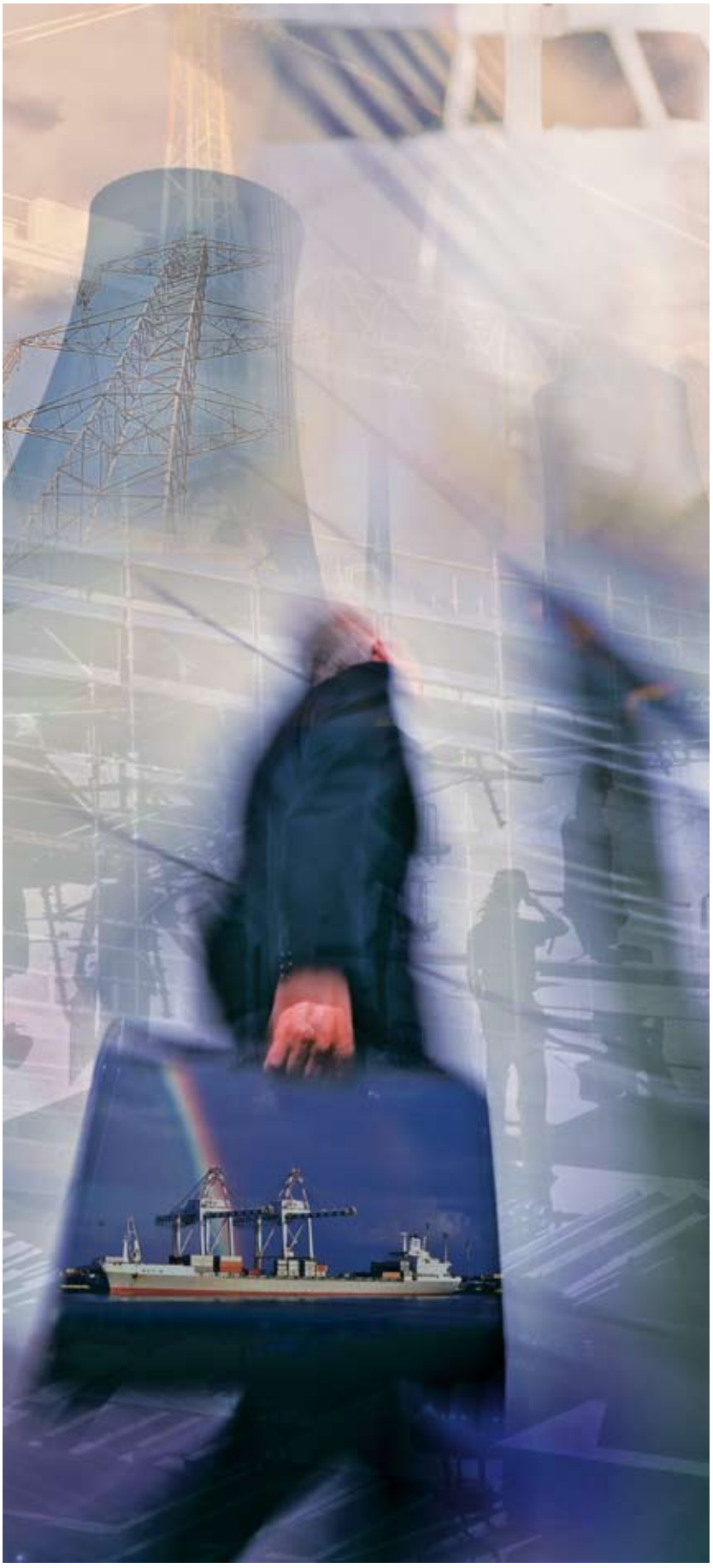

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The Economic Society of Australia warmly welcomes you to the Gold Coast, Queensland, Australia for the 37th Australian Conference of Economists.

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The impact of monetary policy: The high frequency responses of Australian financial futures to cash rate target announcements

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ABSTRACT

This paper examines the high frequency responses of Australian financial futures to monetary surprises using intra-day futures data. Using the event-window method with tick data to control for the endogeneity issue between market interest rates and the cash target rate, our empirical findings support that first, monetary policy announcements impact significantly not only on the short-term interest rate futures, but also on longer-term Treasury security futures markets. Second, the most significant responses of these markets occur in the event-window which contains the policy announcement. Third, a weak relationship between monetary surprises and the movements of stock index futures is also identified.

JEL classifications: E52; G12; G14

Keywords: Monetary policy effect; Financial futures, High frequency response to monetary news

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1. Introduction

This paper examines the high frequency responses of Australian Treasury security yields and stock index futures to monetary policy announcements using intra-day futures data from Sydney Futures Exchange (SFE). A large number of studies have tried to assess the effects central banks' monetary policy announcements and actions on asset prices from fixed income securities using lower frequency data such as daily (e.g. Cook and Hahn, 1989; Kuttner, 2001; Demiralp and Jorda, 2004), weekly (Piazzesi, 2005) and even monthly data (Evans and Marshall, 2001). The main drawbacks of those studies with lower frequency data include: a) There is a potential endogeneity problem associated with monetary policy announcement effects, i.e, not only does a monetary announcement impact on financial asset pricing and market volatility, but information on financial asset pricing and market volatility could also enter into the central bank's reaction function. The potential endogenous relationship between monetary policy variables and financial asset returns and volatility makes the classical single-stage regression method used by most previous studies no longer valid, or at least the traditional regression assumption of the orthogonal error term is violated. In the case of fixed income futures securities and stock market index futures markets, regressing financial market returns or price changes against monetary policy surprise variables in a classic single-stage equation by using daily or other lower frequency data would suffer from the endogeneity problem, due to simultaneous equations and omitted variable bias. In particular, the change in monetary policy could actually be a result of the central bank's policy adjustment in response to changes in financial markets that took place in the periods prior to the central bank's

policy announcement, due to, for instance, the direct signal effects that term spreads provide about the future outlook of economic conditions, or due to the direct wealth effect of stock market on the future path of economic indicators. b) Another disadvantage of using lower frequency data in modelling the impact of monetary policy on financial markets is that, by using classic regression method, it is highly possible to pick up other macroeconomic announcement effects other than monetary policy, particularly when the announcement time for monetary policy and other macroeconomic news were very close during the period prior to the mid-1990s in the U.S. and much of the period prior to 1998 in Australia.

