiently aggressively, or promptly, to hold inflation to a desired path". The argument is that by delaying interest rate moves, or by moving by too small an amount, central banks are eventually forced to make further moves in the same direction. Goodhart argues that if a central bank was pursuing an inflation objective, the level of the official interest rate should be random (around some constant mean), so that only the next move (back to the mean) would be predictable.

In contrast, Blinder (1995) has implicitly argued that a sequence of predictable interest rate movements represents optimal behaviour, stating that "a little stodginess at the central bank is entirely appropriate" (p. 13). He suggests that central banks follow a strategy in which movements in interest rates are smaller than optimal, but are followed up with subsequent movements if things work out as expected.

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[11] Rudebusch's (1995) analysis of changes in the federal funds rate between 1974 and 1992 suggests that in the first couple of weeks after a change there is a higher probability that the next move will be in the same direction, rather than in the opposite direction. After four weeks the probabilities are broadly equal.

There has been little formal justification for why central banks might act in this way.[12] As a consequence, the remainder of this section is devoted to discussing possible explanations of the observed pattern of interest rate changes (other than sub-optimal behaviour of the central bank). The most plausible explanations have their roots in the uncertainties that policy makers face.

2.3 Reasons why central banks engage in interest rate smoothing

There are three broad lines of argument why central banks may want to smooth interest rate changes:

- slow adjustment of interest rates represents the optimal response to shocks, even when there are no costs of adjustment;
- when there are adjustment costs, slow adjustment of interest rates reduces these costs; and
- slow adjustment of interest rates is due a combination of uncertainty and the costs incurred in changing the *direction* of interest rates.

2.3.1 Slow adjustment can be optimal

It is sometimes argued that the positive autocorrelation of interest rate changes is *prima facie* evidence that central banks are not doing their job properly; that they are not moving aggressively enough to offset shocks. Certainly, one can build simple models which predict that a central bank with an inflation target will deliver uncorrelated interest rate changes (Goodhart (1996) and Barro (1989)). However, slight variations to these models can deliver systematically positively autocorrelated interest rate changes (see Appendix 2). The critical issue is whether the economy responds to a change in interest rates in the same way as it does to various other shocks. The model in Appendix 2 illustrates that if the response patterns are sufficiently different, moving interest rates multiple times in the same direction may represent the optimal policy response to a shock.

2.3.2 Adjustment costs

If interest rates are costly to adjust, it may be sensible for central banks to move gradually to their desired target. The critical point is that the costs must be increasing at an increasing rate in the size of the adjustment. If so, moving in small steps minimises the total adjustment costs. In contrast, if there is simply a *fixed* cost of adjusting interest rates, small adjustments will be ruled out, but so too would be multiple moves.

One reason why central banks might avoid moving in one large step to the estimated new desired interest rate is that this could be very disruptive in financial markets, and could even threaten the stability of the financial system.[13] Large unexpected changes in funding costs and securities prices could undermine financial institutions. One caveat to this line of reasoning is that, in principle, a

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[12] There is, however, an extensive literature on the issue of whether monetary policy should smooth interest rates in the face of changes in money demand, with Poole (1970) being the seminal article. For example, Mankiw and Miron (1991) have examined the issue of whether central banks should smooth interest rates in the face of seasonal changes in the demand for money. Mankiw (1987) and Barro (1989) have also argued that maintaining a smooth interest rate may be optimal from the point of view of smoothing the inflation tax. There is also an extensive literature on the implicaitons of interest rate smoothing for tests of the expectation theory of the term structure (for example, see Rudebusch (1995), Balduzzi, Bertola and Foresi (1993) and McCallum (1994)).

[13] A version of this argument is made by Cuikerman (1991). He argues that in the US, the maturity mismatch between banks' assets and liabilities means that the Fed wishes to partially offset unanticipated increases in interest rates. The smaller is the maturity mismatch, the smaller is the incentive to smooth rate changes.

small change in interest rates which is accompanied by expectations of further moves should have a similar effect on long bond yields as a large, one-off move. However, in practice, it is questionable whether this is the case, as many financial prices appear to react slowly to news. Recent experience suggests that even though a sequence of policy changes is expected, the full reaction in financial markets does not occur up front, but gradually over the period of adjustment of policy interest rates. Partly as a legacy of the history of relatively small movements, large up-front changes in policy interest rates risk causing much larger short-run movements in securities prices. Even without this history, large unexpected changes in policy interest rates probably add to financial market volatility, and in some cases concentrate the losses in particular institutions, ultimately threatening the stability of the financial system.

Similar issues arise for households and businesses. A gradual adjustment in policy interest rates can provide breathing space for borrowers to re-arrange their financial affairs, so that the liquidity effects of a change in interest rates are not as dramatic. This line of argument is obviously more relevant in financial systems in which variable-rate debt plays a significant role.

2.3.3 Uncertainty and costs of reversals

The most persuasive argument for moving gradually is that monetary policy is made under considerable uncertainty. Policy makers do not know the true model of the economy, they do not know the exact impact that a change in interest rates will have on activity and inflation, and it can be difficult to assess the current state of the economy.

Uncertainty about the model

Blinder (1995) notes that uncertainty regarding the value of the parameters in the policy-maker's model justifies making smaller interest rate movements than would otherwise be the case. The idea, based on earlier work by Brainard (1967), is that as the interest rate is moved further away from its average value, policy makers become more uncertain about how a change in the interest rate will affect their objectives. This increased uncertainty reduces the optimal size of the policy move.

While the idea provides a convincing rationale for policy makers being cautious in changing interest rates, it does not provide a complete explanation for multiple moves in the same direction. It could only do so if, after having moved the interest rate, the central bank learns some information which reduces the degree of parameter uncertainty. The gradual reduction in uncertainty would then lead to multiple moves towards the target rate. A difficulty with this argument is that the time between movements in policy interest rates is often too short for there to be any significant reduction in the degree of parameter uncertainty.

Uncertainty and costly reversals

Another model of the effects of uncertainty is suggested by the work stimulated by Dixit (1989).[14] In attempting to explain the slow evolution of the capital stock to its optimal level, Dixit proposed a model which considered the interactions of:

(i) uncertainty about future returns;

(ii) the irreversibility of investment projects;[15] and

(iii) the possibility of delaying investment.

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[14] For a comprehensive review see Dixit and Pindyck (1994).

[15] More recent models have allowed investment to be reversed, but at a cost (see Abel et al (1996)).

