AUCKLAND UNIVERSITY OF TECHNOLOGY

# Stock market reactions to monetary policy shocks

## Study in Australian Market

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## Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a sustained extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Jun Peng (Tim), Zeng

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## ABSTRACT

It is important for both the monetary policy makers and investors to understand the impact of monetary policy shocks to real asset prices. This paper used the event-study method to test the intraday effects of monetary policy shocks on Australian stock market return in different dimension. The results show that a 25-basis-point rate cut target surprise is associated with 0.62% to 0.7% increase to the whole Australian stock market index. The results of industry indexes show that the industry indexes react differently to monetary policy shocks and path surprise is never significant in all event windows. This paper also tested the speed of stock market reacting to monetary policy shocks. The results suggest that all stock market indexes stop reacting to monetary policy shock after 90 to 120 minutes the monetary policy decision is announced. Lastly, the study of individual stocks shows that the size and market to book ratio factors do not affect magnitude of individual stock reaction to monetary policy shock.

# 1. Introduction

The effect of monetary policy on the real asset market has been and continues to be one of the most popular topics studied in the field of economics and finance internationally in academia. Monetary policy is used in most central banks as a tool to influence the economic variables such as GDP and the inflation rate. One of the monetary tools is to alter the short term interest rate to achieve the macroeconomic goals of government. However, the indirect consequence of changing the short term interest rate can be harmful to the economy overall.

People have differing views whether the central bank should use monetary policy to influence the asset market. Historically, the "monetarist" economists support the usage of monetary policy to regulate the market by arguing that this discretionary monetary policy can help the economy to achieve macroeconomic objectives such as: low unemployment, low inflation rate and high economic growth. On the other hand, contrasting views often point out that some possibly ineffective monetary policy during the "credit trap" period created a different outcome from the intended outcome. The critics' key arguments revolve around low monetary policy transparency with regard to the real economy and the time lag between when the monetary policy changes were brought about and the time it takes to have a positive effect in the real economy.

Therefore, in order to understand how monetary policy changes transmit to the economy and how the market responds to the changes is important for policy makers and investors. Poole et al. (2002) tested how the monetary policy changes affected the bank bill rate in different maturities using U.S. data from 1988 to 1999. They found that the market managed to better forecast the monetary policy action in the more recent period than the earlier sample period.

Cook and Hahn (1989) is the first paper written using the event study method to test the daily effect of monetary policy on asset prices. They found a significant

relationship between changes of monetary policy and bond return. Kutter (2001) improved on the Cook and Hahn (1989) study by decomposing the interest rate changes into expected and unexpected changes and found a significant reaction on the part of stock market to surprise monetary policy changes.

Bredin et al. (2007) and .Gregoriou et al. (2009) adopted the method of Kutter (2001) to test the effect of monetary policy shock on the daily stock returns in the U.K. market and also found similar results.

However, there is no literature so far that focuses on the reaction of the stock market in the Asian Pacific markets to surprise of monetary policy changes. This research attempts to test the monetary policy surprise effects on the Australian stock market, one of the most fast-growing asset markets which has experienced the fastest recovery among the developed countries during the current financial crisis. This paper examines the response of the ASX index to the changes in official cash rates (OCR) using Australian intraday data.

Moreover, another contribution of this study is to focus on the speed of stock market response to monetary policy changes. By analyzing the speed of the stock return response to monetary shocks, we aim to have a better understanding of how long it takes the stock market to fully interpret the monetary policy shocks. In other words, the faster the market reacts to the monetary policy shocks, the better efficiency of the stock market.

The results show that a 25-basis-point rate cut target surprise is associated with 0.62% to 0.7% increase in the whole Australian stock market index. The results of industry indexes show that the industry indexes react differently to monetary policy shocks and path surprise is never significant in all event windows. This paper also tested the speed of stock market reacting to monetary policy shocks. The results suggest that all stock market indexes stop reacting to monetary policy shock 90 to 120 minutes after the monetary policy decision is announced. Lastly, the study of individual stocks

shows that the size and market to book ratio factors do not affect magnitude of individual stock reaction to monetary policy shock.

The rest of the paper is structured in the following manner: section two is the literature review; section three is the Hypothesis and Gaps; section four is the description of methodology; section five is the empirical result and interpretations; Section six is the summary of the paper.

# 2. Literature Review

## *2.1 The effectiveness of monetary policy and its consequences*

Historically, debate about monetary policy is a long-standing issue in the research of monetary economic issues. There have been some changes in academic opinion on how to define the role of monetary policy in relation to the assets market. One of the most striking perspectives in the 1940s to 1960s was the Keynes's general theory, which was followed by other Keynesian economists. They argued that the monetary policy was ineffective by itself and the immediate effect of changing monetary policy on the total demand of the market would have limited effect. In short, their opinion is that fiscal policy has more effect on the economy than monetary policy.

On the other hand, "monetarists" research led by Friedman and Schwartz (1963) and Friedman and Meiselman (1963) argued that inflation was a monetary phenomenon and that the monetary authority such as government should use monetary policy to achieve long-term inflation stability.

According to Dunn and Pressman (2005), the economist Galbraith has a different view from both "monetarist" and "Keynes" arguments. According to Galbraith, both theories have not taken into account the consequences of institutional changes in the industrial structure. Galbraith thinks that monetary policy is not an effective way of controlling inflation and managing demand. He thinks that firms seem to make investment decisions based on long-term strategies and that "most investment will be extremely unresponsive to moderate interest rate increases". On the other hand, he argues that monetary policy does work, but it works at the expense of reducing consumption and increasing unemployment.

The U.S. Federal Reserve monetary policy has been to increase the interest rate in the booming time, to cool down the market, and to decrease the interest rate in the recession time. Galbraith considered this strategy irrelevant to help stabilize the economy

because he was of the belief that monetary policy only actually works theoretically, not in real life.

He argues the following:

- High interest rates do not slow business investments, profit is the major objective that businesses look at
- Lower interest rates may help the mortgage market. However the flow on effect to the consumer is not large as too many borrowers are saving, not spending.

"Monetary policy's widespread economic effect is absent or insignificant" according to J.K Galbraith（2001）

In some countries, the usage of monetary policy has been extremely effective. Germany experienced hyperinflation during the Weimar Republic which maintained a very stable monetary regime resulting in low levels of inflation. During the 1980s, the U.S. Federal Reserve Bank applied a "contractionary" monetary policy with an aim to stabilize high inflation resulting in a significant drop in inflation. Similarly, the Reserve Bank of Canada used an inflation target during the 1990s and the economy experienced a negative inflation rate for the first time since the 1930s.

On the other hand, during the period from 2004 to 2008, New Zealand, a country with an inflation targeting policy had increased the OCR from 5 % to 8.25%, however instead of decreasing the inflation rate, OCR changes helped to increase overseas investments on currency eventually increasing the inflation rate further.

During the crisis time, reserve banks around the world adopted an "expansionary" monetary policy by dropping the interest rate to stimulate market cash flow activities. For example, the U.S. Federal Reserve Bank dropped its federal fund rate from 5.25% to 0.25% and U.K. Official Bank Rate decreased from 5.25% to 0.5%. In fact, during the crisis time when the interest rate was frequently changed, the stock market

volatility increased also. As this paper mentioned earlier, economists argued that the effectiveness of monetary policy could be very small during a crisis time.

Testing the effect of the monetary policy change on the Australian stock market during the crisis period could prove to be a valuable contribution to stakeholders. Furthermore, one of the goals of this research is to compare this effect of the effectiveness of Australian monetary policy during a crisis to policy in a normal economic time.

## *2.2 The importance of testing stock market price*

Patelis (1997) examined a set of monetary policy variables following Fama and French (1988) method of testing the monetary policy effects and found a significant result. He documented that using "monetary policy" as a variable plays a role as a predictor of future excess return of stocks in the U.S. market. He claimed that stock return takes into account future economic output. Therefore, when monetary policy affects the real economy, the stock market should reflect this.

According to Campbell and MacKinlay (1996), the investigation of the transmitting effect from monetary policy to real assets through the stock market is an important channel of transmission of wealth. Firstly, monetary policy changes have a direct effect on stock returns by changing the discount rate used by market participants (affecting the cost of capital and risk-free determinants). Secondly, tighter monetary policy leads to an increase in the rate at which firms future cash flows are capitalised causing stock prices to decline. These factors should affect the economic flow of money as a whole.

Bernanke and Kuttner (2005) point out that the stock market can be an independent source of volatility which policy makers may want to respond to. The stock price in booming and busting cycles may have significant consequences for economic health.

Therefore, studying the impacts of a stock market response to monetary policy will also contribute to the understanding of potential economic impacts on policy changes.

## *2.3 Past study and results*

### 2.3.1 VAR based method

Many researchers in the past have tested the relationship between asset prices and monetary policy. One of popular methodologies that was used is the "Vector autoregression".

Early attempts by Geske and Roll (1983) and Kaul (1987) separately examined the causal chain between monetary policy and stock market returns. Recent empirical studies that used the "Vector Autoregressive" approach, see e.g. Thorbecke (1997), Neri(2004), Christiano et al (1996a), Bernanke and Mihov (1995), among others. The great appeal of using VARs to study monetary policy transmission is that they appear to be able to identify the effects of the policy without a complete structural model of the economy.

Recently, the "simultaneity problem" has been addressed using high-frequency observation to analyze how asset prices are associated with particular policy actions in the short run. Rigobon and Sack (2004) used an identification technique based on the "heteroscedasticity" of shocks present in high-frequency data to analyze the impact effect of monetary policy on the stock market. They found that following a surprise interest rate increase, stock prices declined significantly. Furthermore, using the same method that they analysed reverse causation, Rigobon and Sack (2003) found that stock market movements have a significant impact on short-term interest rates, driving them in the same direction as changes in stock prices. These results are somewhat stronger than results found in more conventional "event studies" like Bernanke and Kutter (2005).

Other researchers questioned the reliability of the result of the VAR based method. Rudebusch (1998) pointed out that the VAR approach is somewhat artificial and meaningless. VAR models results depend on the data frequency used, the variables included and the ordering of the variables. These factors may incur a modelling error. The residuals from these regressions show little correlation across various VARs or with funds rate shocks that are derived from forward-looking financial markets. Compared with other literature that does not use VAR, the author found The VAR approach the Federal Reserve reaction functions estimated in standard monetary VARs appear implausible and specified wrongly in many respects.

### 2.3.2 Early attempts of the event-study method using high frequency data

Another way to test the effectiveness of monetary policy is by using the event-study method. The effect of monetary policy on real asset prices is tested in the monetary policy events method. The advantages of the event-study method are as follows: relatively high data frequency at the time of study, the method is easy to understand and the data can cover long periods compared to other methods used in the same study area.