By using specially designed event-study time-frame windows with tick data, this paper seeks to overcome these drawbacks inherited from the classic regression method, and thus provide a more accurate assessment of monetary announcements and policy actions on Australian 90-day bank bill, 3- and 10-year Treasury bond futures contracts as well as SFE Stock Price Index (SPI) futures market[1]. With our 30-minute and 60-minute event windows, it is unlikely that: 1) the Reserve Bank would adjust their policy within this time frame; 2) our modelling would accidentally pick up any macroeconomic announcement effect other than the cash rate target announcements[2]

The remainder of this paper proceeds as follows. Section 2 outlines our research motivations and methodological advantages. Section 3 explains our data for the Reserve Bank's monetary policy announcements, monetary policy surprises and

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[1] In our data set, the stock price index includes SFE All Ordinaries SPI Equity Index Futures and SFE SPI 200 Equity Index Futures.

[2] No other macroeconomic releases fell into the monetary policy event windows in the period from 1998 and onwards, the period covered by our data set. However, data for the SPI Equity Index Futures contract suffer from a thin trading problem. And, because of that, the event windows including police announcement has to start an hour and 20 minutes earlier than from the designed posting, which may result in accidentally picking up other unknown effects fell into the time interval.

detailed description of the Australian Treasury security futures markets data. Section 4 analyses monetary policy announcement effect on Treasury bond futures and SFE stock index futures contracts and presents the empirical modelling results. Section 5 concludes the paper.

2. Motivation and methodological advantages

How does the Reserve Bank's monetary policy affect money market interest rates and treasury security yields in Australia since 1991, when the Reserve Bank of Australia (RBA) first started announcing its monetary policy decision after the Board's regular and irregular meetings? The question we raise here is important because money market interest rates, along with Treasury fixed-income security yields and credit supply, constitute the main channels through which monetary policy affects real economic output and prices. Thus, predicting the impact of monetary policy actions on market interest rates is important to for us gauge the effect on the ultimate targets of monetary policy.

The relationship between monetary policy and financial markets is typically a two-way communications process—monetary policy decisions influence the financial markets, while policy decisions are also derived under certain economic condition under which financial markets operate.

Studies on responses of market interest rates and stock index futures rates to monetary policy, or cash target interest rates, typically face an "endogeneity problem"—do correlations between market interest rates, stock index futures rates and the Reserve Bank's policy target reflect the effect of monetary policy on market

rates, or the effect of market rate fluctuation on monetary policy via the central bank's reaction function?

One way to handle this endogeneity issue is to focus on the short-run reaction of market interest rates to monetary policy target rates by designing a short-time reaction window on which monetary policy actions and policy announcements were not themselves endogenous to financial market interest rate movements. We first need to identify a list of "reaction windows" for monetary policy events and actions. We then run the following regression:

$$\Delta R_t = \alpha + \beta \Delta i_t + \varepsilon_t \qquad (1)$$

Where Δi_t is the unexpected cash rate target changes, for which we choose yield changes of 30-day bank-accepted bill on the day of a policy announcement as a proxy of the unexpected cash rate target movements. ΔR_t is the change in the market interest rate futures or the stock index futures prices in the same day. Parameter β is used to measure the linear relationship between monetary surprises and the yield changes in market interest rates futures—or the impact of unexpected cash rate changes on market interest rate movements. Δi_t serves as a measure of the surprise content of monetary policy announcement. It is designed to be sufficiently short to reflect the policy rates or targets that the Reserve Bank set for the immediate future, but at the same time sufficiently "long" to react only to the extent that the changes in the target rate were not anticipated. By using the policy "event windows" technique, we can identify the impact of a monetary policy decision by isolating the surprise component of the change in monetary policy. This study employs a policy surprise proxy method, developed by Kuttner (2001), which utilizes changes in market interest rates as proxy

for the surprise component of the change in monetary policy. Market interest rates incorporate a risk premium, but the change in market rate is a good proxy for the policy surprise as the risk premium is unlikely to move in the short time periods used in the event study (Piazzesi and Swanson, 2004).

For each of the monetary policy events, we measure the movements in market interest rates and stock index futures prices around the event time using tick data, with an event window of 60-minute. This reduces the information content received by the market in the event window and so the number of the events that otherwise would have to be discarded due to both the policy target rate and market interest rate futures response to the news.

The 60-minute windows will also serve to remove the possibility that market interest rate movements influence monetary policy decisions. With this short time event window, the information regarding market interest rate fluctuations will surely not enter into the monetary authority's reaction function, so that the endogeneity problem is unlikely to occur in this case. In the case of SFE stock price index futures market, the 60-minute window will also ensure us that the movements of the share price index will not influence the central bank's policy decisions through the wealth effect of the share price movements, and thus monetary policy will not, in such a short time horizon, be adjusted by the Reserve Bank in response to stock market' performance.