The analogy to monetary policy is clear:

(i) policy makers are uncertain about the future state of the economy;

(ii) changes in the direction of interest rates are seen as costly; and

(iii) there is always the possibility of delaying an interest rate change until the policy maker has more information.

The investment literature makes the point that the ability to delay investment decisions can profoundly affect the decision to invest today. If there are costs of reversing an investment, making a decision to invest today involves giving up the option of waiting for new information, and perhaps making a better decision tomorrow. As a result, it may be optimal to delay investment, or to make a smaller investment and subsequently increase its size if the uncertainty is resolved in the direction that was expected. While a delay in investment is a common prediction of these models, Abel et al (1996) note that other outcomes are possible. For instance, if the cost of future investment is expected to rise, delaying an investment may be sub-optimal even in the presence of considerable uncertainty.

For these insights to apply to monetary policy, changing the direction of interest rate movements must be costly – that is, there must be a cost to "reversing the investment". The costs might arise in terms of additional volatility in financial markets and potential damage to the central bank's reputation.

To investigate the issue of whether changes in the direction of the cash rate lead to greater short-term volatility in security market yields we estimate the following equation:

$$|\Delta i_t| = \alpha + \beta|\Delta \bar{r}_t| + \delta\, REVERSAL_t + \varepsilon_t$$

where i_t is either the 90-day bank bill rate or the 10-year bond rate, $\bar{r}_t$ is the target cash rate and *REVERSAL* is a dummy variable that takes a value of 1 if there is a reversal of policy on that day, and takes a value of zero otherwise. We use daily data and restrict the estimation period to the period over which announcements have been made. The results are presented in Table 3. If policy reversals cause increased volatility in the yields on 90-day bills or 10-year bonds the coefficient on the *REVERSAL* dummy variable should be significant and positive.

Table 3
Interest rate changes and market interest rates: regression results

	90-day bills	**10-year bonds**
Intercept (α)	3.2	6.5
	(0.1)	(0.2)
Absolute change in target rate (β)	0.209	0.003
	(0.013)	(0.017)
Dummy for reversal (δ)	6.2	14.7
	(2.9)	(3.8)
$\bar{R}^2$	0.16	0.01
Number of observations	1,678	1,678

Notes: Standard errors are in parentheses below coefficient estimates. Sample period is from 23rd January 1990 to 2nd September 1996. Interest rates are expressed in basis points.

In both equations, a change in the direction of monetary policy appears to be associated with a larger than average movement in the market interest rate, with the effect being particularly

pronounced for the 10-year bond yield. The estimates suggest that on days when policy is moved in the opposite direction from the previous move, bond yields have tended, on average, to move by an additional 15 basis points; for bill rates the figure is 6 basis points. This larger movement occurs despite the fact that the change in direction was not always unexpected. The results also confirm that the larger is the change in the cash rate, the larger the change in the bill rate. This suggests that large changes in policy interest rates would induce more volatility into the short end of the yield curve. There appears to be no such effect at the longer end of the curve. While it is difficult to draw strong conclusions due to the small number of reversals in the sample period, the results suggest that policy reversals increase short-term volatility across the yield curve. This issue is a topic for future research.

A more difficult issue to evaluate is whether this additional volatility is itself costly. Perhaps more difficult still is the issue of whether reversals would continue to generate additional volatility if they were more frequent. If reversals occurred as often as continuations, would they be less newsworthy and would they invoke a smaller reaction from the market? Or would the frequent reversals undermine confidence in the central bank, ultimately leading to greater volatility in financial markets?

The issue of how frequent reversals might affect the credibility of the central bank has importance beyond the implications for financial markets. If frequent changes in the direction of interest rates undermine public confidence in the central bank, inflation expectations might be higher than would otherwise be the case and the climate for investment may be adversely affected.

In Australia, as in all developed countries, changes in interest rates attract considerable public attention; on the day of the change, it is usually the leading story in the media. The Reserve Bank's practice of announcing and explaining interest rate changes has tended to make policy changes more newsworthy, which may have made frequent changes in the direction of interest rates more difficult. In the absence of clearly defined shocks (such as a large exchange rate change) it may be difficult for the central bank to make the case to the public that interest rates should be lowered one month, raised the next, and then lowered again a month later. Regardless of whether or not such a policy was "optimal", the public would probably see the central bank as indecisive. As discussed earlier, the flexibility to change direction without adverse effects was an important reason why many central banks in the 1980s did *not* announce changes to policy.

While announcements might make reversals more difficult, they have significant benefits in terms of accountability and the transmission mechanism. These benefits currently outweigh any reduced flexibility that might be associated with the announcements. However, the need to minimise the probability of costly reversals means that some caution is called for in moving rates. By making a smaller change, policy makers can reduce the probability of having to make a costly reversal. If developments turn out as expected, policy can be moved again in the same direction; if the unexpected happens and it turns out that no change in policy was required, the costs of reversing policy are saved. The end results of waiting for uncertainty to be partly resolved are systematically positively autocorrelated interest rate movements and positively autocorrelated inflation and economic activity.

The major qualification to this line of argument arises if the size of the required policy adjustment depends upon the speed and magnitude of the initial policy adjustment. Suppose a delay in adjusting policy to an inflationary shock led to inflation expectations rising. The end result would be much higher interest rates, as the central bank struggled to reverse the rise in expectations of future inflation. In this case, an early and large increase in interest rates may be warranted, despite the fact that an increase of this type increased the probability that the policy move would have to be reversed.

Finally, the stronger is a central bank's inflation record, the longer may be the period it can wait before adjusting policy. If the central bank has high credibility, inflation expectations are less likely to adjust up, and this should give the authorities more scope to wait and to assess the exact nature of the shock and the appropriate policy response. In so doing, increased credibility might provide more scope for the central bank to avoid costly reversals of policy.

Uncertainty and the decision making process

A third way that uncertainty contributes to the positive autocorrelation of interest rate changes is the impact that it has on the decision-making process. There is rarely unanimity among experts concerning the exact magnitude of necessary monetary policy adjustments. Many of the differences of opinion arise from the uncertainty regarding the current state of the economy, the exact nature of shocks and the exact structure of the economy and the associated policy multipliers. Decision making by committee creates an environment in which the various views can be discussed and reduces the probability that extreme decisions are made. However, committee-based decision making can also systematically affect the way policy responds to shocks. It can lead to compromise solutions which involve a smaller initial change in interest rates followed up by a further increase, when the case becomes more compelling.