At the beginning, studies have been using lower frequency data such as monthly or quarterly return of asset prices. More recently, analysts started using higher frequency data. Among the extensive studies done on this topic, Cook and Hahn (1989) are the first authors to test the one-day response of the bond prices to the changes in the target Fed Reserve funds rate. This study is also the first one to use the event study method to test the effect of the monetary policy on the bond market (which has been used more often by other followers). They found that the interest rate of bonds significantly and positively responded to the changes in the target Fed Reserve funds rate in every maturity. Following the Cook and Hahn (1989), Roley and Sellon (1995) re-tested this relationship and found similar but declining significance using more recent data.

Despite the early study results, Kutter (2001) improved the event study method by distinguishing the monetary policy announcement between surprise and non-surprise elements. They argue that under an efficient market, stock prices should only react to surprise elements of the news. Kutter et al. (2005) used a simple way to distinguish surprise from non-surprise elements. They followed Kruger and Kutter (1996) and Kutter (2001) to measure the surprise elements and separate them into surprise reaction and anticipated reaction. Kutter (2001) defined monetary policy surprises as the changes in the Federal Reserve funds future rate on event days and the difference between actual interest rate changes and unexpected changes are the expected changes. They tested the U.S. stock reactions to the change in Fed Reserve policy and found significant relationships between them. These authors also took into account the asymmetries of monetary policy change, timing versus level of surprise, monthly data and industry differences into their regression and tested for these properties. They found that an unexpected 25 basis points cut in the Federal funds rate was associated with a one percent increase in stock prices.

Other studies like Gurkaynak et al. (2005) and Wongswan (2006) analyzed the short-term level of stock and bond market reaction to the monetary policy changes. They also found a significant relationship with the U.S. market. However, these relevant studies only focused on the monetary policy in the U.S. market and there are few works that have been done on other markets. Brandt et al. (2006) tested European markets and found a similar relationship with regard to monetary surprise. They also adopted the event study method and used an identical process to obtain the market surprise of monetary policy announcements.

Recent studies done by Ioannidisa & Kontonikasb (2008) examined the impact of monetary policy on the stock market using 30 years of data across 13 OECD countries. The results indicated that changes in monetary policy have significant effects on stock returns and the findings are robust by using various alternative measures of stock performance such as: expected stock returns and dividend adjusted

returns. They also took into account the increase of international stock market co-integration.

### 2.3.3 Problems with early monetary policy event studies

There are two critical assumptions the event study methodology takes into account.

1. Endogeneity issue

   Researchers wished to isolate the influence of the changes in the monetary policy and how they affect the stock market prices however they were not interested in the other way around where causality may go in opposite direction. The policy makers could change the monetary policy based on the economic conditions of asset prices, however asset prices could also react to monetary policy changes. This would cause a bias of the regression results. Rigobon and Sack (2003) attempted to solve the endogenous problem by using the VAR model and they found an insignificant result using daily U.S. data.

2. Joint-response issue

   This joint-response issue could occur when other information affects the stock market during the event window period. For example, the stock market and monetary policy both react to the change in "balance of trade" news. Therefore, it is difficult to distinguish which factors affect the stock market prices most significantly.

Although using the event-study method to test the relationship between monetary policy and asset price has been widely accepted in the academic world, some studies have been criticised.

Rigobon and Sack (2003, 2004) argue that the event study method does not test how monetary surprises relate to other surprises and does not compare the changes on event days with changes on non-event days. Rigobon and Sack (2003, 2004) used a reduced form of the simultaneous model which can be written as a factor model (VAR-based). The VAR-based approach required a much weaker set of assumptions than the "event-study" approach required. They reported an unexpected 25-basis-point decrease in the three month Euro-dollar future rate which resulted in a 1.7 percent increase in the S&P 500 index.

Rigobon and Sack also argue that the standard event-study approach poorly measures the market macroeconomic expectations. Most previous studies calculated the "surprise element" by using the expectations taken from surveys conducted ahead of the event. The problems of this method of "surprise" measurement are documented in their research. First, it is difficult to accurately measure the market expectation at a fixed date. The time gap between when the survey actually took place and actual event time created uncertainty regarding the results. Secondly, the survey reports can be noisy. The expectation of a particular macroeconomic variable is usually one component of the report, however because most of the reports are quite complicated and have different relevancy in different areas.

Leonardo Bartolini( reference) responded to Rigobon and Sack's study by supporting the problematic view of the traditional survey-based event study method, then added other problems which the error-in-variables estimation model did not take into account. He argued that the forecasters in the survey had a possible incentive which could create bias in the result. Forecasters found to make forecasts toward realizations that benefit their own position, so called 'wishful expectations" in Ito (1990). Leonardo Bartolini argued the result from Rigobon and Sack overestimated the response of asset prices to monetary policy news. ( Rigobon and Sack (2008))

### 2.3.4 Support and improvements of the event-study method

The early analyses on the effect of monetary policy to asset prices have been proved to be biased in different ways. Researchers' main arguments against the event study method include: the violation of Joint-hypothesis, Endogeneity problems and the difficulty of catch the "true market expectations". Realising the problems of early study attempts of the event study method, researchers improved the methodology and extended the areas studied to wider samples. The following paragraphs illustrate what recent research has done to improve the understanding of monetary policy and asset price relationships.

Bernanke and Kutter (2005) support the event-study method by arguing that although other literature that uses different methods to test the relationship between stock market return and the monetary policy changes was similar to what they have found. According to their study, the alternative econometric methods that were used to correct the "mis-measurement" of the "funds rate surprise" uniformly yielded similar results to the test used by the event-study methodology.

**Improvement of measuring the surprise element**

Early studies relied on the surveys of economists from various sources such as: Reuters, Bloomberg and so forth. By using the various surveys, the authors compute the expectation of the market and compared it with the actual announcement results to calculate the surprises element of the monetary policy. In the earlier chapter of this paper which talks about the event-study method, it has been shown that by using the results from economists' surveys computing the market expectation can be biased estimates. In order to solve the measurement bias problem, several papers have attempted to measure the market expectation of monetary policy using different instruments.

Gurkaynak et al. (2002) also tested these different instruments to measure the market expectation of the market. They found the Federal Reserve fund rate future is the best measurement of market expectation among 6 different instruments and they found the short term T-bill rate had “tight” linkages with the Federal Reserve Fund rate. Because of the fact that there are not Federal Reserve Fund rate futures in other markets, research done in other countries uses different instruments such as the T-bill future, Commodity bill and other fixed assets which have similar properties to the U.S. Federal Reserve Fund rate.

Blattner et al. (2008) studies tested different ways of measuring the market expectation of monetary policy in both short term and long term. They used different proxies to test the predictability of market participants on the monetary policy decision and found the future of the short term bank bill rate are good estimates for market expectation on the Central Reserve bank monetary policy decisions. In fact, the study by Gregoriou et al. (2009) on U.K. data used the three-month sterling LIBOR futures to calculate the market expectation on monetary policy.

Studies of the Australian market attempted to measure the monetary policy expectations from the bank bill rate and the bank bill rate futures. The short term bank bill rate is one of the interest rates that the Reserve Bank wants to influence by changing the OCR rate. According to Zettelmeyer (2004), using the daily changes in bank bill rate is a good measure of market expectation on monetary policy decision. Kearns and Manners (2006) followed Zettelmeyer’s (2004) method and extended the study by testing the intraday exchange rate reaction and path surprise effects. However, in the Australian market, the intraday bank bill future rate data were not used at the time of the study and only the daily changes were obtained. Although it was not the best estimate of measurement, the authors used the daily change of bank bill rate as the proxy for measuring the market expectation changes and regressed it with the intraday day changes in the stock price return.

**Improvement of Endogeneity and Joint-response issue by USING INTRADAY DATA**

These two critical assumptions of the event-study method have been broadly criticised in many analyses. Recent studies attempted to solve this problem by using the intraday data and a shorter event window. The advantage of using the intraday data is that it allows more precise control over the Endogeneity problems and other external factors that may influence both real asset prices and interest rates. The example of these effects is the unemployment rate which is announced during the same day as monetary policy. As documented, both monetary policy and unemployment macroeconomic news could affect the stock return in different directions. By using shorter event windows such as 30 minutes, this attempted to eliminate the probability of other macroeconomic news which could have a joint effect on the stock returns. Gurkaynak et al. (2005) used intraday data to test the effect of monetary policy surprise on the different markets and they found stronger reaction of bond market return to monetary policy shocks. Many past studies have also found a more significant relationship between prices and macroeconomic news using the intraday data. For example, Andersen et al (2007) found that the asset price reaction to monetary policy shocks becomes stronger using intraday data.

New Zealand study Drew and Karagedikli (2007) has tested the effect of monetary policy surprise on the return of long term bond rates in different maturities using intraday data. They argue the daily calculation could underestimate the short term effects of unexpected events on asset prices and most of the market reaction lasted only several hours after the monetary policy announcement occurred.

**Improvement of measuring two surprise elements**

One of the most striking papers done by Gurkaynak et al. (2005) tested the asset price responses to monetary policy surprise in the U.S. market using the intraday data. It is

one of the first papers that used the intraday data to form a narrower event window to compare the results with the daily data. The main contribution of this research is that it used two surprise factors to analyse the effects of monetary policy on asset price and found the "path effect" had a significant effect on the market asset prices. Unlike previous papers, the authors mentioned their support of the use of two factors by rejecting the null hypothesis of one or zero common factor to determine the asset price. They found that the results did not reject the idea that two common factors determine the asset price movement. The authors continued the use of a tight window of one hour. They found that the tight window helped to reduce noise such as return variables and path factors which require time to digest and could be subject to a greater deal of uncertainty.

Gurkaynak et al. (2004) found that the path surprise had more effect on the long term yield curve than the target surprise had. They also found that the path surprises increase the explaining power of the changes in asset price (higher R-square). The most recent example is the OCR announcement of the Reserve Bank of New Zealand (RBNZ) 29$^{th}$ October 2009. There was no interest rate change in the announcement statement, and they also expected no interest rate changes until the end of 2009. The market fully anticipated that there would be no interest rate change in the announcement however the market reacted negatively to the possibility of no interest rate increases up until the end of 2009. The New Zealand currency reacted negatively to the announcement and dropped more than 200 basis-points against the U.S. dollar.

Wongswan (2009) analyzed the impact of U.S Monetary policy surprises on the stock market index returns in sixteen countries. The author's study contributed to the academic world by using the high-frequency intraday data of the stock market index (emerging and developing countries) for the period from September 1998 to November 2004. They introduced a new method to control for other unrelated news, unrelated to U.S Monetary policy announcements that were considered to have a possible influence on the overnight returns of other Asian and European equity indexes. This paper was followed by Gurakynak, Sack, and Swanson (2005) study in

which they used two proxies of measurement of monetary policy surprises: the target rate surprise and the path of future monetary policy surprises. They found significant results in that the countries indexes reacted to the U.S. Federal fund rate surprises. However, they found that the path surprise coefficients were not significant using all the sample countries' stock indexes returns.