In order to test the speed of market interest rate reaction to monetary policy announcements, a series of consecutive 30-minute event windows around the Reserve Bank's monetary policy announcement time are also constructed to catch market responding patterns in different time intervals. Details of the time frame for these event windows will be discussed in the next section.

3. Data

3.1. The Australian Treasury bond futures and the stock index futures markets

We analyse the high frequency response of short- and long-term interest rate futures markets and the stock index futures market to monetary policy surprises by tick data for 90-day bank bill futures, 3-year and 10-year Australian Treasury bond futures contracts and SFE All Ordinaries SPI Equity Index Futures contracts. All tick data were obtained from Sydney Futures Exchange (SFE). The sample period runs from January 1, 1998 to December 31, 2004.

3.2. The RBA's cash rate target announcements

Australian monetary policy has undergone progressive changes since the early 1990s. The RBA started its more transparent monetary policy practice by publicly announcing policy target changes in January 1990. The Reserve Bank routinely announces its cash rate targets set by the Board at regular meetings on the first Tuesday of every month, with no meeting in January. However, prior to 1998, monetary policy decisions were frequently not announced or implemented immediately after a Board meeting. The changes on monetary policy decision have been publicly announced the day immediately after a Board meeting only since 1998. Since September 2002, there has been a public announcement on the day after the Board meeting in the event that monetary policy was left unchanged. Moreover, market commentary in the period from 1998 to 2002 suggests that if policy was unchanged following a Board meeting then no change was anticipated until the next meeting. Therefore, when we construct our monetary policy event windows, we also include the days where no-change decisions have been made from the beginning of

1998.[3] As the Reserve Bank Board holds 11 regularly scheduled meetings each year, the total number of policy events contained in the sample period is 77 announcements from these meetings. Details on announcement dates and time as well as the associated cash rate target changes are listed in Appendix 1. The unit used to measure the changes in policy target rates and changes in interest rate futures contracts are in basis points. In this study we chooses to use basis points as the measurement of these rates, not because this is the best measurement, but because it is a method most frequently used by many other researchers (e.g. Cook and Hahn, 1989; Kuttner, 2001; Fleming and Piazzesi, 2005) on this topic.

3.3. The policy event windows and monetary policy surprises

The Reserve Bank Board holds scheduled meetings on the Tuesday of every month except January. Since January 1998, a written statement of monetary policy changes or no-change decisions has subsequently been released at 9:30 on the Wednesday morning immediately after the meeting. For financial market participants prior to January 1998, it was clear that a monetary policy decision had been made on the Tuesday's Board meeting, but the news was embargoed over the subsequent days, with the market not knowing exactly when the information would be released. For the sample period since 1998, however, the market knows the date and time a policy change or no-change announcement will be released, which allows us to catch the policy effect by constructing event time windows around the regular Wednesday morning policy announcement time using tick data. The 60-minute event window used in this research starts 10 minutes before the announcement and 50 minutes

[3] The main difficulty for this research is the insufficient policy events where cash rate target changes. The total policy changes since 1998 are only 17, which makes the validity of any modelling problematic. The inclusion of no-change policy events has significantly enlarged the number of the total event windows and thus the number of the sample observations.

immediately after the policy target announcement, while the 30-minute event window starts 10 minutes before the announcement and 20 minutes immediately after the policy target announcement, e.g., we use the time frame from 9:20 a.m. to 10:20 a.m. in Wednesday mornings for the 60-minute intervals and from 9:20 a.m. to 9:50 a.m. for the 30-minute intervals.

4. Empirical results

4.1. Monetary policy surprises on 90- day BAB futures and Treasury security futures

We assess the macroeconomic effects of Australian monetary policy announcements by regressing the yield changes from interest rate futures contracts on the Reserve Bank's monetary surprises around the monetary policy announcement in our event windows. We use the short-end money market interest rate, the 30-day bank accepted bill (BAB) rate to calculate Australian monetary policy surprises.[4]

Equation (1) $\Delta R_t = \alpha + \beta \Delta i_t + \varepsilon_t$ is used to asses the effect of monetary policy surprises. In equation (1), ΔR_t is the changes on yields of the market interest rate futures from the last quote in an interval to the last quote in the next interval for tick data sample and from the last quote on a pre-announcement day to the last quote on an announcement day for daily data. $\Delta\ i_t$ serves as a measure of the surprise content of monetary policy announcement. Yield changes and monetary surprises are both measured in percent, over the policy event interval starting 10 minutes before the announcement and 20 or 50 minutes after the announcement.

[4] Literature on the US monetary policy announcement effect frequently uses prices of the fed funds futures contracts traded on Chicago Board Of Trade (CBOT) to identify monetary policy surprises around the announcements (see, for example, Kuttner, 2001; Piazzesi and Swanson, 2004; Flemming and Piazzesi, 2005). While the fed funds futures seem a better proxy for monetary policy surprises for the US market, it is not available for our sample period in Australia market. A number of previous researches have, however, showed that the 30-day bank bill rate is a good proxy in identifying the Australian monetary policy surprises (see, for example, Kearns and Manners, 2005).