A related issue is that monetary policy needs to be broadly acceptable to the community as a whole. Again, because of uncertainty about the future, it may be difficult to convince the community that a large interest rate change is the appropriate response to a shock. The case for such a change is likely to depend heavily on the central bank's forecasts for activity and inflation. These forecasts might differ from those of other forecasters and the public may not be convinced that the large change in interest rates is required. With little history of large one-off interest rate movements, the public in most countries is unlikely to find such movements acceptable. The ability of the central bank to convince the public of the need for large movements in interest rates will depend importantly on the confidence that the central bank enjoys in the community. A record of good policy making would undoubtedly assist in this regard. But, even central banks with good records must constantly weigh up the risks of policy errors as public support can quickly be lost. As a result, to maintain a broad consensus concerning the direction of monetary policy, interest rate changes may be smaller and more gradual than would have otherwise been the case.

2.4 An assessment

Three of the defining characteristics of Australia's recent monetary policy arrangements are:

1. changes in policy interest rates have been explicit and the reasons for the change are explained in detail;
2. individual changes in policy interest rates have tended to be large by international standards; and
3. policy interest rates have typically been moved multiple times in one direction before a move in the other direction is made.

As discussed above, clear announcements are not only important from the perspective of accountability, but they also mean that interest rate changes more effectively influence people's expectations about future economic and financial conditions. In turn, the monetary transmission process should be quicker and the amplitude of the interest rate cycle smaller.

Beneficial announcement effects are more likely to be achieved if the changes in policy interest rates retain their newsworthiness. If changes in rates occur extremely frequently, or are very small, their newsworthiness is likely to be diminished, and they are less likely to force a relatively quick change in banks' posted lending rates. Changes in these rates reinforce the attention that the change in official interest rates receives. If policy interest rates were changed frequently, and/or by small amounts, the immediate link between monetary policy and lending rates might be weakened, reducing the overall effectiveness of the policy changes.

There is, however, no clear, unequivocal basis for deciding what is the optimal size and pattern of interest-rate adjustments. The decision is influenced by the expected overall move in rates that is required; by the impact that changes of various sizes will have on people's expectations; by the

costs that are paid if the policy change has to be reversed; and by the degree of uncertainty. In turn, these factors will be influenced by the nature of the forces necessitating the policy change, the institutional structure of the economy and the financial system, and the historical context of policy changes.

The pattern of interest rate changes that has been adopted by the Reserve Bank of Australia is one that has delivered positively autocorrelated inflation rates. The same is true in almost all countries. While the simple models of some economists suggest that this persistence could be eliminated by changing the way in which central banks move their policy instrument, this has rarely been attempted, or achieved, in the real world. The range of uncertainties that policy makers face provide a solid explanation for the persistence of interest rates, and ultimately inflation rates. It is a question of attempting to balance the beneficial announcement effects of relatively large changes in interest rates against the costs that can arise if policy changes are frequently reversed.

3. The impact on financial markets

The move to a transparent approach to implementing policy has reduced volatility in short-term interest rates and resulted in faster pass-through of policy changes to lending and deposit rates of financial intermediaries.

3.1 Volatility in the overnight interest rate

The panels in Graph 1 show daily observations of the overnight interest rate for the period since the mid 1980s. The shaded areas in the pre-announcement period show the informal operating levels that guided market operations.

Graph 2 shows a measure of cash rate volatility over the same period.[16]

The main points to note from these two graphs are as follows:

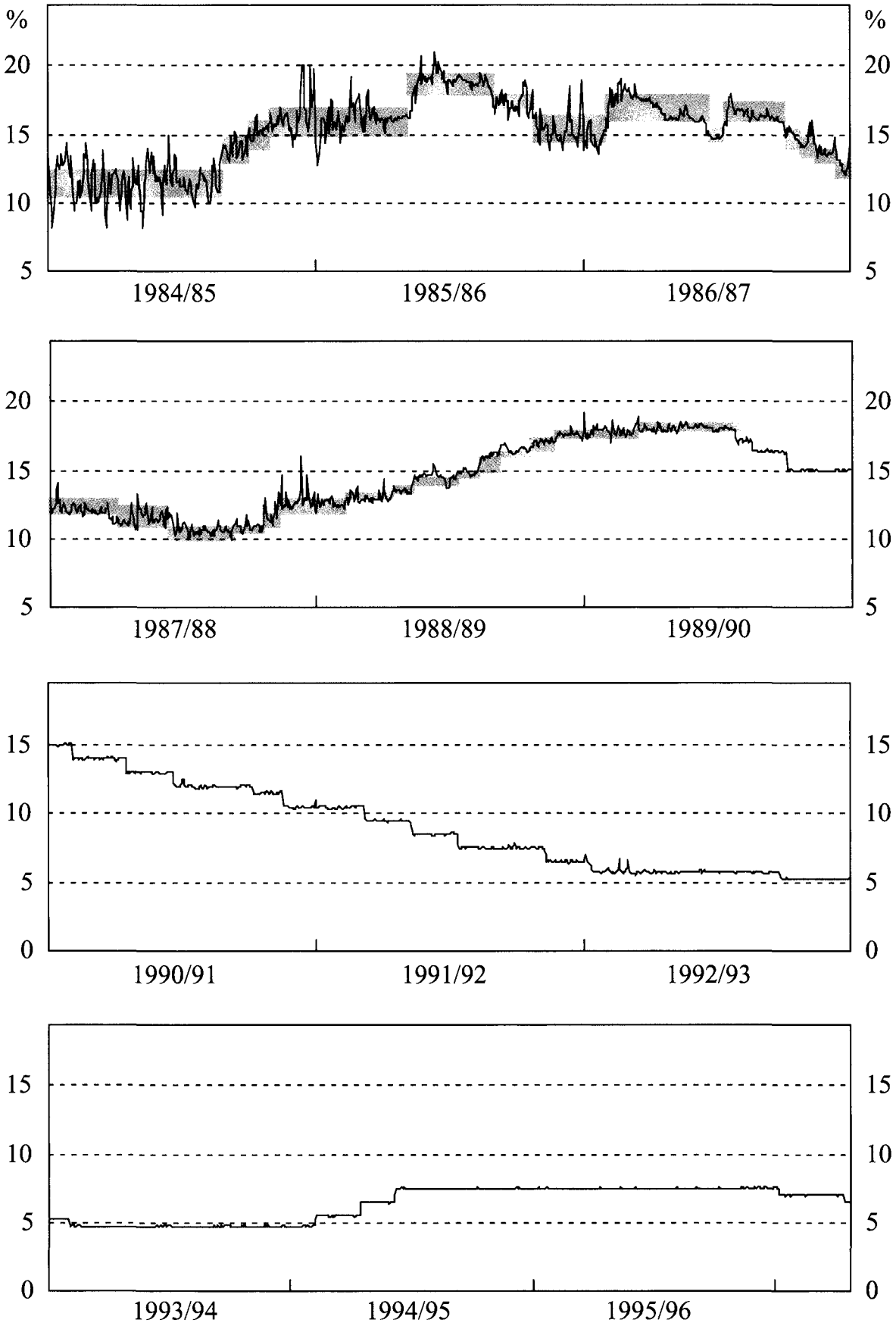
- First, volatility tended to decline progressively in the pre-announcement period, as operating techniques were gradually refined after the start of deregulation.[17] By late 1989, just prior to formally announcing changes in policy, daily volatility had declined to around 25 basis points, compared with around 100 basis points in the mid 1980s.
- Second, after the move to formally announcing policy changes, volatility fell noticeably further. Currently, it is rare for the cash rate to deviate by more than a couple of basis points from the announced target. One of the reasons for this appears to be that market participants assume that the Bank will keep rates very close to the target rate, so that the demand curve for settlement balances tends to be very elastic around the announced rate. The tighter range for the overnight rate has not required the Bank to be more active in managing the supply of reserves. Indeed, the opposite is the case. In the pre-announcement period, around 1 in 5 daily market operations were more than