**Other improvements**

***Improve the dimension of analysis***

Bernanke and Kutter (2005) studied the different asymmetry variables in their study. The asymmetry variables are the direction of announcements interest rate changes, the direction of surprise, the rate reversal event and the sub-sample post-1994 period. All of these variables are sorted with dummy variables and regressed with target surprise and expected changes of interest rate.

***Sub-period and in the U.K. stock market***

Gregoriou et al. (2009) studied the relationship between the stock market returns and monetary policy shocks in the U.K. market. They found the relationship was significantly negative before the current financial crisis however the relationship became positive during the current financial crisis.

***Monetary shock effects on asset price Volatility***

Anderson (2007) tested the bond and stock market volatility reaction in the European and U.S. markets for the effect of monetary policy announcements using intraday data. The sample period used was from April 1999 to May 2006. The test focused on short-term predictability which assumed that investors had the ability to forecast the upcoming interest rate decisions. They found a strong upsurge in the intraday volatility around the time of the monetary policy announcement. Lunde and Zebedee (2009) extended Anderson's (2007) work by testing the effect of changes of U.S. monetary policy to U.K. stock volatility. He found that the volatility spikes only

lasted for approximated 15 minutes and the magnitude of the volatility depended on the direction of the monetary policy.

# 3. Hypothesis and gap

## 3.1 Australia's stock markets

Although there are many "monetary policy and asset price" studies done on the U.S. market, Euro and Asian zones, there are only a few studies that analyse the monetary policy effect on the Australia stock market which is seen as one of the fastest growing countries.

The Australian Stock Exchange (ASX) and the Sydney Futures Exchange (SFE) merged into the "Australia Security Exchange" in December 2006. It became the 9th largest stock exchange in the world and one of the fastest growing stock markets in the world. The major market index is still the ASX 200, which contains the 200 most represented stocks in various sectors. During the recent global financial crisis, the ASX 200 dropped more than 59% from late 2007 to early 2009. Afterwards, the stock market bounced back increasing 45%. On 6 October 2009, The Reserve Bank of Australia (RBA) increased its OCR rate by 0.25 percent, indicating its view that the crisis was over. The stock market shot up by 0.4% after the RBA announcement. It was the first OECD country to raise the interest rate and the only developed country that was able to avoid "technical recession". One of the main reasons they recovered fast is due to their massive commodity resources in iron, gold and natural gas reserves. Because other fast growers like China and India import substantial quantities of commodity products from Australia, this has provided tremendous cash flow from these foreign countries into the Australian economy. In fact, Australia is one country among others that has shown the most growth.

In terms of the Reserve Bank of Australia (RBA)'s monetary policy, the Australian government has adopted a target inflation rate policy ranging from 2% to 3% inflation per year since 1998. In order to control inflation and keep it within the target range, one of the main tools the RBA has used has been to change the OCR, with a goal in mind that the effects from changes in monetary policy would transmit to different sectors of the economy to help achieve the target inflation goals. The RBA has 11 monetary meetings each year and announces the new interest rate at 2:30pm after the

meeting. During the recent financial crisis, the RBA cut the interest rate from 7.25% to 3%. As a consequence, the exchange rate against the U.S. dollar dropped from 0.96 to 0.63 from July 2007 to January 2009 (Blandeburgo, 2009).

There are only a few studies testing the reactions of asset prices to monetary policy surprises in Australia. Among those studies done in this area, Zettelmeyer (2004) was the first to study effects of the surprise monetary policy on asset prices in this market. They used the 3 month bank bill rate to measure the market expectation of interest rates. They tested the daily reaction of monetary policy surprises and how they affect the exchange rate. The authors found an unexpected increase of 100 basis points in the interest rate helped increase the exchange rate by 2% to 3%.

Based on Zettlemyer (2004), Kearns and Manners (2006) improved on Zettelmeyer's study in several ways. They investigated the effects of monetary policy on the exchange rate using the event study method to study four countries: Australia, Canada, New Zealand and the United Kingdom. The main contributions of the paper are as follows: First, they used higher frequency data (intraday) to run the regressions. Second, they used more recent data from 1998 to 2005. They found an unanticipated tightening of 25 basis points which led to a rapid appreciation in bond prices around 0.35 percent. They also found that the path surprises had a higher effect on the exchange rate compared to target surprises.

However, there were gaps in the studies, because they only focused on the relationship between exchange rate and monetary policy changes. As mentioned earlier, testing the reaction of stock market is also important.

This paper is going to test:
Null hypothesis: All Australian stocks significantly react to monetary policy surprise in different short term event windows (intraday and daily).
Alternative hypothesis: Some Australian stocks do not react to monetary policy surprise in some event windows.

3.2 Study at individual stock levels

Studying at the level of individual stocks one by one enables us to explore in more detail how size, market to book ratios and industry factors affect the relationship of monetary policy and stock index return. Most of the papers studying stock return and monetary policy relationship use the major stock index return. Some studies have been done at the industry index level. By studying individual stocks one by one, we have the ability to attain a larger number of samples enabling us to test the cross-sectional effect of the monetary policy effect on the stock market.

Fama and French 3 factors model have been widely study and used in different stock market. Size and market to book ratio are two of the factors in the model. Different size and market to book ratio affect the stock behaviour in many market. This paper is going to test the effects of size and market to book ratio to the reaction of monetary shocks for individual stocks.

The second hypothesis test is therefore:

Null hypothesis: The sensitivity of stock returns to monetary policy shocks is not relevant to the Size and Market to Book Ratio factors.

Alternative hypothesis: The sensitivity of stock returns to monetary policy shocks depends on the Size and Market to Book Ratio of the stocks.

3.3 Reaction speed tests in intraday event windows

Many previous studies have tested how long it takes for the market to react to macroeconomic news and how long the reaction lasts. In particular, some studies have attempted to test the speed of stock market reactions to the monetary policy announcement decisions. The purpose of testing the speed of reaction is to measure the market efficiency of reaction to public released news and find out if there are any

chances for arbitrage opportunities. As the semi-strong market efficient theory states that: an efficient market should react immediately to publicly available news. In fact, many past studies have found the market reacts to public news within seconds or minutes after the announcement. However, there are no studies that have tested the Australian stock market so far with regard to the reaction speed to the monetary policy shocks. Having the intraday data enables us to test the speed of the reactions after monetary policy announcements. Furthermore, this paper is the first to test the reaction speed to path surprise in the Australian stock market. The object of this paper is to gain knowledge about how the market reacts to different type of shocks (Target and Path) and how long it takes the market to digest monetary surprises macroeconomic news.

This paper also tests the industry indexes for their speed of reaction to monetary policy shocks. Referring to the results of Bernanke and Kutter (2005), the response of different industry portfolios is different. In their study, the Health care, Utilities and Energy sectors have insignificant reactions to Federal Funds Rate Surprises and the R-square is much smaller than in other industries which have a significant reaction to monetary surprises. This indicates that the monetary surprise has very little effect on the return in the Health care, Utilities and Energy sector. In order to study the effects of monetary policy surprise and the speed of reaction within different industries, these tests provide more insight about how efficient the market is, how different industries behave differently and how these factors affect the magnitude of reaction to monetary surprise.

Null hypothesis: The stock market takes more than one day to fully digest the monetary policy shocks.
Alternative hypothesis: The stock market immediately reacts to the monetary policy shocks and therefore the stock market is efficient.

# 4 Methodology

## *4.1 Data*

The sample period includes RBA monetary policy announcements from November 2000 to October 2009. The sample covers 102 monetary policy announcements from the Reserve Bank of Australia (RBA) and during this time there were no unscheduled meetings. The table below splits the sample into 2 periods: before 2007 and after 2007, both periods had an equal number of meetings each year. One difference was that the announcement times during each of the 2 periods were different. The descriptive statistics (Table 1) below were based on 69 events in the period before 2007 and 32 events in the period after 2007. However, the number of rate-change announcements in the period before 2007 is similar to the number of rate-change announcements in the period after 2007. In the period before 2007 there were 14 rate-change announcements compared to 12 in the period after 2007. The standard deviation of event day returns also shows that there is more volatility in returns, with standard deviation of 0.5533 in the period prior to 2007 period as compared to 0.715 in the period after 2007. Most of the observations show that the interest rates do not change in the announcements. There are 26 observations which show that the interest rates changed in the announcements whereas the other 75 observations did not indicate this change. This shows that the Reserve Bank of Australia does not adjust the interest rate on a regular basis. In addition, the interest rates appear stable for awhile after the various announcements changing the interest rate.

Table two indicates the statistics of change announcements comparing actual rates and the 90-day bank bill rate during the event days. For the sample period, there are only 89 observations included in our calculation, because the 90-day bank bill rates data from SIRCA database is available only from May 2002 until recent. Because the intraday data for bank bills futures information has just recently become available, previous studies on Australian monetary policy surprise (reference) used the daily

bank bill rate for the calculation of monetary policy shocks. The mean of the daily change in the bank bill rate is 0.000349, which is much closer to zero. The actual changes in the interest rates are also given in the following tables.

### Table 1 Descriptive Statistics of Monetary policy Interest decision

The table below shows the descriptive statistics of Monetary policy interest decisions over the sample given in the column headings.

| | NOV 2000-DEC 2006 | FEB 2007- OCT 2009 |
|---|---|---|
| **NUMBER OF EVENT USED** | 69 | 32 |
| **NUMBER OF CHANGES** | 14 | 12 |
| **NUMBER OF NO-CHANGES** | 55 | 20 |
| **NUMBER POSTIVE CHANGES** | 8 | 6 |
| **NUMBER OF NEGATIVE CHANGES** | 6 | 6 |
| **Std Dev of event day returns** | 0.5533 | 0.7150 |
| **MEETING PER YEAR** | 11 | 11 |
| **ANNCOUNCEMENT TIME** | 9:30 a.m. on the day after board meeting | 2.30 p.m. on the same of board meeting |

### Table 2 Descriptive Statistics of Target Surprises calculation illustrated by the daily changes bank bill rate compared to the actual rate changes

The table report the target surprises values calculated by two different methods. The first column reports the daily changes of 90 day bank bill. The second column reports the actual changes in the OCR during the announcement days.

| | Bank bill daily changes | Actual change of rate |
|---|---|---|
| **Mean** | 0.000349 | -0.0245 |
| **Absolute mean** | 0.0259 | 0.0980 |
| **std dev** | 0.0451 | 0.2294 |
| **observation** | 89 | 102 |

# *4.2 Methodology*

### 4.2.1 Target surprise

Following the works of Gurkaynak et al. (2005) using U.S. data and Kearns and Manners in 2006 using Australian data, both these studies provide evidence that monetary policy surprises contain both target and path surprises. The target surprise is the difference between the expected interest rate from the market and the announced OCR rate from RBA. According to Kearns and Manners (2006), the market expectation of interest rates can be measured by the 90-day bank bill rate future, the 90-day bank bill rate or the 30-day bank bill rate. This paper's target surprises are derived from the changes in market interest rates or the changes of the interest rate futures by extracting data gathered from a thirty-minute event window beginning from the moment of the RBA monetary policy announcement. Following Kearns and Manner (2006), the initial prices are taken from 10 minutes before the monetary policy release to avoid leaking of news before actual public announcement time. The formula of Target surprise is as follow:

(1) $\mathrm{TS_t} = \text{market interest rate}_{t+30} - \text{market interest rate}_{t-10}$

(2) Expected surprises= actual interest rate changes – Target surprises

When I am using the 90-day bank bill future and 90-day bank bill rates to compute the market expectation on interest rates, the target surprises are the difference of the two rates mentioned during the event window. Because there are four different maturities of Australia 90-day bank bill futures (March, June, Sept, Dec), the future contract prices which have the closest expiry date are used. For example, to measure 6$^{th}$ of Oct 2009 RBA monetary policy announcement surprise, the 90-day bank bill future with a maturity of Dec 2009 is used. The reason for using the closest expiry bank bill future is to ensure the best estimate of market expectation of changes in the shortest market interest rate. The intraday data all are sourced from the SIRCA data base.