Table 1 Effect of monetary surprises on Australian Treasury security futures yields,1998-2004

Panel: 1 Effect of CRT surprises with 60-minute interval

Security	Constant (α)	CRT surprise (β)	Adjusted R^2	F-statistic
90-day BAB	0.671(0.425*)	0.781 (0.111***)	0.585	108.210
3-year bond	1.268 (0.346***)	0.569 (0.079***)	0.530	86.571
10-year bond	0.573 (0.280**)	0.214 (0.060***)	0.226	23.186
SPI Index	-0.058 (0.031*)	-0.010 (0.005*)	0.046	3.644

Panel 2: Effect of CRT surprises with 30-minute interval

Security	Constant (α)	CRT surprise (β)	Adjusted R^2	F-statistic
90-day BAB	0.308 (0.362)	0.729(0.099***)	0.572	102.710
3-year bond	0.726 (0.463**)	0.692 (0.084***)	0.563	89.512
10-year bond	0.439 (0.341**)	0.159 (0.078**)	0.272	26.433

Panel 3: Effect of CRT surprises with daily data

Security	Constant (α)	CRT surprise (β)	Adjusted R^2	F-statistic
90-day BAB	0.024(0.012)	0.988(0.162***)	0.192	19.10
3-year bond	1.583 (0.289**)	0.489 (0.198**)	0.146	11.37
10-year bond	0.704 (0.379*)	0.121 (0.347)	0.014	2.019
SPI Index	0.181 (0.090**)	0.005 (0.009)	-0.012	0.089

This table presents the regression results by using equation $\Delta R_t = \alpha + \beta \Delta i_t + \varepsilon_t$, where ΔR_t is the change on yields of the market interest rate futures from the last quote in an interval to the last in the next interval for tick data sample and from the last quote on a pre-announcement day to the last quote of an announcement day for daily data. Δi_t serves as a measure of the surprise content of monetary policy announcement. Sample covers all Cash Rate Target (CRT) announcements from January 1998 to December 2004. Yield changes and monetary surprises are both measured in percent, over the 60- and 30-minute interval starting 10 minutes before the announcement in Panel 1 and Panel 2, and over the day of day of the announcement in Panel 3. Data for SPI Equity Index Futures between 9:20 a.m. and 9:50 a.m. is not available, thus SPI Equity Index Futures data in Panel 1 is for a interval from 7:59 a.m., the closest time posting to 9:20, to 9:50 a.m. Heteroskedasticity-consistent (Newey-West) standard errors are reported in parentheses. *, **, and *** denote significance at 10-, 5- and 1-percent level, respectively.

Table 1 presents the effect of monetary policy surprises on yields from 90-day bank bill and 3- and 10- year Treasury bond futures contracts. The empirical results with tick data in Panel 1 show that the yield changes are closely correlated with the monetary policy surprises in both short-term interest rate futures and longer-term interest rate futures markets. With our 60-minute event windows we find that a 100 basis point surprise in monetary policy changes is estimated to lead to a 0.78 per cent change in the yield for 90-day BAB interest rate futures, a 0.569 per cent change in yield for 3-year bond futures and a 0.214 per cent yield movement in 10-year bond futures. The results are closely matched with previous research for US monetary policy effects (see, for example, Kuttner, 2001; Demiralp and Jorda, 2004; Fleming and Piazzesi, 2005). The key findings of this study are summarized as follows:

1) Monetary policy surprises have strong effects on the yield changes across the yield curve. The effects of policy surprises on yields decrease with maturity and are highly significant for short-term and longer-term securities. However, the decreasing size of slope coefficients captured by β further out of the yield curve may not suggest that the longer-term interest rate futures react little to the policy announcements, but that they react little to the surprise content of cash rate target announcements.
2) When the policy event windows are narrowed to 30-minute intervals, as reported in Panel 2 of Table 6.1, the significance patterns of the impact of monetary policy surprises on yields from all three interest rate futures contracts are similar to those we found with our 60-minute interval, which suggests that policy announcement effect does not significantly decay within the first 20 minutes after the announcement.

3) Compared with the empirical results with tick data, the estimation results with daily data presented in Panel 3 show a similar significance pattern, notably with a less significant level for 3-year bond futures contract and no significant effect of monetary policy surprises found for the longer-term 10-year bond futures contract.

4) The adjusted R^2s for the short- and longer-term interest rate futures markets with high frequency data reported in Panel 1 are 0.59 for 90-day BAB futures and 0.53 for 3-year Treasury bond futures, respectively. The adjusted R^2s for the short- and longer-term interest rate futures markets with high frequency data reported in Panel 2 are 0.57 for 90-day BAB futures and 0.56 for 3-year Treasury bond futures, respectively. The R^2s with wide and narrow event windows are all high for 90-day BAB futures and 3-year Treasury bond futures, while adjusted R^2s for the 10-year bond futures are modest.

For comparison purpose, we also report the empirical results with daily data in Panel 3. The slope coefficient for 10-year bond futures with daily data becomes insignificant while the significance level of slope coefficient for 3-year bond futures is modest. Adjusted R^2 s for the three interest rate futures contracts are all lower, indicating that the explanation power of the slope coefficient for CRT announcement effect is decreased with the daily data, which is possibly due to the enlarged event windows with lower frequency data which may not enable us to pick up the effects of monetary policy surprises precisely around the policy announcements. The lower significance level of CRT surprises effects and lower R^2s for the three interest rate futures markets with daily data provide us with clear evidence of significant benefits of using tick data to identify effects of monetary policy. By using high-frequency data, we are actually able to control for other information flows affecting the interest

rate futures markets by effectively isolating the monetary policy effect from other information flows through construction of appropriate policy event windows. We verified that no other key macroeconomic announcements would be scheduled in our 30-minute and 60-minute event windows around the Reserve Bank's CRT announcements in Australian financial markets. It is also unlikely that our narrowly designed event windows would accidentally pick up other unknown effects of other information flows.