[16] For the period prior to making policy announcements, the observations represent the standard deviation of the actual daily cash rate from the centre of the band; after January 1990, volatility is measured using differences between the actual and announced cash rate target.

[17] Significant changes included: the start of dealing in repurchase agreements (repos) with the authorised dealers; allowing authorised dealers to deal in repos with others in the market; increasing the flexibility of the terms on which the Bank deals in repos; and the use of foreign exchange swaps.

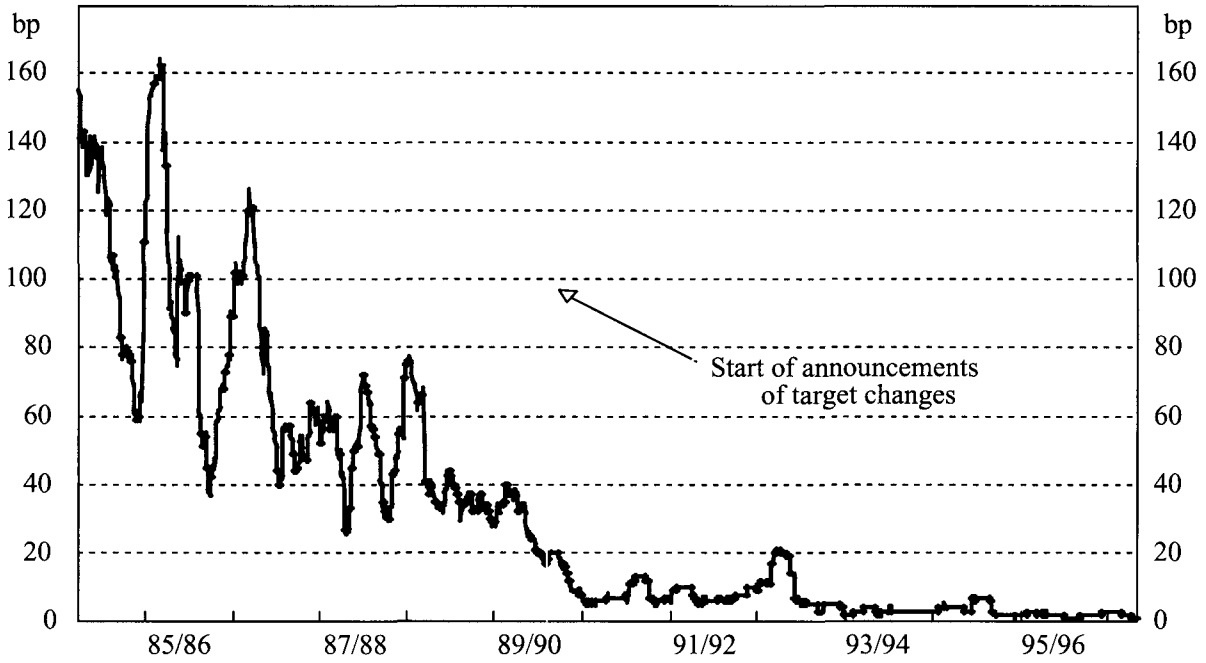
Graph 1

Australian overnight interest rate (daily data)



one-quarter of the size of banks' settlement balances.[18] In contrast, in the post-announcement period, just 1 in 10 daily operations are associated with transactions of this magnitude.

Graph 2
Volatility in the overnight interest rate



3.2 Influence on other short-term interest rates

Short-term market yields are, of course, closely related to expectations of the future level of the cash rate. With the Bank announcing the target cash rate, and daily volatility in the cash rate much reduced, one would expect a commensurate decline in volatility in short-term yields, with yields unlikely to move significantly unless views about the future direction of monetary policy change.

The three panels in Graph 3 show, respectively, the distribution of daily movements in 30-day bill yields, 90-day bill yields and 10-year bond yields, divided into the pre- and post-announcement periods.[19] For bill yields, movements in the pre- and post-announcement periods are strikingly different. In the pre-announcement period, yields moved by more than 10 basis points on almost one in two days. In contrast, the distribution of the daily change in short-term rates in the post-announcement period tends to be much more clustered around zero. More than 90% of changes are 10 basis points or less, with rates rarely moving by more than 25 basis points on any given day. The strong implication is that much of the noise in movements in short-term rates has been removed by increasing the transparency of monetary policy actions. As expected, the change in procedures has not had a significant impact on the distribution of daily movements in bond yields. These yields are influenced more by broad domestic and international economic developments rather than by changes in cash rates.

[18] Prior to July 1996, we have used banks' loans to authorised dealers as for the measure of reserve balances.