### 4.2.2 Outliners of target surprises

The target surprises distribution in figure 1 shows that the histogram has two outliners on the right hand side. These two outliners are announcements in October 2008 with a surprise of 0.70 and November 2008 with a surprise of 0.45. The two outliers are the result of the bankruptcy of Lehman Brother and trouble of AIG's operation.

As observed from the histogram, these two outliners are around three to five times larger than the far observation from the right which is 0.15. In order to obtain a good estimation of real target surprises, there are two methods of managing the outliners. The 1st method is to remove the outliner and use the balance of the samples distribution, the 2nd method is to smooth down the two outliers by making both into the third quarter average of the sample. Because the observation number is relatively small in previous event studies on monetary policy, this paper aims to retain the outliners. Therefore, the second method of smoothing down the two outliers is used.

The following histogram shows the distribution of the samples before and after smoothing the outliers. The mean before and after smoothing were 0.006327 and 0.001020. The mean negative at -0.001020, therefore it is close to zero. The standard deviation of sample without outliers is positive, but smaller than before the smoothing. After the outliners smoothing, the "Skewness" drops from 4.443 to 0.0027 which is close to zero.

Figure 1 **Absolute changes in 90 day bank bill in 30 minutes (full sample)**

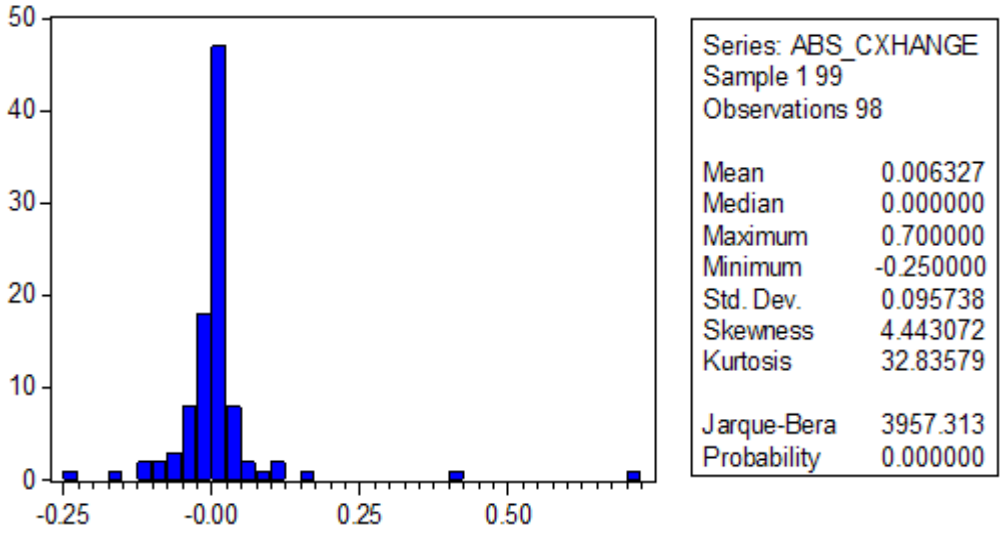
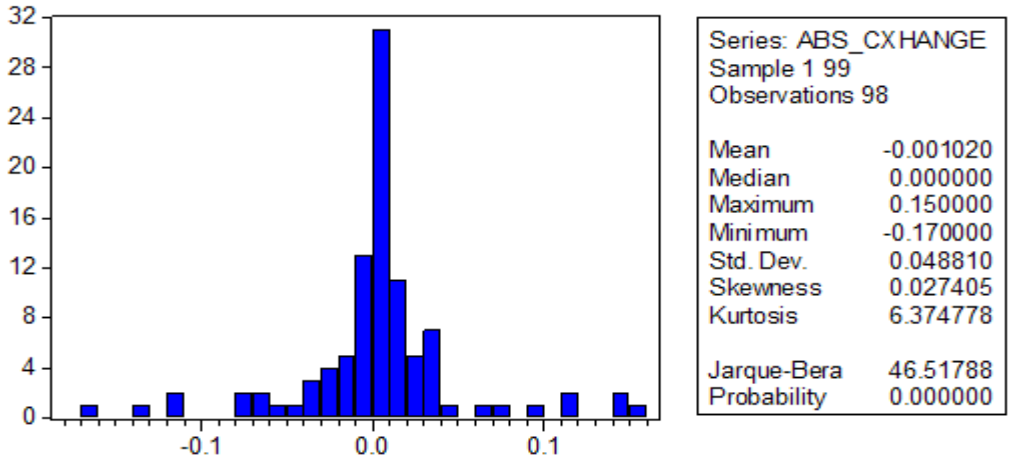



Figure 2 **Absolute changes in 90 day bill future in 30 minutes (no outliners)**




### 4.2.3 Path surprise

The path surprise is the change in market expectation which is uncorrelated to the target surprise. The path surprise represents the unexpected information that the RBA monetary policy statement indicates about the future path of interest rate movement. To calculate the path surprise, the following method of Bernanke (2005) is used. The path surprise is calculated by taking the difference between changes in the 2$^{nd}$ period

interest rate future and changes in current period interest rate future. In Bernanke (2005) method, the author uses the difference between changes of second closest expiry date of Federal Reserve Fund Rate Future and the target surprise element to calculate the "timing surprise" which is equivalent to the "path surprise". Some articles in this area derived the path surprise using regression of the changes in Eurodollar interest rate futures on target surprises, and the regression error terms are considered to be path surprises. In this paper, I have used the method used by Bernanke and Kutter (2005) which calculated the path surprise using the difference between 2nd contract interest future (in this case, it is the 90 day bank bill future) and the changes in the 1st contract interest future (which is the target surprise). The formula is shown as follows:

$$(3)\quad PS_t = TS_{2nd\ period} - TS_{current\ period}$$

**Table 3 Descriptive Statistic of target and path surprise in different event windows**

This table shows the descriptive statistic of target and path surprise calculated in 30mins, 60mins and 90mins intraday event windows.

| 90 day bank bill future | Target surprise | | | Path surprise | | |
|---|---|---|---|---|---|---|
| | 30 mins | 60 mins | 90 mins | 30 mins | 60 mins | 90 mins |
| **Mean** | 0.0063 | 0.0079 | 0.0070 | 0.0051 | -0.0047 | 0.0045 |
| **Absolute mean** | 0.0378 | 0.0393 | 0.0391 | 0.0155 | 0.0165 | 0.0173 |
| **std dev** | 0.0957 | 0.0976 | 0.0960 | 0.0273 | 0.0289 | 0.0293 |
| **Observations** | 98 | 98 | 98 | 98 | 98 | 98 |

Table 3 shows the descriptive summary of target and path surprise using the intraday 90-day bank bill future. The sample target surprises have average mean of 0.006327, 0.007857 and 0.007041 for the event window 30, 60 and 90 minutes after the monetary announcements, respectively. Among these three mean values, the mean of the 60-minute event window has the highest value. The hypothesis test of mean value is equal to zero shows p-values of 0.8365, 0.9052 and 0.9840, which indicates that there is no evidence against null hypothesis which is the means are equal to zero for the event windows. The absolute means describes the size of average target surprise during the event days, which shows a similar pattern compared to the mean which has the highest value in 60-minute event windows.

The path surprises have average mean of 0.005102, -0.00469 and 0.00449 for the mentioned event windows, respectively. The absolute mean shows the average magnitudes of path surprises are 0.01551, 0.016531 and 0.017347 which are smaller than the target surprise. The standard deviation of means also indicate that the path surprise has lower volatility than the target surprise.

### 4.2.4 Equity market data

#### Whole market index returns

In this paper, the intraday data of ASX200, ASXALL market index and individual stock prices in ASX200 are retrieved from SIRCA database. ASX200 is the most representative market index which gives the highest liquidity in terms of trading. It also captures the overall stock market performance. The Australian market trading hours are from 10am to 4pm on Monday to Friday. ASXALL index has the largest 500 companies and includes around 95% of the total market capital in Australia Stock Exchange.

In order to follow the reaction of the stock market during the event window, a tailored event window is to be selected. From the previous studies, an intraday period window of 30 minutes or 60 minutes after the event is often chosen.

In this paper, the Australian monetary policy announcement time changed from 9:30AM on the next day to 2:30 PM on the same day of the meeting after the beginning of 2007. Assuming that the Australian market is efficient, the market should respond to publishable news. In this case, the market should react after the actual announcement, instead of at the time when the meeting is finished. The first market trading price is assumed as the opening price of the stock market at 10AM on the announcement date during the pre-2007 sample period. By the time when the monetary policy is announced at 9:30 AM, the stock market is still closed. However, the Australian stock market has a pre-trading section from 7am to 10am before market trading officially opens. The main purpose of this pre-trading section is to have a preview of the day session. The opening prices are considered the most important prices of the day. The opening price illustrates information that occurs during the non-trading period. Orders and trades of stock price are most likely set during this opening period. To avoid crashing the trading system and to increase the efficiency of trading prices during this opening period, the ASX Board has an AM Pre-Open Phase from 7 am until 10 am. During this Pre-open Phase, securities are not traded. However, limited orders can be placed and withdrawn at any time in this period. The bid and ask price of the orders would overlap in the market depth system and create a “match area”. The ASX posts a weighted average of the matching prices. The orders are renewed all the time to reflect the market expectation of the stock price and the matching price is re-calculated progressively. The opening price therefore is created by the last display matching prices in the pre-open phase. On the monetary policy event days, the pre-open phase matching prices would reflect the effects of the target surprise to the stock market. Therefore, the opening prices contain information regarding market reactions to monetary policy announcements during the event days and they are considered as a good measurement of the true stock market prices.