4.2. The speed of market response to monetary policy surprises

To test the speed with which yield changes from the three interest rate futures markets react to the monetary policy surprises, the yield changes of three interest rate futures are regressed on unexpected changes in the cash rate target over a series of consecutive 30-minute intervals around the Reserve Bank's cash rate target announcements by using equation (1). The first time window used here is from 8:50 to 9:20 a.m., which is the only 30-minute interval prior to the monetary policy announcement time at 9:30 a.m. The policy announcements fall into the second window, starting from 9:20 to 9:50 in the morning, e.g. from 10 minutes before the policy announcement to 20 minutes after the announcement. Four consecutive half-hour time intervals for the post-announcement hours are then constructed, starting from 9:50 a.m. and ending at 11:50. Table 2 below presents the empirical results of market reaction speed analysis with all six consecutive time intervals.

The empirical results presented in Table 2 show that for all three interest rate futures markets, the largest and most significant responses occur in the event window of interval 2, which contains the monetary policy announcement. Consistent with previous studies, market reaction to monetary policy peaks at the announcement and

calms down within half an hour after the news release (see, Ederington and Lee 1993; Fleming and Remolona, 1999; Kim and Sheen, 2000; Frino and Hill, 2001). The results of this study indicate that market responses to the monetary policy announcement are still significant up to the second 30-minutes interval immediately after the policy release for the short-term interest rate futures and 3-year bond futures markets. Strong reaction from 10-year bond futures markets occurs only in the time interval in which the policy announcement releases. The slope coefficients for three securities reported for time interval 1 prior to the scheduled announcement time are all insignificant, suggesting that the monetary policy is not well anticipated by financial market participants until the Reserve Bank's policy release.

The reported adjusted R^2s for the three interest rate futures markets show that the largest adjusted R^2s are all for the models using the time span of interval 2 in which the policy target decisions are released. The adjusted R^2s for other event windows are either close to zero or even with negative value, which means that the explanation power of monetary surprises for the yield changes in other time interval is quite limited or the fitness of modelling is poor with those time intervals other than interval 2 and interval 3.

We therefore come to the conclusion that market responses to monetary policy surprises in Australian short-term interest rate futures markets are instant and complete, the effect of monetary announcement peaks in the 30-minute interval including the policy release, and dies off within 50 minutes after the policy announcement. This study has also documented a strong effect of monetary announcements on longer-term treasury security futures contracts in the 30-minute interval including the policy release, and the effect of policy surprises dies off 30 minutes after the policy announcement in the 10-year bond futures market and 50 minutes after the policy release in the 3-year bond futures market.

Table 2
Effect of monetary surprises with 30-minute intervals around the CRT announcements: Analysis of market reaction speed

	Interval 1	Interval 2	Interval 3	Interval 4	Interval 5	Interval 6
Time span	(8:50 –9:20)	(9:20 –9:50)	(9:50 –10:20)	(10:20 –10:50)	(10:50 –11:20)	(11:20 –11:50)
90-day BAB	-0.004 (0.120)	0.729(0.099***)	0.052 (0.031*)	0.019 (0.033)	0.011 (0.026)	0.022 (0.039)
Adjusted R^2	-0.013	0.572	0.035	-0.011	-0.012	-0.009
3-year bond	0.106 (0.137)	0.692 (0.084***)	0.073 (0.143*)	0.015 (0.042)	0.014 (0.031)	0.013 (0.042)
Adjusted R^2	0.001	0.564	0.027	-0.001	0.000	-0.004
10-year bond	-0.003 (0.128)	0.159 (0.078**)	0.018 (0.027)	0.024 (0.037)	0.032 (0.019)	0.009 (0.138)
Adjusted R^2	-0.011	0.3787	0.024	0.000	-0.008	-0.014

This table presents the slope coefficients of β_t for all 6 intervals. Heteroskedasticity-consistent (Newey-West) standard errors are reported in parentheses. Sample covers all Cash Rate Target (CRT) announcements from January 1998 to December 2004. The above table reports the regression results by using equation $\Delta R_t = \alpha + \beta \Delta i_t + \varepsilon_t$ (1), where ΔR_t is the change on yields of the market interest rate futures from the last quote in an interval to the last quote in the next interval. Δi_t serves as a measure of the surprise content of monetary policy announcement. Yield changes and monetary surprises are both measured in percent, over the 30- minute intervals starting 40 minutes before the announcement and 2 hours and 20 minutes after the policy announcement occurred in interval 2 at 9:30 in the morning. *, **, and *** denote significance at 10-, 5- and 1- percent levels, respectively

4.3. Effect of monetary surprises on Australian stock market

We examine share market reactions to monetary policy announcements by using tick data for ASX stock price index futures contract from SFE. The test results with 60-minute time interval are presented in the last row in Panels 1 and 3 of Table 1. The empirical study shows that the impact of monetary policy announcements on stock price index futures contract is statistically significant at 10% level, suggesting that the announcement of the official cash rate target by the Reserve Bank of Australia significantly impacts on the movements of stock index futures. However, the effect of monetary policy announcements on the share market tends to be weaker compared with the effect we have documented on the three interest rate futures markets. The possible reasons for this result may include the following:

1) The event study method with tick data suffered the drawback of a thin-trading period in the time interval around 9:20 before the RBA release its monetary policy announcement. The closest posting of intraday tick records of futures prices for SPI equity index in the pre-announcement intervals is 7:58 am for almost all the tick pricing records, which prevents us from constructing the narrowly defined policy event windows starting from 5 or 10 minutes before the announcement. The broader time intervals starting from early morning at about 8:00 am cover a time interval of 1 hour and 20 minutes longer than the normal intervals set for the three interest rate futures contracts. The broader time interval starting 1 hour and 20 minutes earlier may lead us to pick up effects of other information flows or market risk premiums. The declining value adjusted R-square for the fitness of modelling for SPI stock index futures seems to provide supportive evidence for this notion.