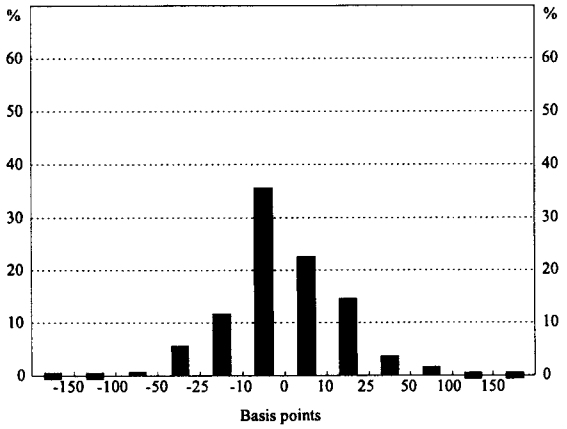
[19] The distribution for movements in 180-day bill rates is virtually the same as for other bill yields.

Graph 3

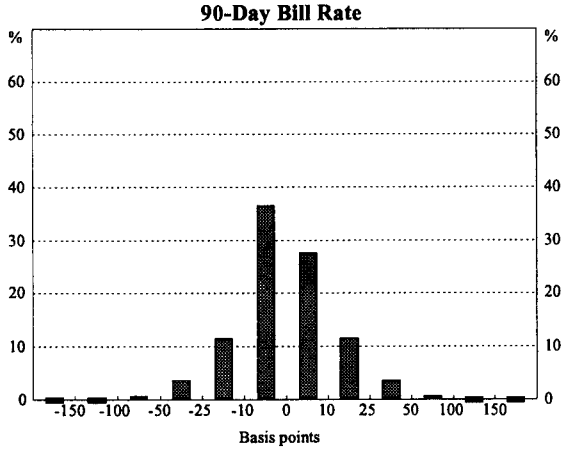
Distribution of daily movements in yields