In recent periods, since February 2007, the RBA has announced the statement of monetary policy decision at 2:30 pm local time after the morning meeting. The announcement is released during trading time. The event windows are therefore taken 30, 60 and 90 minutes after the 2:30pm event time.

Returns of stocks are calculated as follow:

$$(4)\ R_{i\,t-10,t+n} = LN(stock_{i\,t+n}/stock_t)$$

Where n is 30, 60, or 90 minutes, and t is the time of the announcement.

Industry indexes return

This paper also tests the industry index reaction to monetary policy shocks. There are nine industry indexes in Australian market. The indexes are sourced from SIRCA data base. The industry indexes are consumers' discrete goods, energy, finance, Information Technology, material, property, consumers' staple goods, telecommunications and utility.

### 4.2.5 Index's reaction after monetary policy changes

To test the stock market reaction to monetary policy surprises, this paper adopts the regression method used by most event studies on monetary policy shocks. This method was first used in Cook and Hahn (1989) to test the relationship between the return and monetary change. Kuttner (2001) improves the method by testing only the surprise elements of monetary policy changes and their effects on the stock market. Path surprises are also important factors documented by Gurkaynak (2004) to real asset market returns following the method of Kearns and Manners (2006), this paper tests both target and path effects on stock returns.

The regression is shown as below:

$$(5)\ R_t = b0 + b1 * TS_t + b2 * PS_t + e_t$$

$$R_t = \text{return of index}$$

$$TS_t = \text{target surprise}$$

$$PS_t = \text{path surprise}$$

### 4.2.6 Individual stock reaction to monetary policy changes

In order to follow the ASX200 movement of stocks correctly, the list of ASX200 must be updated for every single event time. To create the list of ASX200 stocks, the addition and deletion of ASX200 are updated from Standard & Poor's Australia.

In this paper, the stock level reactions from monetary policy shocks are also tested. By analyzing individual stock returns this will give information on how different stocks behave during the period of changes in monetary policy. Because of the fact that the composition of ASX 200 changes frequently, some stocks have only a few observations in our sample period. To avoid any errors from only a few observations, we only look at the stocks which have more than 30 observations in the sample period. In ASX200 list, the stocks added or deleted are most often small stocks compared to the other stocks. The deletion of the stocks that were deleted has little effect to the overall result, because they were small stocks.

Method one:

$$(6)\quad R_{stock\ i,t} = b0 + b1_{stock_i} * TS_t + b2_{stock_i} * PS_t + e_t$$

After doing the regression on individual stock return with the monetary policy surprises, the individual coefficients, $b1_{stock_i}(TS_{coefficents})$ and $b2_{stock_i}(PS_{coefficents})$, are then put together and tested against their size and

market-to-book ratio. The purpose of this is to analyse the effect of size and market-to-book factors in comparison with the sensitivity of the monetary surprise reactions. The two factors are constructed by averaging the 10 year market capitalizations and market to book ratios retrieved from the DataStream database. The equation for cross-sectional regression is as follows:

$$(7)\ \mathrm{b1}_{\mathrm{stock_i}} = \mathrm{b0} + \mathrm{b1} * \mathrm{M/B}_{\mathrm{stock\,i}} + \mathrm{b2} * \mathrm{Size}_{\mathrm{stock\,i}} + \mathrm{e_i}$$

$$\mathrm{b2}_{\mathrm{stock_i}} = \mathrm{b0} + \mathrm{b1} * \mathrm{M/B}_{\mathrm{stock\,i}} + \mathrm{b2} * \mathrm{Size}_{\mathrm{stock\,i}} + \mathrm{e_i}$$

Method two:

Instead of using a two-stage regression analysis, method two use a single-stage regression and test the interaction effects of size and market to book ratios:

$$(8)\ R_{stock\,i,t} = c0 + c1 * \mathrm{TS_t} + c2 * \mathrm{TS_t} * \mathrm{M/B}_{\mathrm{stock\,i}} + \mathrm{c3} * \mathrm{TS_t} * \mathrm{Size}_{\mathrm{stock\,i}} + c4 * \mathrm{PS_t} + c5 * \mathrm{PS_t} * \mathrm{M/B}_{\mathrm{stock\,i}} + \mathrm{c6} * \mathrm{PS_t} * \mathrm{Size}_{\mathrm{stock\,i}} + \mathrm{e_i}$$

The sample data are structured as panel data with observations across time (10 years) and cross-sectional (individual stocks).

### 4.2.7 Speed of reaction

The purpose of this section is to test the efficiency of market reaction to monetary policy shock. Some studies have tested the market efficiency of monetary policy shock either in lower data frequency (i.e. daily level) or intraday level which is higher. In this paper, the stock returns in the first thirty minutes after the events are regressed on path surprises measured in the first thirty minutes after the events. By testing the relationship between path surprise and stock market returns in different time periods, the results are expected to indicate the speed of the market to digest the monetary policy publishable news.

To measure the speed of reaction, the stock returns from thirty, sixty and ninety minutes after the monetary announcements are regressed on the target and path surprises measured by the first 30 minutes after the monetary announcements. The significance of the relationship between the different periods of stock returns and the path surprise are expected to indicate the speed at which the stock market reacts to path surprise. For instance, a 60 minute window is significant, however after 90 minute, the reaction is not significant in relation to path surprises therefore we can conclude that the market does not react to path surprises after 60 to 90 minutes after announcements are released. The time-series regression is as follows:

(9) $$R_{t=30,60,90,120\ or\ end\ of\ day} = \mathrm{b0} + \mathrm{b1} * \mathrm{TS}_{\mathrm{t=30\ mins}} + \mathrm{b2} * \mathrm{PS}_{\mathrm{t=30\ mins}} + \mathrm{e_t}$$

This paper also tests the speed of various industry index reactions to the monetary policy surprises. Using the same methodology which measures the speed of reaction of the ASX200 index, the returns of the industry index in 30 minutes, 60 minutes, 90 minutes and 120 minutes up to the end of the day are regressed against the target and path surprises created in the first 30 minutes after the interest rate decision announcements.

# 5 Results

## *5.1 How the monetary policy changes affect the stock market returns*

### 5.1.1 Daily regression

**Table 4 Daily regression results using different measurements**

The purpose of this table is to show the magnitude of effects from monetary policy changes to stock market return in daily level. The table below shows the regression between daily stock return calculated by ASX200 and ASXALL indexes and target surprise measured by 90 day bank bill rate, 90 day bank bill futures and actual changes of OCR interest rates.

| | **ASX 200** | **ASX ALL** |
|---|---|---|
| **90 day bank bill** | -3.5527 | -5.4659 |
| P-value | （0.8348） | (0.7390) |
| Adj R square | 0.0005 | -0.0111 |
| **90 day bank bill futures** | -3.2583 | -3.1704 |
| p-value | （0.1736） | （0.1686） |
| Adj-R-square | 0.0088 | 0.0193 |
| **actual change of interest rate** | -0.4506 | -0.4001 |
| P-value | （0.3806） | （0.4184） |
| Adj-R-square | -0.0023 | -0.0035 |

This section tests Hypothesis one by examine the relationships between the daily measures of surprises and the daily changes of the stock market. Following the Kearns and Manners (2006) paper, this section uses the daily changes 90 day bank bill rate to measure the target surprise. For comparison purposes, the target surprises measured by daily changes in the first expired 90 day bank bill futures contract and the daily changes in the actual interest rate are displayed in the table above. The equation used in this table refer to equation 5 of the methodology.

The result shows that all three measures in the daily level do not have a significant impact on the daily stock returns. Among them, both the coefficient of surprise measured by the actual rate changes and daily 90 bank bill rates is very small; Adj-R-square measured at 0.008797 and -0.00229 for market surprise calculated by 90 day bank bill and actual rate; the P-value is larger than 5% level at 0.9585 and 0.3806. The target surprise measured by changes in the 90 day bank bill futures has the highest coefficient of -3.258 however the P-value of 0.1736 shows an insignificant relationship to the stock return daily changes.

The results are different compared to other studies in the US stock market and in other asset prices studies in Australia. Most of the other studies of the US stock market indicate that the stock market return is significant in reaction to monetary surprise. The study on bond and exchanges rate in Australia market also found significant result in daily level (Kearns and Manners (2006)).

Due to the fact that the daily test of monetary surprise and stock market return does not show a significant connection, the next section will test the relationship of monetary surprise and stock market return in a shorter event window, namely the intraday level.

### 5.1.2 Intraday

As noted above, the intraday event study provides a shorter event window which helps to identify a stronger relationship as well as addressing the “Endogeneity” issue and the “Joint-response” issue. The table below shows the results of using the 30-minutes event window. This study follow the event window used in Wongswan (2009) and other intraday day studies. Past study has shown that the stock prices stop reacting to the monetary policy shock in around 30 minutes. The table below indicating the relationship between the changes in stock market during the first 30 minutes after the monetary announcement is released and the changes of target

surprise measured by changes in the 1st 90-day bank bill future rates contract. Sensitivity test for longer event windows has also been done in the later section.

### Table 5 The intraday 30 minutes Response of stock return to monetary policy changes (ASX200)

The table report the results of regression between Australia stock return (calculated using ASX200 and AXALL index) and independent variables such as target surprise changes, raw interest rate changes and expected rate changes. The raw interest rate changes variable is the actual interest rate changes in the sample periods, the expected rate changes is the different between actual interest rate changes and the target surprises (refer to methodology). All variables are sourced from 30 minutes event windows. The table below also shows the full sample regression results compare to regression results excluding outliers. Under each coefficient, the p-value is shown in the brackets under each coefficient. (refer to equation 5)

| **ASX200** | Full Sample | | | Excluding outliers | | |
|---|---|---|---|---|---|---|
| Regressor | (a) | (b) | (c) | (a) | (b) | (c) |
| | | | | | | |
| Intercept | 0.0264 | 0.0502 | 0.0362 | 0.0446 | 0.0335 | 0.0362 |
| | (0.6504) | (0.4253) | (0.5674) | (0.4663) | (0.5950) | (0.5674) |
| Raw interest rate changes | | | -0.0016 | | | -0.0016 |
| | | | (0.5533) | | | (0.5533) |
| expected rate changes | | 0.3126 | | | 0.2495 | |
| | | (0.3069) | | | (0.3274) | |
| target surprise | -2.3552 | | | -2.8096 | | |
| | (0.0002) | | | (0.0292) | | |
| R square | 0.1384 | 0.0111 | 0.0038 | 0.0496 | 0.0102 | 0.0038 |
| ADJ R SQUARE | 0.1293 | 0.0006 | -0.0068 | 0.0395 | -0.0003 | -0.0068 |

| **AXALL** | Full Sample | | | Excluding outliers | | |
|---|---|---|---|---|---|---|
| Regressor | (a) | (b) | (c) | (a) | (b ) | (c) |
| | | | | | | |
| Intercept | 0.0251 | 0.0474 | 0.0003 | 0.0418 | 0.0319 | 0.0003 |
| | （0.6525） | (0.4287 ) | （0.5674） | 0.4736 | （0.5941） | （0.5674） |
| Raw interest rate changes | | | -0.0014 | | | -0.0014 |
| | | | （0.0003） | | | (0.5903) |
| expected rate changes | | 0.3010 | | | -0.2200 | |
| | | (0.3006) | | | (0.3638) | |
| target surprise changes | -2.1752 | | | -2.5451 | | |
| | (0.0003) | | | (0.0379 ) | | |
| R square | 0.1307 | 0.0114 | 0.0031 | 0.4736 | 0.0088 | 0.0031 |
| ADJ R SQUARE | 0.1214 | 0.0009 | -0.0075 | 0.0349 | -0.0018 | -0.0075 |

The two tables above have four sections of results, columns (a) and (c) show the descriptive statistics of regression for stock market returns measured against expected and unexpected changes of interest rate announcement. Columns (b) and (d) show the descriptive statistics regression between stock market returns and raw interest rate changes. The outliners are excluded from the full sample in columns (c) and (d). Both the ASX 200 and the ASX ALL index are used in the calculation of the stock returns.