2) Another possible explanation for the less significant effect of monetary surprises might be that the releases of monetary surprises do not significantly impact on the stock index futures market. This does not necessarily mean that monetary policy releases do not have influence on the stock index futures contracts, instead, the overall effect of monetary policy releases can still play a role in influencing the movements of stock prices and price volatility.

5. Conclusions and contributions

Using high frequency tick data, this paper examines the monetary policy announcement effect on Australian interest rate futures market by looking at three treasury security futures contracts and SPI stock index futures contracts. There are three main empirical findings of this study.

First, the Reserve Bank's regular policy announcements have a significant impact not only on the short-term interest rate futures contracts, but also on longer-term Treasury security futures markets. With our 60-minute event windows we find that a 100 basis point surprise in monetary policy changes is estimated to lead to a 0.78 per cent change in yield of 90-day BAB futures contracts, a 0.569 per cent yield change in 3-year bond futures and a 0.214 per cent yield movement in 10-year bond futures. Monetary policy surprises have strong effects on the yield changes across the yield curve – the effect of policy surprises on yields decreases with maturity and is highly significant for short-term and longer-term securities.

Second, the analysis on speed of market responses with a series of consecutive intervals reveals that the largest and most significant responses occur in the event window that contains the monetary policy announcement. Consistent with previous

studies, market reaction to monetary policy peaks at the announcement time and calms down within the first 20 minutes of the first half-hour interval after the news. Sluggish responses to the monetary policy announcement are only found for short-term and 3-year bond futures, within 50 minutes of the end of time interval next to the policy release.

Third, this study has also documented a weak effect of monetary surprises on the movements of stock index futures. The impact of monetary policy announcements on stock market index futures contract is statistically significant at the 10% level.

This paper makes contributions by adding the following to the literature on the response of interest rates and share index futures markets to monetary policy:

First, we use the event-window method with tick data to control for the endogeneity problem between market interest rates and the cash target rate. Second, using high frequency data allows us to effectively control other information flows affecting markets even without knowing what that information is. We can actually filter off the effect of other information flows, including the effects of all other macroeconomic releases other than monetary policy announcements, by carefully designing monetary policy event windows around the policy announcement time. *Third*, we explore the linkage between monetary policy surprises and yield changes from Australian Treasury bond futures and stock index futures markets, which are yet untouched area by the previous studies.

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Appendix A

The RBA's cash rate target (CRT) announcements: Date, time, target changes and policy surprises, Feb 1998—March 2005

Date of CRT Announcement	Ann Time (1)	New CRT rate (%) (2)	CRT changes (Basis point) [a] (3)		yield changes in 30-day BAB [a] (4)
30/07/97	9:30 a.m.	5.00	-50	-0.26	1
04/02/98	9:30 a.m.	5.00	0		0
04/03/98	9:30 a.m.	5.00	0		0
08/04/98	9:30 a.m.	5.00	0		0
06/05/98	9:30 a.m.	5.00	0		0
03/06/98	9:30 a.m.	5.00	0		0
08/07/98	9:30 a.m.	5.00	0		-2
05/08/98	9:30 a.m.	5.00	0		-4
02/09/98	9:30 a.m.	5.00	0		-1
07/10/98	9:30 a.m.	5.00	0		5
04/11/98	9:30 a.m.	5.00	0		5
02/12/98	9:30 a.m.	4.75	-25	0.00	-18
03/02/99	9:30 a.m.	4.75	0		2
05/03/99	9:30 a.m.	4.75	0		-1
07/04/99	9:30 a.m.	4.75	0		1
05/05/99	9:30 a.m.	4.75	0		1
02/06/99	9:30 a.m.	4.75	0		1
07/07/99	9:30 a.m.	4.75	0		0
04/08/99	9:30 a.m.	4.75	0		-1
08/09/99	9:30 a.m.	4.75	0		0
06/10/99	9:30 a.m.	4.75	0		1
03/11/99	9:30 a.m.	5.03	+25	0.43	-6
08/12/99	9:30 a.m.	5.00	0		1
02/02/00	9:30 a.m.	5.50	+50	0.36	18
08/03/00	9:30 a.m.	5.50	0		-1
05/04/00	9:30 a.m.	5.75	+25	0.18	0
03/05/00	9:30 a.m.	6.00	+25	0.32	0
07/06/00	9:30 a.m.	6.00	0		-1
05/07/00	9:30 a.m.	6.00	0		0
02/08/00	9:30 a.m.	6.25	+25	0.11	10
06/09/00	9:30 a.m.	6.25	0		-4
04/10/00	9:30 a.m.	6.25	0		-12
08/11/00	9:30 a.m.	6.25	0		-6
06/12/00	9:30 a.m.	6.25	0		-2
07/02/01	9:30 a.m.	5.75	-50	-0.51	-7
07/03/01	9:30 a.m.	5.50	-25	-0.18	-6
04/04/01	9:30 a.m.	5.00	-50	-0.34	-14
02/05/01	9:30 a.m.	5.00	0		7
06/06/01	9:30 a.m.	5.00	0		5
04/07/01	9:30 a.m.	5.00	0		0
08/08/01	9:30 a.m.	5.00	0		1