Pre-announcement

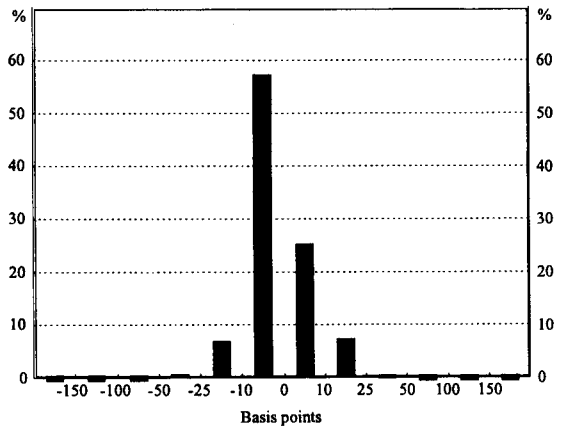
30-Day Bill Rate



90-Day Bill Rate

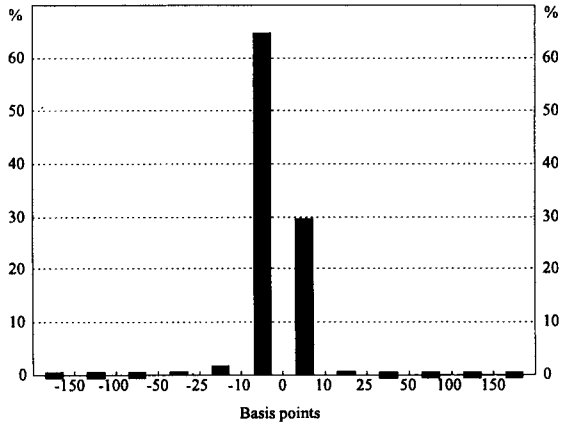


10-Year Bond Yield

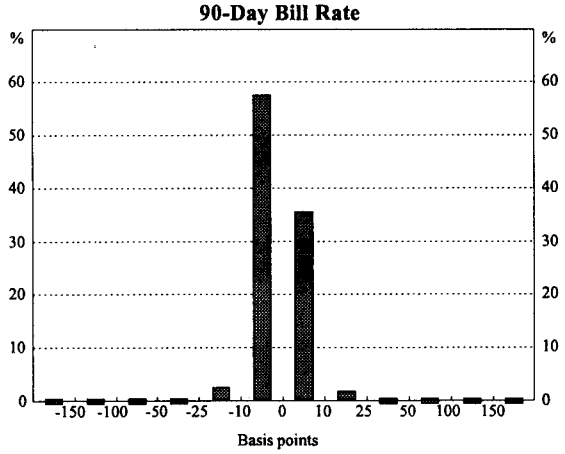


Post-announcement

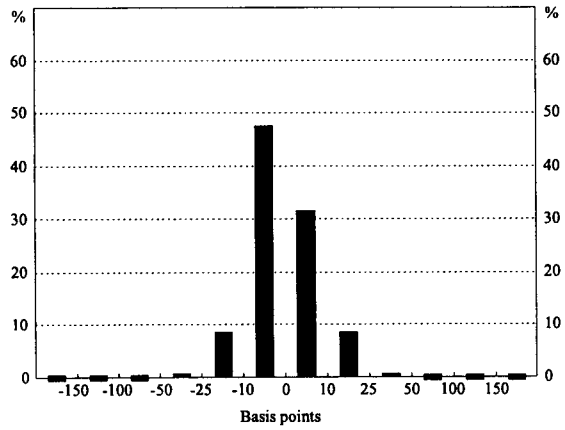
30-Day Bill Rate



90-Day Bill Rate



10-Year Bond Yield

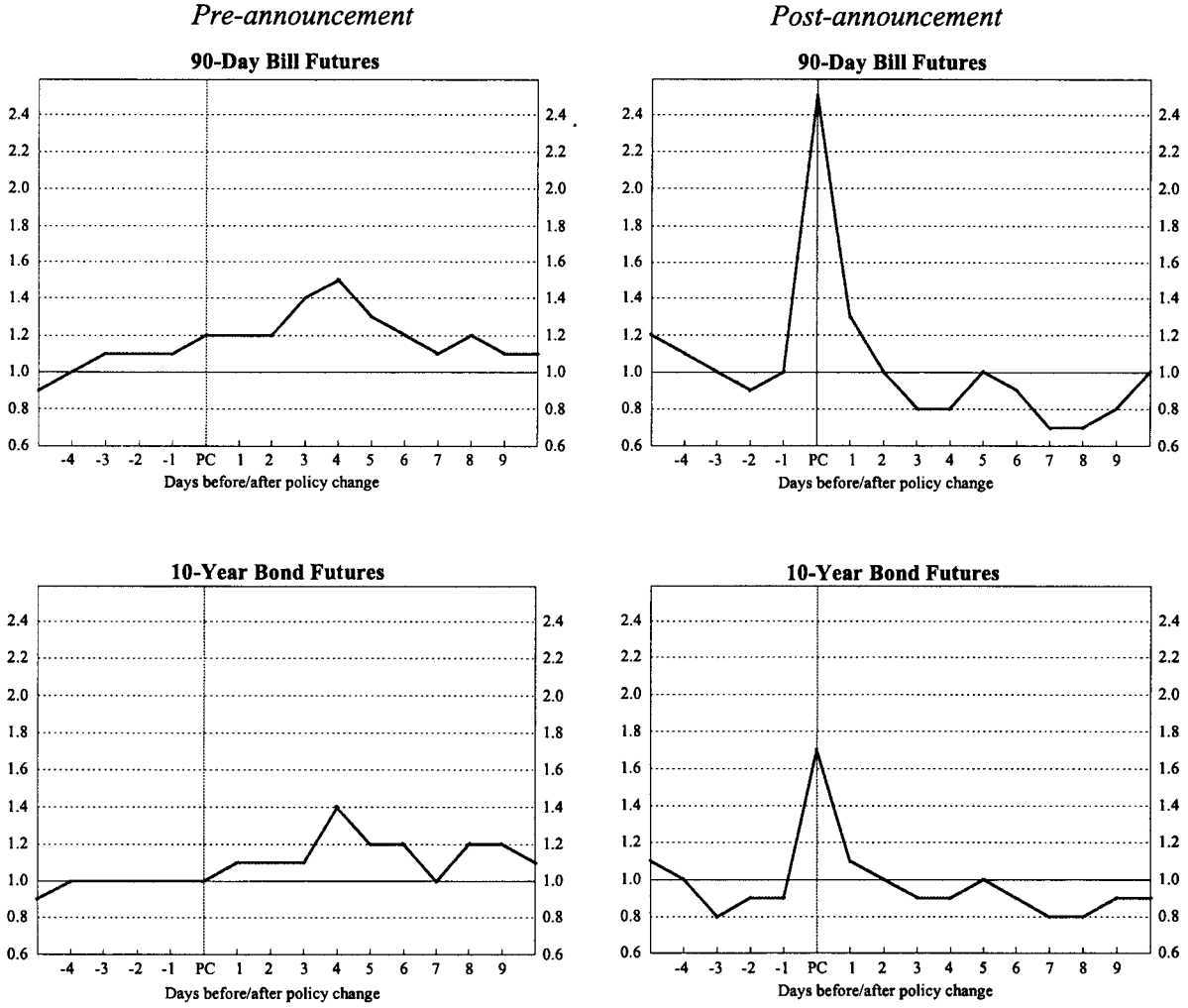


3.3 Impact on futures trading

With relatively deep and liquid futures markets in Australia, many investors find it more cost-effective to take on or unwind interest rate exposures in the futures markets, rather than buying or selling securities outright. Turnover of 90-day bill futures, for instance, is more than ten times the turnover in physical bank bills. We might expect, therefore, that the announcement of changes in policy may initially show up in the level of activity on futures exchanges.

Graph 4 shows the average volume of 90-day bill futures and 10-year bond futures contracts traded around the dates of changes in policy. Volumes have been adjusted to take account of the natural growth of the market, by expressing daily turnover as a ratio of the average daily turnover in that year. A figure around 1, therefore, implies that turnover was "average" on that day, numbers above/below 1 indicate the extent to which turnover was above/below "average".