The results from columns (b) and (d) show the response of stock returns to raw interest rate changes. The results are small and insignificant. However, when considering interest rate changes as expected changes and surprise changes, the stock market responds in a positive and highly significant way. These results support the view of Kutter (2001), where he claims that the market should only react to surprise element of the news. The results reported in column (a) imply 0.6% increase on 30

minutes of ASX200 stock return response to a 25 basis point surprise in interest rate cut. To determine whether the results of the full sample are sensitive to the inclusion of outliners, column (c) shows the effects of smoothing down the outliners in the regression. The estimated response of the stock market return to the target surprise is negative and significant, however the R-square and Adjusted R-square drop from 15.4% and 13.58% to 4.97% and 2.93% respectively. The results of using the ASXALL index are very similar. These results are also close to what has been documented in the Bernanke and Kutter (2005) study using the US stock market data.

To compare the results of Kearns and Manners (2006) which using the 90-day bank bill to measure the target surprise with the results above, the next section will test the relationships of stock market return and surprise using daily changes of the 90-day bank bill rates.

**Table 6 Intraday 30 minutes Stock market response to target surprise calculated from daily changes of 90 day bank bill**

This table shows the intraday effects of monetary shocks measured by daily changes of 90 day bank bill to stock market returns 30 minutes after the announcements. The purpose of this table is to compare the results from using a different method ((method used in Kearns and Manners (2005)). The P-values are shown below in the brackets the coefficients.

| AX200 USING 90 DAY BANK BILL | Full Sample |
|---|---|
| Regressor | (a) |
| | |
| Intercept | -0.0366 |
| | (0.5957) |
| target surprise changes | -2.3412 |
| | (0.1310) |
| R square | 0.0286 |
| | |
| | |
| AXALL USING 90 DAY BANK BILL | Full Sample |

| Regressor | (a) |
|---|---|
| | |
| Intercept | 0.0316 |
| | (0.6312) |
| target surprise changes | -1.9594 |
| | (0.1850) |
| R square | 0.0221 |

The results above show the reaction of the stock market return to the target surprise calculated by daily changes of 90-day bank bill rate. Although the sign of coefficients are close to what the previous literature has already reported, both coefficients are statistically insignificant. The p-values are 0.1310 and 0.1850 respectively. The reason for this insignificant relationship between the stock market return and target surprise can be caused by less accurate measurements of the true market expectation of the interest decision. In other words, the target surprises measured by intraday changes of the 90-day bank bill future rates are a better measurement of market expectation than the daily changes of 90-day bank bill. This fact has been documented by Kearns and Manners (2006). In fact, studies in U.S. and U.K. that tested different market interest rate products and found the interest futures are a better measurement of market expectation than other market interest rates (see section 2.3.4 for more details). Also, the intraday data with shorter event windows is less influenced by other news during the rest of the trading day than the daily measurements and enable us to better study the direct effect from monetary policy shocks to stock market returns.

### 5.1.3 Timing or Path surprise effects

As documented by previous studies, the surprise of the more long-lasting and durable effects on the policy expectations would have a larger effect on the stock prices than those that slightly alter the path of policy actions. (From Pages 125 of Bernanke and Kutter (2005)) In order to find out the effect of the path surprise to stock market

return and whether the path surprise changes the relationship of target surprise and stock market return, this section will perform regression on both the path and target surprise with the change of the stock returns in 30 minutes event windows.

### Table 7 Intraday 30 minutes stock market returns response to target and path surprises

The table below shows the regression between stock return and market surprises. Both target and path surprise is tested against ASX200 index return in 30 minutes event windows. Equation (a) and (b) shows full sample and excluding outliers respectively.

| **AX200** | Full Sample | Excluding Outliers |
|---|---|---|
| Regressor | (a) | (b) |
| | | 2nd contract |
| Intercept | -0.0393 | -0.0630 |
| | (0.5125) | (0.3155) |
| target surprise changes | -1.9609 | -2.5196 |
| | (0.0093) | (0.0445) |
| Path surprise changes | 2.6754 | 4.0776 |
| | (0.3505) | (0.2011) |
| R square | 0.1465 | 0.0662 |

The table above shows that the target surprise is still significant against the stock market return. However, the path surprise is not significant in both the Full Sample and the Excluding Outliners. Although, the R-squares are slightly increased from 4.97% to 6.6% in the Excluding Outliner samples, the path surprise has insignificant coefficients with p-value of 0.3505 and 0.2011 respectively. The p-value shows the path surprise has insignificant effects on the stock market returns. The coefficients of target surprises in both samples are significant and the magnitudes of those coefficients become smaller dropping from -1.9609 to -2.51.

## 5.1.4 Sensitivity test

The results above may be subject to the specific event window data in which changes to other event windows may have different results. To increase the reliability of the results above, this section performs sensitivity tests using different event windows of 60 and 90 minutes after monetary policy announcements.

**Table 8 Intraday 60 minutes stock market returns response to target and path surprise**

The table report the stock market reactions to target and path surprise during 60mins event windows. The purpose of this table is to test the sensitivity of results in a different event window. The table shows two returns calculated by ASX200 and ASXALL. Both full sample and excluding outliers results are shown under equation (a) and (b). P-value is described under the coefficients.

60 minutes

| **ASX200** | Full Sample | Excluding outliers |
|---|---|---|
| Regressor | (a) | (b) |
| | | |
| Intercept | 0.0102 | 0.0117 |
| | (0.8610) | (0.8352) |
| target surprise changes | -2.8573 | -2.6095 |
| | (0.0000) | (0.0000) |
| Path surprise changes | 1.0333 | 0.7817 |
| | （0.6308） | （0.7065） |
| R square | 0.1888 | 0.0740 |

| **ASXALL** | Full Sample | Excluding outliers |
|---|---|---|
| Regressor | (a) | (b) |
| | | |
| Intercept | 0.0384 | 0.0378 |
| | （0.5343） | （0.5240） |
| target surprise changes | -3.5306 | -3.1730 |
| | （0.0040） | （0.0070） |
| Path surprise changes | -0.6358 | -0.8216 |

| | | |
|---|---|---|
| | （0.7987） | （0.7319） |
| R square | 0.0843 | 0.0749 |

### Table 9 Intraday 90 minutes stock market returns response to target and path surprises

The table report the stock market reactions to target and path surprise during 90mins event windows. The purpose of this table is to test the sensitivity of results in a different event window. The table shows two returns calculated by ASX200 and ASXALL. Both full sample and excluding outliers results are shown under equation (a) and (b). P-value is described under the coefficients.

## 90 Minutes

| **ASX200** | Full Sample | Excluding outliers |
|---|---|---|
| Regressor | (a) | (b) |
| | | |
| Intercept | 0.0124 | 0.0277 |
| | （0.8453） | （0.6747） |
| target surprise changes | -2.5047 | -3.2727 |
| | （0.0005） | （0.0172） |
| Path surprise changes | -0.5447 | -0.8984 |
| | （0.8112） | （0.7194） |
| R square | 0.1304 | 0.0703 |
| adj R square | 0.1120 | 0.0507 |
| **ASXALL** | Full Sample | Excluding outliers |
| Regressor | (a) | (b) |
| | | |
| Intercept | 0.0118 | 0.0259 |
| | （0.8476） | （0.6843） |
| target surprise changes | -2.2946 | -3.0092 |
| | （0.0009） | （0.0229） |
| Path surprise changes | -0.2500 | -0.6147 |
| | （0.9095） | （0.7987） |
| R square | 0.1211 | 0.0626 |
| adj R square | 0.1026 | 0.0429 |

The two tables above show the results of using different event windows. Both table show consistent results compare to the previous stock market return and surprises relationships. The target surprise coefficients are all significant in 60 and 90-minute event windows respectively. With the 60 and 90-minute event windows the coefficients are larger when compared to the 30 minute event windows. The R-square values show that the 60-minute event window has the best fit for the linear regression result. The path surprise is insignificant during the event windows in both the full sample and Excluding Outliners.

The path surprises statistics result contradicts the null hypothesis, which means the path surprise should have a significant effect on the market asset returns. Also, past literature Kearns and Manners (2006) shows significant response of long term bond price to path surprise. However, the results are supported by the works of Wongswan (2009) and Gurkaynak et al. (2005), where they found "equity indexes return" mostly react to the target surprise, but not the path surprise, using data from the U.S. stock market. A possible reason for this is that the changes in future direction of monetary policy may affect not only the discount rate factor of stock indexes, but also the future cash flow expectation. Both factors have an opposite effect with regard to stock market returns. Therefore, the total effect of path surprise is muted (or insignificant). One example of this explanation is that when the market expects the future interest rate to increase, at the same time, the market expectation may indicate a better economic outlook for the companies' returns. As a consequence, the total value of the stock market may not change as the path surprise occurs.

## *5.2 Speed of reactions*

This section tests reactions of the stock return in 30, 60, 90 and 120 minutes up until the end of the day, to the surprises calculated by the changes in the first 30 minutes after the monetary policy announcement. The 120 minutes and end of day samples cover the period from 2000 to 2006, because post 2007 samples have only 90 minutes of trading after 2:30PM announcements (the market closes at 4PM).