05/09/01	9:30 a.m.	4.75	-25	-0.17	-6
03/10/01	9:30 a.m.	4.50	-25	-0.39	11
07/11/01	9:30 a.m.	4.50	0		4
05/12/01	9:30 a.m.	4.25	-25	-0.23	2
06/02/02	9:30 a.m.	4.25	0		1
06/03/02	9:30 a.m.	4.25	0		-1
03/04/02	9:30 a.m.	4.25	0		-14
08/05/02	9:30 a.m.	4.50	+25	0.22	4
05/06/02	9:30 a.m.	4.75	+25	0.29	-2
03/07/02	9:30 a.m.	4.75	0		-13
07/08/02	9:30 a.m.	4.75	0		0
04/09/02	9:30 a.m.	4.75	0		0
02/10/02	9:30 a.m.	4.75	0		0
06/11/02	9:30 a.m.	4.75	0		1
04/12/02	9:30 a.m.	4.75	0		0
03/02/03	9:30 a.m.	4.75	0		0
05/03/03	9:30 a.m.	4.75	0		0
02/04/03	9:30 a.m.	4.75	0		0
07/05/03	9:30 a.m.	4.75	0		0
04/06/03	9:30 a.m.	4.75	0		0
02/07/03	9:30 a.m.	4.75	0		9
06/08/03	9:30 a.m.	4.75	0		1
03/09/03	9:30 a.m.	4.75	0		0
08/10/03	9:30 a.m.	4.75	0		0
05/11/03	9:30 a.m.	5.00	+0.25	0.11	16
03/12/03	9:30 a.m.	5.25	+0.25	0.25	-1
04/02/04	9:30 a.m.	5.25	0		-9
03/03/04	9:30 a.m.	5.50	+0.25	0.27	-5
07/04/04	9:30 a.m.	5.50	0		-3
05/05/04	9:30 a.m.	5.50	0		-4
02/06/04	9:30 a.m.	5.50	0		0
07/07/04	9:30 a.m.	5.50	0		-1
04/08/04	9:30 a.m.	5.50	0		-1
02/09/04	9:30 a.m.	5.50	0		0
06/10/04	9:30 a.m.	5.50	0		0
03/11/04	9:30 a.m.	5.50	0		1
08/12/04	9:30 a.m.	5.50	0		0

This appendix table contains: (a) CRT stands for RBA's cash rate target. CRT changes in column (3) and 30 day-BAB rate changes in column (4) are in basis points. (b) Date in the table is in DD/MM/YY format. (c) Column (2) is the level of CRT, column (3) is changes CRT, and column (4) is changes in bank bill rates from the day prior to the policy announcement day to the policy announcement day.

Appendix B

Yield changes around RBA's cash rate announcements within the event windows: monetary policy surprises and 3 Treasury security futures contracts

		BAB90 Futures Prices			TB3f Futures Prices			TB10f Prices		
Ann Date	BABS30	10:20	9:20	BABF Yield Diff	10:20	9:20	Tb3F Yield Diff	9:20	10:20	TB10F Yield Diff
4/02/1998	0	94.94	94.94	0	94.62	94.62	0	93.96	93.97	-1
4-Mar	0	94.98	94.98	0	94.6	94.6	0	93.87	93.88	-0.5
8-Apr	0	95.23	95.23	0	94.95	94.95	0	94.47	94.48	-1
6-May	0	95.07	95.07	0	94.82	94.81	-1	94.23	94.24	-0.5
3-Jun	0	95.16	95.17	1	95.12	95.12	0	94.63	94.63	0.5
8-Jul	-2	94.72	94.77	5	94.75	94.78	3	94.54	94.53	1.5
5-Aug	-4	94.95	94.94	-1	94.88	94.87	-1	94.54	94.54	0
2-Sep	-1	94.62	94.6	-2	94.58	94.56	-2	94.26	94.28	-2.5
7-Oct	5	95.35	95.35	0	95.45	95.48	3	95.10	95.09	1
4-Nov	5	95.39	95.5	11	95.4	95.51	11	94.97	94.93	4
2-Dec	-18	95.43	95.34	-9	95.43	95.36	-7	95.02	95.06	-4
3/02/1999	2	95.23	95.29	6	95.11	95.15	4	94.78	94.80	-2
3-Mar	-1	95.13	95.11	-2	94.86	94.85	-1	94.28	94.27	0.5
7-Apr	1	95.36	95.34	-2	95.19	95.14	-5	94.68	94.71	-3
5-May	1	95.03	95.04	1	94.72	94.72	0	94.22	94.21	1.5
2-Jun	1	94.87	94.87	0	94.46	94.46	0	93.85	93.85	0
7-Jul	0	95.04	95.04	0	94.26	94.26	0	93.66	93.66	0
4-Aug	-1	95.09	95.09	0	94.32	94.32	0	93.64	93.64	0.5
8-Sep	0	94.69	94.68	-1	94.24	94.24	0	93.57	93.57	0
6-Oct	1	94.25	94.24	-1	94.06	94.02	-4	93.48	93.50	-2.5
3-Nov	-6	94.2	94.22	2	93.84	93.85	1	93.41	93.39	2
8-Dec	1	94.35	94.36	1	93.92	93.93	1	93.44	93.43	0.5
2/02/2000	18	93.91	94.12	21	93.04	93.18	14	92.85	92.81	3.5
8-Mar	-1	93.76	93.76	0	93.53	93.54	1	93.31	93.30	1
5-Apr	0	93.72	93.74	2	93.67	93.67	0	93.74	93.75	-0.5
3-May	0	93.31	93.3	-1	93.54	93.53	-1	93.52	93.53	-0.5
7-Jun	-1	93.76	93.76	0	94.02	94.03	1	93.94	93.93	0.5
5-Jul	0	93.83	93.83	0	94.05	94.06	1	93.93	93.92	0.5
2-Aug	10	93.34	93.28	-6	93.68	93.8	12	93.79	93.75	4.5
6-Sep	-4	93.44	93.46	2	93.85	93.88	3	94.05	94.00	5
4-Oct	-12	93.53	93.46	-7	93.88	93.86	-2	93.85	93.83	1.5
8-Nov	-6	93.63	93.59	-4	93.96	93.97	1	93.82	93.79	3
6-Dec	-2	94.08	94.06	-2	94.48	94.47	-1	94.32	94.32	-0.5
7/02/2001	-7	94.55	94.57	2	95.08	95.12	4	94.70	94.66	3.5
7-Mar	-6	94.67	94.73	6	95.26	95.27	1	94.79	94.79	-0.5
4-Apr	-14	95.51	95.37	-14	95.32	95.21	-11	94.70	94.74	-4.5