Graph 4
Daily futures market turnover
As a ratio of annual average

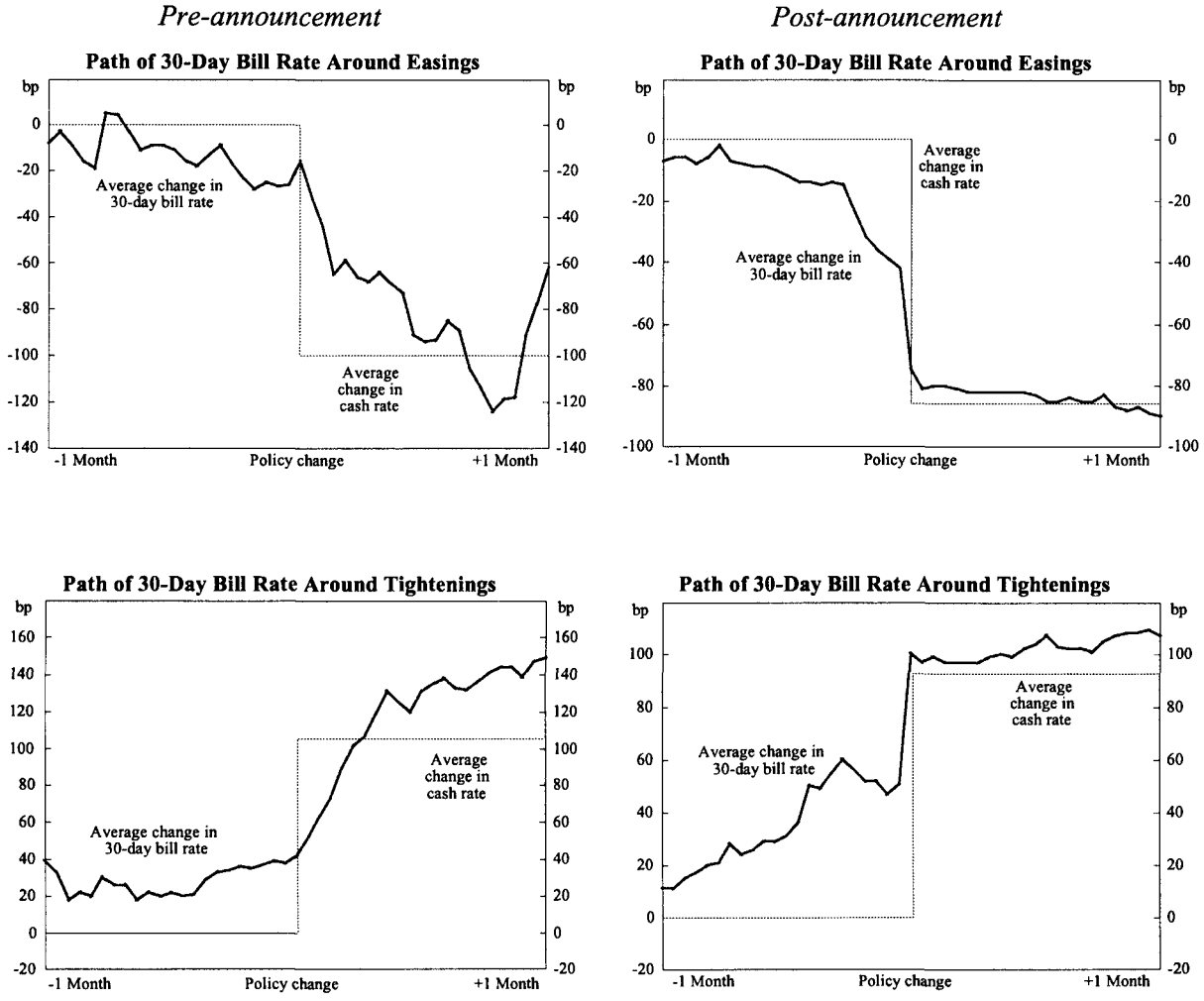


In the period when announcements were not made, there was little impact upon trading on the day when the Bank moved to implement a change of policy. This is not surprising, given that it took time for market participants to guess whether the movement in the cash rate represented a change to a new operating level or day-to-day noise around an unchanged target. Over the course of the next

few days, however, it typically became apparent to the market that policy had, in fact, been changed. The market gradually adjusted, as more participants acknowledged that a change had taken place. Activity on the futures market rose, peaking at around 40 to 50% above average four days after the Bank moved to implement the policy adjustment. The adjustment continued over the course of a couple of weeks.

In contrast, the portfolio balancing occurs at a much faster pace now that policy changes are announced. Turnover surges on the day of the announcement. Trading in bill contracts is about 2.5 times larger than average, with turnover in bond contracts almost 1.8 times higher than average. There is some residual rebalancing on the day following the announcement, probably reflecting offshore investors adjusting their exposures. Turnover quickly settles to around average levels thereafter.

Graph 5
Response of 30-day bill yields to changes in monetary policy



Graph 5 shows the behaviour of the physical 30-day bill yield around the time of a change in monetary policy.[20] In the post-announcement era, expectations of a change in policy have typically built up in the month prior to the rate change, so that typically about half the adjustment has been priced into 30-day bill yields before the announcement; the change is fully priced in on the day

[20] Again, in the pre-announcement period, the mid-point of the informal band is taken as the appropriate reference point.

of the adjustment. One reason why markets now better anticipate policy changes is that, by making announcements, the Bank over time highlights the issues which are important in setting monetary policy. Market participants are therefore in a position to assess data in the economy as they become available and thereby make assessments about policy settings. In the pre-announcement period, the adjustment path was very different. The market typically priced in only a small part of the change in policy prior to its implementation. It then went on to continue adjusting short-term yields in the two or three weeks following the policy change, usually overshooting. In other words, the adjustment phase was slower and much less well-defined.

3.4 Pass-through into lending and deposit rates

In Australia, a high proportion of banking products have traditionally been priced off short-term interest rates. Most loans for housing and for business have variable interest rates, which are set by banks on the basis of the level of short-term interest rates. With policy changes now more transparent, their flow-through to deposit and lending rates could be expected to be faster. Table 4 shows the time lapse between a change in the cash rate and the movement in the 3-month deposit rate, the mortgage rate and the business loan indicator rate for each episode of policy easing and tightening over the past decade. It shows the average time it has taken banks to bring about a change in deposit and lending rates in response to changes in monetary policy.[21]

Table 4
Flow-through of changes in cash rates*
Lags in changes to deposit, mortgage and business indicator rates

	3-month deposit rate	Mortgage rate	Business indicator rate
Tightenings	***Pre-announcements***		
1985	4-5 weeks	20 weeks	9-15 weeks
1988-89	2-3 weeks	3-4 weeks	3-4 weeks
	Post-announcements		
1994	1-2 weeks	1-3 weeks	1-3 weeks
Easings	***Pre-announcements***		
1986	2-3 weeks	0	4-9 weeks
1987	2-4 weeks	7 weeks	4 weeks
	Post-announcements		
1990-93	1-2 weeks	4-5 weeks	3-4 weeks
1996	1 week	1-5 weeks	1-5 weeks

* These figures refer to the time taken for the change in rates to become effective for new customers. Lags in announcement of rate changes are significantly shorter.

The lag with which banks altered their deposit and lending rates fell substantially in the second half of the 1980s, and was reduced further in the post-announcement period. In the mid 1980s, banks took about one month to adjust deposit rates and up to 4-5 months to adjust lending rates in response to tightenings of policy. The lags were roughly halved in the tightening cycle in 1988-89 and halved again in the 1994 phase. Changes to deposit and lending rates are now moved within 1 to 5 weeks of the change in cash rates compared with upwards of 20 weeks in the pre-announcement era.

[21] An earlier paper by Lowe (1994) looked at the extent of the pass-through for the period from 1986 to 1994. He estimated that, in the medium term, the pass-through of changes in the cash rate to 3-month money market rates, housing mortgage rate and business indicator rates were 0.97, 0.65 and 0.89 respectively.

Another change is in the way banks pass through rate changes. In the pre-announcement period, business rates tended to be changed in small amounts over a long period, with changes occurring in up to 10 steps. In contrast, recent changes to cash rates have tended to be fully passed through in one step.

There are many other variables, such as the structure of banks' deposits, the riskiness of bank lending and the degree of competition in banking, that affect the extent and the speed by which changes to monetary policy are reflected in commercial banks' borrowing and lending rates. The gradual decline in banks' deposits which paid a low interest rate and increased competition from non-bank institutions in the housing market would have contributed to the faster pass-through of monetary policy changes. Nevertheless, the unambiguous signal that policy has altered has led to a much greater awareness amongst banks' customers of the extent and the speed by which changes in policy show up in changes in banks' interest rates.

Conclusion

The move to announcing and explaining changes to the overnight interest rate has brought with it a number of benefits. Market conditions are easier to manage, given that the behaviour of participants is conditioned by the fact that they do not expect the cash rate to move much away from the announced target. Benefits have spread to the wider market, including less day-to-day variability in other interest rates. Pass-through of policy changes into both deposit and lending rates has also quickened, which, together with the effect of announcements on expectations, may have contributed to a speeding up of the transmission mechanism. The announcements have also increased the transparency and accountability of monetary policy and helped to promote public understanding of the monetary-policy framework.