**Table 10 speed of reactions of ASX200 index**

The table reports the effects from monetary policy surprise to stock market returns in the 30mins, 60mins, 90mins, 120mins and end of the day event windows. From this table, we can find out the speed of Australian stock market react to monetary policy shocks. (refer to equation 9)

| | 30mins | 60mins | 90mins | 120mins | end of day |
|---|---|---|---|---|---|
| Intercept | 0.0630 | -0.0140 | -0.0180 | -0.0170 | -0.0440 |
| p-value | （0.3155） | （0.5891） | （0.5236） | （0.5334） | （0.5950） |
| target surprise changes | -2.5196 | -2.5521 | -2.7950 | -2.2450 | -0.7046 |
| p-value | （0.0445） | (0.0457 ) | (0.0570) | (0.1124) | (0.7439) |
| Path surprise changes | 4.0780 | -0.7133 | -0.6435 | -0.4510 | 1.3606 |
| p-value | (0.2011) | (0.1661) | (0.2766) | (0.5412) | (0.8064) |
| R square | 0.0662 | 0.0531 | 0.0442 | 0.0425 | 0.0030 |

Target surprise is significant during the 30 and 60 minutes event windows however the reaction becomes insignificant during the 90 and 120 minute event windows. The P-value of 90-minute event windows is insignificant in the 5% significant level, and significant in the 10% significant level. The path surprises are insignificant through the different event windows. The target surprise coefficients are stable around -2.5. The Adj-Rsquare becomes smaller as the time passes and eventually becomes 0.002998 during the end of the day event window. The results indicate the stock market takes between 60 and 90 minutes to react to the target surprises and the stock market does not react at all to path surprise in any event windows. These results provide information of the market efficiency of the stock market reacting to monetary

policy news. The findings indicate the stock market is efficient and the monetary policy shocks transmit to the stock market quickly.

## 5.3 Asymmetries

Following the Asymmetries test in Bernanke (2005), this section tests the possibility that the stock market response to the monetary policy surprise depends upon the direction of the action, or period of financial crisis.

Columns (a) and (b) regress “the sign of reaction dummy variables” together with the stock market responses. When the surprise is positive, the positive surprise dummy variable is “1” and “0” if it is negative or zero. There are 14 positive changes of rate during our sample period. The dummy is equal to “1” when the event is a positive change of announcement interest rate and “0” if it is otherwise, the same for the dummy variable “no rate changes” with “1” for no rate changes and “0” for changes of rate. The result of column (a) shows insignificant support of the magnitude of the market’s response depending on the sign of surprises. The column (b) shows both the no rate changes and the direction of rate changes are not important determinants to market returns. This indicates the sign of reaction does not affect the magnitude of reactions and the surprise element is a more important determinant. The results are similar to Bernanke (2005) except the “No rate changes” dummy is significant.

The third sort of Asymmetries is the period of crisis: whether the stock market responds differently during the financial crisis period or it does not. As there are no clean timelines showing when the financial crisis happens, this paper uses December 2007 as the approximate start time of the financial crisis. The dummy variable is set to be “1” during the financial crisis period and “0” for the period before the crisis. The results show insignificant support to the financial crisis dummy variable, which means the monetary policy surprise does have significant effects in relation to stock market returns during the current financial crisis.

## Table 11 Test for Asymmetries (ASX 200)

This table test the relationships between stock returns and asymmetries variables of monetary policy announcements. Equation (a) tests the effect of target surprise to stock returns when the target surprise is positive. Equation (b) shows the monetary policy effects during "no rate changes" and "positive rate changes" (c) tests the dummy variable of rate reversal and different time period. All calculations are based in 30 minutes event windows. The P-value is shown in the bracket below the coefficients.

Note for table: "no rate changes" means no interest rate change during the monetary policy announcement. "Positive rate change" stands for positive change of OCR during the monetary policy announcement. "Reversal" stands for announcement decisions that change the direction of previous OCR decisions.

| AX200 | | | |
|---|---|---|---|
| Regressor | (a) | (b) | ( c ) |
| | | | |
| Intercept | -0.0157 | -0.0195 | -0.0673 |
| | （0.985） | （0.9547） | （0.3319） |
| target surprise changes | -3.5595 | -2.8311 | -2.7589 |
| | (0.0301) | (0.0385) | （0.0366） |
| positive surprise changes | -0.1251 | | |
| | (0.4487) | | |
| no rate changes | | -0.0247 | |
| | | (0.9439) | |
| positive rate changes | | -0.0341 | |
| | | (0.9455) | |
| Reversal | | | 0.2967 |
| | | | (0.4185) |
| post-2007 | | | 0.0673 |
| | | | (0.6149) |
| adj R square | 0.0249 | 0.008 | 0.0615 |

## *5.4 Industry test*

The results so far focused on the response of major market stock indexes however individual industry indexes can response differently as shown in Bernanke (2005). The following section tests the 9 different industry indexes in the Australian market and how they responded to the monetary target and path surprises. To extend the Bernanke (2005) study, the second section analyses the speed of reaction of individual industry returns to monetary policy shocks.

### 5.4.1 Industry index reaction to monetary policy shocks

All industry indexes have insignificant coefficients which translates into that they do not respond to path surprise. The results are consistent with the ASX 200 and ASX ALL index results. The most responsive to target surprises industries are Information-technology and the Finance industry, with coefficients double the market index (ASX200). On the other hand, consumer discretionary products, consumer staple products and the raw material industries show insignificant coefficients of both target and path surprise. The Adj-R-Square and R-square values for these industries are all lower compared to those industries which have significant reactions to monetary policy target surprises. The results are similar to Bernanke (2005) in terms of IT and the financial industries which show they have the most significant reaction to monetary policy changes. All industry indexes returns are insignificant to path surprise element. Among all the insignificant reactions, the Consumers staple industry path surprise coefficient has a p-value of 0.087, which it indicated the path surprise significantly affected stock return in 10% significant level. All industry indexes' path surprise coefficients are all insignificant in 5% significant level, which indicate all sample industry indexes do not react to path surprise created by monetary policy announcements.

## Table 12 Intraday 30 minutes industry indexes response to target and path surprises

The table below reports the effect of monetary policy announcements to industries index returns from Australia stock market. The industry indexes are listed first row of table. Each of the industry index return are calculated in the 30 minutes event window. The regression is between the monetary policy surprises and industry indexes responses during the 30minutes event window. (Refer to equation 5)

| | Consumers discrete | Energy | Finance | I-Tech | Material | Property | Consumers staple | Telecommunication | Utility |
|---|---|---|---|---|---|---|---|---|---|
| **target surprise** | -4.3525 | -3.3360 | -5.0757 | -4.9313 | -3.6364 | -5.2154 | -1.5867 | -3.3481 | -3.2944 |
| **path surprise** | -2.1665 | -3.3188 | -3.6756 | 2.8266 | -0.9850 | 0.5978 | -5.0509 | -0.0060 | 4.3748 |
| **p-value** | 0.0995 | 0.0043 | 0.0002 | 0.0238 | 0.0694 | 0.0002 | 0.1058 | 0.0271 | 0.0005 |
| **p-value** | 0.7375 | 0.2403 | 0.2489 | 0.5941 | 0.8404 | 0.8580 | 0.0877 | 0.7911 | 0.1300 |
| **constant** | 0.0002 | -0.0004 | -0.0005 | -0.0001 | 0.0003 | 0.0000 | -0.0011 | 0.0003 | 0.0004 |
| **p-value** | 0.8566 | 0.4306 | 0.4430 | 0.8947 | 0.7613 | 0.9827 | 0.1289 | 0.6574 | 0.5369 |
| **R-square** | 0.0309 | 0.1089 | 0.1556 | 0.0626 | 0.0370 | 0.1474 | 0.0689 | 0.1043 | 0.1142 |
| **adj R-Square** | 0.0088 | 0.0886 | 0.1364 | 0.0413 | 0.0151 | 0.1280 | 0.0478 | 0.0935 | 0.0940 |

### 5.4.2 Speed reaction of industry indexes

This section test hypothesis three on the speed of reaction of industry indexes return to monetary policy shocks. The table below shows the reaction of industry indexes to monetary policy shock created in the first 30 minutes after the announcement in 30, 60, 90, 120 and end of day event windows.

**Table 13 speed of reactions of industry indexes**

The table reports the results of regressions between monetary policy surprises and industry index reaction measured in 30mins, 60mins, 90mins, 120mins and end of day event windows. All coefficients are in bold letter and the p-values are given in the bracket below each coefficient.

| | **30mins** | **60mins** | **90mins** | **120mins** | **end of day** |
|---|---|---|---|---|---|
| **Consumers Discrete** | | | | | |
| Intercept | **0.0232** | **0.1302** | **0.1104** | **0.0987** | **0.0493** |
| | (0.8566) | (0.2510) | (0.3515) | (0.3548) | (0.2596) |
| target surprise changes | **-4.3525** | **-3.8202** | **-3.5590** | **-3.4750** | **-5.7532** |
| | (0.0995) | (0.1007) | (0.1430) | (0.1846) | (0.2596) |
| Path surprise changes | **2.1665** | **3.5735** | **3.4240** | **2.4573** | **-1.6433** |
| | (0.7375) | (0.5306) | (0.5655) | (0.5242) | (0.2599) |
| R square | 0.0309 | 0.0370 | 0.0299 | 0.0274 | 0.0284 |
| adj R square | 0.0088 | 0.0151 | 0.0078 | 0.0039 | 0.0003 |
| **Energy** | | | | | |
| Intercept | **-0.0441** | **-0.0526** | **-0.1010** | **-0.1410** | **-0.2811** |
| | (0.4306) | （0.5733） | （0.3096） | （0.5482） | （0.0792） |
| target surprise changes | **-3.3360** | **-2.6193** | **-2.9571** | **-2.4510** | **-1.9531** |
| | （0.0043） | （0.1716） | （0.1453） | （0.2014） | （0.6712） |
| Path surprise changes | **3.3188** | **4.5395** | **5.5370** | **2.4510** | **1.4053** |
| | （0.2403） | （0.3352） | （0.2674） | （0.4758） | (0.2870） |
| R square | 0.1089 | 0.0343 | 0.0410 | 0.0021 | 0.0167 |
| adj R square | 0.0886 | 0.0124 | 0.0192 | 0.0042 | -0.0118 |
| **Finance** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Intercept | **0.0447** | **0.0433** | **0.0541** | **0.0474** | **-0.0487** |
| | （0.5744） | (0.4939) | (0.4097) | (0.5114) | (0.5950) |
| target surprise changes | **-5.0757** | **-5.5762** | **-5.0850** | **-4.0710** | **-3.3680** |
| | (0.0002) | (0.0000) | (0.0003) | (0.0887) | (0.2081) |
| Path surprise changes | **-3.6756** | **-2.9044** | **-2.6655** | **-2.4000** | **-8.7340** |
| | (0.2489) | (0.3629 | (0.4202 | (0.2848) | (0.2530) |
| R square | 0.1556 | 0.1774 | 0.1431 | 0.1201 | 0.0323 |
| adj R square | 0.1364 | 0.1587 | 0.1236 | 0.1015 | 0.0043 |
| **I-Tech** | | | | | |
| Intercept | **-0.0139** | **0.2851** | **0.5140** | **0.0154** | **-0.1474** |
| | (0.8947） | (0.1672） | (0.8003） | (0.4872） | (0.3740） |
| target surprise changes | **-4.9313** | **-3.0478** | **-5.4002** | **-4.2400** | **-3.7905** |
| | (0.0238） | (0.4682） | (0.3681） | (0.3357） | (0.4307） |
| Path surprise changes | **2.8266** | **5.4588** | **2.2670** | **1.1540** | **1.2068** |
| | (0.5941） | (0.5979） | (0.1254） | (0.7845） | (0.9299） |
| R square | 0.0626 | 0.0101 | 0.0384 | 0.0258 | 0.0105 |
| adj R square | 0.0413 | -0.0124 | 0.0165 | 0.0015 | -0.0182 |
| **Property** | | | | | |
| Intercept | **-0.0014** | **0.0436** | **0.0549** | **0.6770** | **0.0396** |
| | (0.9827） | (0.6527） | (0.5917） | (0.5781） | (0.4599） |
| target surprise changes | **-5.2154** | **-5.1753** | **-5.2101** | **-4.2700** | **-1.9047** |
| | (0.0002) | (0.0104） | (0.0143） | (0.1056） | (0.6503） |
| Path surprise changes | **0.5978** | **5.5291** | **7.8250** | **5.8450** | **3.3360** |
| | (0.8580） | (0.2593） | (0.1313） | (0.2454） | (0.6549） |
| R square | 0.1474 | 0.0911 | 0.0965 | 0.0597 | 0.0147 |
| adj R square | 0.1280 | 0.0704 | 0.0760 | 0.0246 | -0.0139 |
| **Utility** | | | | | |
| Intercept | **0.0352** | **0.0243** | **0.0390** | **0.0870** | **-0.0795** |
| | （0.5369） | （0.7151） | （0.6292） | （0.8756） | （0.4111） |
| target surprise changes | **-3.2944** | **-5.2401** | **-4.6460** | **-3.2570** | **-3.9797** |
| | （0.0005） | （0.0002） | （0.0059） | (0.1258) | (0.1587) |
| Path surprise changes | **4.3748** | **1.5255** | **2.8088** | **2.5700** | **2.3173** |