2-May	7	95.29	95.33	4	94.85	94.86	1	94.18	94.21	-3
6-Jun	5	95.14	95.2	6	94.65	94.68	3	94.08	94.09	-1
4-Jul	0	94.95	94.96	1	94.21	94.19	-2	93.76	93.77	-0.5
8-Aug	1	95.02	95.03	1	94.41	94.42	1	93.96	93.96	0
5-Sep	-6	95.29	95.29	0	94.78	94.78	0	94.24	94.22	2
3-Oct	11	95.75	95.83	8	95.37	95.46	9	94.54	94.53	1
7-Nov	4	95.96	95.99	3	95.79	95.8	1	94.92	94.91	1
5-Dec	2	95.89	95.9	1	95.15	95.16	1	94.44	94.43	1.5
6/02/2002	1	95.67	95.68	1	94.61	94.61	0	94.07	94.07	0.5
6-Mar	-1	95.3	95.3	0	94.32	94.32	0	93.82	93.81	1.5
3-Apr	-14	94.97	94.85	-12	93.86	93.86	0	93.49	93.54	-5
8-May	4	95.08	95.18	10	94.34	94.45	11	93.96	93.89	7
5-Jun	-2	94.22	94.21	-1	93.91	93.92	1	93.73	93.72	1
3-Jul	-13	94.89	94.79	-10	94.47	94.37	-10	94.03	94.06	-3
7-Aug	0	95.14	95.14	0	94.86	94.88	2	94.36	94.35	1.5
4-Sep	0	95.18	95.18	0	95.04	95.04	0	94.60	94.60	-0.5
2-Oct	0	95.14	95.12	-2	94.9	94.89	-1	94.56	94.54	2
6-Nov	1	95.15	95.17	2	95.04	95.05	1	94.45	94.45	0
4-Dec	0	95.24	95.25	1	95	95.01	1	94.43	94.42	0.5
5/02/2003	0	95.32	95.32	0	95.37	95.37	0	94.88	94.87	0.5
5-Mar	0	95.27	95.3	3	95.57	95.58	1	94.98	94.99	-1
2-Apr	0	95.34	95.36	2	95.22	95.26	4	94.70	94.65	5
7-May	0	95.56	95.57	1	95.37	95.37	0	94.87	94.87	0
4-Jun	0	95.25	95.24	-1	95.49	95.5	1	95.11	95.11	0
2-Jul	9	95.57	95.68	11	95.34	95.48	14	95.01	94.91	9.5
6-Aug	1	95.18	95.22	4	94.96	95.01	5	94.48	94.46	2
3-Sep	0	94.99	94.99	0	94.7	94.7	0	94.27	94.29	-1.5
8-Oct	0	94.92	94.93	1	94.65	94.66	1	94.37	94.35	1.5
5-Nov	16	94.37	94.53	16	94.26	94.38	12	94.21	94.15	6.5
3-Dec	-1	94.22	94.25	3	94.12	94.16	4	94.03	94.03	0.5
4/02/2004	-9	94.38	94.34	-4	94.44	94.38	-6	94.23	94.27	-4
3-Mar	-5	94.39	94.39	0	94.55	94.59	4	94.39	94.37	2
7-Apr	-3	94.5	94.49	-1	94.55	94.55	0	94.24	94.24	0
5-May	-4	94.39	94.37	-2	94.31	94.3	-1	94.06	94.07	-0.5
2-Jun	0	94.49	94.39	-10	94.52	94.51	-1	94.12	94.13	-0.5
7-Jul	-1	94.47	94.46	-1	94.48	94.45	-3	94.20	94.22	-2
4-Aug	-1	94.52	94.48	-4	94.52	94.49	-3	94.29	94.30	-1.5
8-Sep	0	94.45	94.46	1	94.75	94.75	0	94.44	94.45	-1
6-Oct	0	94.51	94.51	0	94.74	94.75	1	94.52	94.49	3
3-Nov	1	94.53	94.53	0	94.83	94.83	0	94.63	94.64	-0.5
8/12/2004	0	94.74	94.73	-1	95.07	95.06	-1	94.83	94.83	0

Notes: In this appendix *Ann* is announcement; *BAB90* is 90-day bank accepted bill; *BABS30* is 30-day bank accepted bill spot rate; *BABF* is 90-day bank accepted bill futures; *TB3F* Australian 3-year Treasury bond futures; *TB10F* Australian 10-year Treasury bond futures.