The announcement and explanation of movements in official interest rates has not led to increased delays in changing policy, as some had feared. In fact, the changes in operating procedures, together with the adoption of an inflation target, have seen policy become more forward looking and pre-emptive. As the experience of late 1994 illustrates, the Bank has been prepared, when appropriate, to move interest rates in quite large steps and by a relatively large amount in a short period of time. Despite this, movements in interest rates have tended to follow a relatively smooth pattern with a sequence of moves being made in one direction. While a number of factors help to explain this pattern, the most plausible explanations centre on the uncertainty that policy makers face and the costs that would ultimately be incurred if the direction of policy were to be changed too frequently.

Further changes to operating procedures will be necessary with the move to a real-time gross settlement system in late 1997. Inter-bank settlement for high-value payments, including securities settlements will no longer take place on a deferred (next-day) basis, but in real time. This will mean that the cash position of the market will not be known at the start of the day, as it is at present, and the Bank may therefore have to refine its dealing procedures. Changes are under consideration at present.

The push for greater policy transparency and accountability is a continuing one. The Governor has recently agreed to release specific statements on monetary policy, including information on the outlook for inflation, at six monthly intervals, thereby formalising commentary the Bank was providing in its Bulletin. In future, the Bank will also formally report on the conduct of monetary policy to Parliament twice a year.

Appendix 1

Adjustment of actual cash rate to target rate

The table below reports the estimation results for the following equation:

$$\Delta r_t = \alpha + \sum_{i=1}^{K} \beta_i \Delta r_{t-i} + \sum_{i=0}^{L} \gamma_i \Delta \bar{r}_{t-i} + \lambda r_{t-1} + \phi \bar{r}_{t-1} + \varepsilon_t$$

where r_t is the actual cash rate and $\bar{r}_t$ is the target and cash rate.

Daily data were used in estimation and seven lags of the changes in both the actual and target cash rate were included initially. We then used the general-to-specific methodology to obtain a more parsimonious specification. The first sample period (the "pre-announcement" period) runs from 1st July 1985 to 22nd January 1990. The second period (the "announcement" period) runs from 23rd January 1990 to 2nd September 1996.

Regression results

	Pre-announcement period	Announcement period
Constant	0.29	0.00
	(0.09)	(0.00)
Δ in cash rate {t-1}	-0.20	0.00
	(0.06)	(0.04)
Δ in cash rate {t-2}	-0.19	-0.03
	(0.05)	(0.04)
Δ in cash rate {t-3}	-0.14	-0.09
	(0.04)	(0.04)
Δ in cash rate {t-4}	-0.12	..
	(0.05)	
Δ in cash rate {t-5}	-0.03	..
	(0.04)	
Δ in cash rate {t-6}	-0.08	..
	(0.03)	
Δ in target rate	0.26	0.81
	(0.08)	(0.05)
Δ in target rate {t-1}	..	0.07
		(0.04)
Δ in target rate {t-2}	..	0.03
		(0.04)
Δ in target rate {t-3}	..	0.08
		(0.04)
Target rate {t-1}	0.22	0.47
	(0.03)	(0.07)
Cash rate {t-1}	-0.22	-0.47
	(0.03)	(0.07)
$\bar{R}^2$	0.21	0.66
Standard deviation of cash rate changes	0.60	0.10

Note: Standard errors are in parentheses below coefficient estimates.

Appendix 2

A model of interest-rate adjustment

Huang and Goodhart (1996) present a simple model in which the policy interest rate varies randomly around a constant mean. Their starting point is the following inflation process:

$$\pi_t = \alpha + \phi\pi_{t-1} - \gamma I_{t-1} + \mu_t \tag{A1}$$

where π is the inflation rate, I is the policy interest rate and μ is a serially uncorrelated shock to inflation.[22] One could think of this shock as an "exogenous" change in the exchange rate or wages. In this model, inflation is persistent and interest rates affect inflation with a lag. The central bank is assumed to know with certainty that this model represents the true inflation process, and it also knows the parameters with certainty. The objective of the bank is to minimise the expected discounted squared deviations of inflation from some desired level (π^*); that is, it minimises:

$$E\sum_{t=1}^{t=\infty} \lambda^t (\pi_t - \pi^*)^2 \tag{A2}$$

subject to equation (A1). Without loss of generality we assume that π^* is equal to zero. Solving the model, the optimal interest rate at any point in time is given by:

$$I_t = \frac{\alpha + \phi\mu_t}{\gamma} \tag{A3}$$

This rule means that the central bank sets the interest rate at the point where in expectation it achieves its inflation objective. Given that μ is a random variable, the level of the interest rate is also a random variable (around a constant mean), with past movements providing no information regarding the future level of interest rates. This leads Huang and Goodhart to conclude that in a model with persistence and lags, and with the central bank caring only about inflation, there should be no interest rate smoothing.

Now consider what happens when we change the inflation process to the following:

$$\pi_t = \alpha + \phi\pi_{t-1} - \gamma I_{t-1} + \mu_t + \beta\mu_{t-1} + \theta\mu_{t-2} + \eta\mu_{t-3} \tag{A4}$$

The change here is that the shocks to inflation have different dynamic effects on inflation than do changes in the interest rate. For particular values of the parameters, this model allows the inflationary impact of the shock to build over time and then to dissipate.

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[22] All parameters are assumed to be non-negative and the policy interest rate is chosen after the shock is known.

In this model the optimal interest rate rule is given by:

$$I_t = \frac{\alpha + (\phi + \beta)\mu_t + \theta\mu_{t-1} + \eta\mu_{t-2}}{\gamma} \tag{A5}$$

and the autocorrelation of interest rate changes by:

$$E[\Delta I_t \Delta I_{t-1}] = \left[\frac{\sigma}{\gamma}\right]^2 \left\{-[(\phi + \beta)(\eta - \theta)]^2 + (\phi + \beta)\eta\right\} \tag{A6}$$

where σ is the standard deviation of the inflation shock.

Under some sets of parameters, the optimal interest rate response to an inflation shock is to increase the interest rate twice and then to reduce it in two steps back to its initial value – similar to the general pattern observed in practice. Whether or not such a pattern generates positively correlated changes in interest rates on average again depends upon the particular parameters. If η and θ are close in magnitude, then interest rate movements are likely to exhibit positive autocorrelation. In contrast, if η is zero, the correlation between interest rate changes will be negative.

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