| | | | | | |
|---|---|---|---|---|---|
| | (0.1300） | (0.6487） | (0.4905） | (0.2547） | (0.1275） |
| R square | 0.1142 | 0.1456 | 0.0848 | 0.0757 | 0.0477 |
| adj R square | 0.0940 | 0.1261 | 0.0640 | 0.0572 | 0.0201 |
| **Telecommunication** | | | | | |
| Intercept | **0.0288** | **0.0033** | **0.0456** | **0.0057** | **-0.0835** |
| | (0.6574) | (0.9479) | (0.4470) | (0.5475) | (0.4353) |
| target surprise changes | **-3.3481** | **-3.1867** | **-3.5568** | **-2.5470** | **-0.3710** |
| | (0.0271) | (0.0025) | (0.0045) | (0.1548) | (0.9047) |
| Path surprise changes | **-0.5989** | **0.8884** | **0.1287** | **0.0578** | **1.6097** |
| | (0.7911) | (0.7252 | (0.9659 | (0.5548 | (0.0726) |
| R square | 0.1043 | 0.0995 | 0.0887 | 0.0575 | 0.0516 |
| adj R square | 0.0935 | 0.0791 | 0.0680 | 0.0259 | 0.0241 |
| **Material** | | | | | |
| Intercept | **0.0295** | **0.0206** | **0.0652** | **0.0234** | **-0.0685** |
| | (0.7613) | (0.6979) | (0.2348) | (0.5476) | (0.6463) |
| target surprise changes | **-3.6364** | **-1.6864** | **-1.8424** | **-1.3833** | **-3.7679** |
| | (0.0694) | (0.1215) | (0.1472) | (0.2034) | (0.3854) |
| Path surprise changes | **-0.9850** | **3.0386** | **2.6710** | **3.2420** | **3.6185** |
| | (0.8404) | (0.2561) | (0.3334) | (0.4233) | (0.7700) |
| R square | 0.0370 | 0.0449 | 0.0581 | 0.0325 | 0.0110 |
| adj R square | 0.0151 | 0.0232 | 0.0367 | 0.0134 | -0.0177 |
| **Consumer staple** | | | | | |
| Intercept | **-0.1055** | **-0.0076** | **-0.0790** | **-0.2340** | **-0.0795** |
| | (0.0289) | (0.8913) | (0.2182) | (0.3245) | (0.4111) |
| target surprise changes | **-1.5867** | **-2.7674** | **-1.9993** | **-8.2344** | **-3.9797** |
| | (0.1058) | (0.1701) | (0.1277) | (0.1445) | (0.1587) |
| Path surprise changes | **-5.0509** | **-2.5421** | **0.7310** | **0.4230** | **2.3173** |
| | (0.0377) | (0.3675) | (0.8201) | (0.5423) | (0.1275) |
| R square | 0.0689 | 0.0759 | 0.0277 | 0.0235 | 0.0477 |
| adj R square | 0.0478 | 0.0549 | 0.0056 | 0.0035 | 0.0201 |

The results show inconsistency of the industry indexes reaction in terms of magnitude and persistency. Section one results are shown in the first column of the table for comparison purposes. In the 60 minutes event windows, four out of the nine industry indexes have significant reactions to the target surprises. Among them, the IT industry is surprisingly insignificant after having the significant and large coefficient among all industry indexes in section one. Compare with the 30 minutes event window, the four industries which have significant coefficients all have decreasing magnitude, with the exception of the utility industry index's coefficients which was -5.2401 compared to -3.2944 in section one. During the 90-minute event windows, the four industries which reacted significantly to target surprises are still actively reacting to monetary policy surprises. However, the magnitude of the reaction decreases as the coefficients become smaller.

All of the surprise coefficients become insignificant in the 120 minutes and end of day event windows. This indicates all industry indexes reaction to monetary policy shocks is muted after 120 minutes of trading.

## *5.5 Individual stock reaction*

This initial study attempts to test hypothesis two on how individual stocks behave during the monetary policy shocks. The results give investors ideas about what determines the reaction response of stock to monetary policy shocks.

**Table 14 Individual stock coefficients reaction to Size and Market to book ratio Two-stage regression**

Table 14 shows the regression results using two-stage regression (refer to equation 6 and 7 in the methodology). P-value of coefficients is shown in the bracket.

| **Individual stock reaction to Size and Market to book ratio** | | | | | | |
|---|---|---|---|---|---|---|
| Method One | Target surprise | | | Path surprise | | |
| | Coefficient | P-value | R-square | Coefficient | P-value | R-square |
| Size | 2. 13E-07 | (0. 6345) | 0.02764 | -0. 000113 | (0. 3986) | 0.021417 |
| M/B ratio | 4. 28E-05 | (0. 9792) | | -0. 000668 | (0. 8905) | |
| D/E ratio | -1. 12E-05 | (0. 5868) | | -0. 000113 | (0. 3649) | |

Unfortunately, the results show the size and "Market to book ratio" do not have a significant effect to the sensitivities of stock versus monetary policy surprises. The R-square are very small which indicate the standard errors are very high. The possible reason for such negative results is the large standard errors which are created during the process of calculating the individual stock coefficients. Future study is needed to have a better estimated of how the individual stocks react to the monetary policy shocks.

## Table 15 Individual stock reaction to Size and Market to book ratio one-stage regression

The table below shows the regression result of one-stage regression. Interaction factors are shown in the second row. All P-values of interaction factors are shown in the brackets. (refer to Equation 8)

| Method Two | Individual Variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | C | TS | TS*M/B ratio | TS*Size | PS | PS*M/B ratio | PS*Size | R-square |
| coefficient | 0.1204 | 2.438 | 0.1344 | 6.71E-01 | 2.3416 | 2.921 | 1.76E-01 | 0.08452 |
| P-value | (0.3253) | (0.0345) | (0.034) | (0.0033) | (0.0991) | (0.2101) | (0.221) | |

The table above test the interaction effects of Size and Market to book ratio with monetary policy surprises to the individual return. The results show significant relation in TS, TS*M/B ratio and TS*size variables with p-value under 5% level. on the other hand, independent variable PS, PS*M/B ratio and PS*size shows insignificant effects to individual stock returns. The results indicate the size and market to book ratio provides additional explanation power to the changes in individual stock returns during the monetary policy events. However, the effects of size and market to book ratio factors do not show significant effects to individual stock returns for path surprises.

# 6 Conclusions and Recommendations for future research

This study has found a relatively strong and consistent response of stock market returns to monetary policy target surprise. The method to measure the market expectation of monetary policy interest rate decision is using the 90 day Bank Bill Rate Futures. For the stock market as a whole, the ASX200 increase rapidly about 0.625% and the ASX ALL increase about 0.7% response to 25-basis-point rate cut. The result is robust exclusion of Outliers and to different event windows. Unlike the results of testing response of bond and foreign exchange rate in other studies, the stock market returns do not react to Path surprises. However the results are consistent with Gurkaynak et.al (2005) Wongswan (2009) where they support their results by the fact company value is not driven by only the discount rate, future cash flow of the company can also affect the total firm value. The shocks of monetary policy path affects both firm discount rate and firm cash flow in different directions ( i.e. increase of OCR might indicate a better economic future outlook ), which the effects from both directions can cancel out each other.

The Asymmetric table tested stock returns with different direction of rate changes and sample periods. The results show neither the sign of monetary surprise, rate changes, or the post-crisis period have a significant effect on the return reaction. The target surprise coefficients are unaffected at around 2.5.

The results also found the reactions to monetary policy surprise are different across industry indexes. The Information-technology and Finance sector have the highest magnitude in terms of monetary policy surprise, and the Customer Staple and Customer Discrete goods seem not to react strongly to the monetary policy shocks.

By testing the speed of stock market return to monetary policy shocks, the results show the stock market as a whole stops reacting to monetary policy surprise during the 90 to 120 minute event window. Industry indexes reactions differ from industry to

industry, however all industry indexes become insignificant during the 120 minute event windows.

The test size and M/B ratio shows an insignificant effect to individual stock coefficients. However, the method used for testing does not provide good results, because of the excess standard error from the dependant variable (the individual stock coefficients).

Although this paper has been one of the first studies testing monetary policy surprise effects in Australian stock market. There has been some limitations of this study. One of the limitations comes from defining the suitable size, M/B ratio and leverage ratio from individual companies. In this paper, I used the average of 10 years for all three factors. There can be huge changes in all three factors during the 10 year sample periods and the averages for 10 years can be biased.

There have been many studies focusing on the effect of monetary policy shocks to real asset price returns in US, Euro and some other developed markets. One reason could be the lack of high frequency data from emerging markets. As the data become more available in the future, studies of monetary policy effects can be performed in other markets.

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