The Asymmetric Effect of Macroeconomic News Surprises on Australian Financial Markets

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Abstract

This paper examines the effects of news surprises of macroeconomic announcements on Australian financial markets. We find that overall, the news arrivals are influential in both stock and debt markets but in an interesting array of responses across asset classes. Debt markets are more responsive to macroeconomic news surprises compared to the stock market, hence supporting the notion that information revealed from the macroeconomic news is related to interest rates. Specifically, news about CPI is important over the full sample period and especially during expansions for both stock and bond returns while the unemployment rate news is influential to the money market rates. Furthermore, these effects are seemingly asymmetric in nature, with their signs and magnitudes conditional on the state of economy.

Keyword: Asymmetric effect, macroeconomic news surprises, financial markets, state of economy

JEL Classification: G1, G12

1. Introduction

Asset pricing models such as the CAPM and APT provide a cross-sectional relationship between asset prices and risk factors at a given point in time (see Brenner et al. 2005). Modern financial theory has focused on systematic risk as the source of investment risk, since investors hold diversified portfolios. Therefore a change in one or more of these risk factors will have an effect on asset returns, with the changes being dictated by the speed of new information arriving to the market. Intuitively, basic economic theory (see Chen et al. 1986 for a detailed review) suggests that news influencing asset returns are those that change discount factors, cash flows and risk premia.

An extensive literature examining the impact of macroeconomic news surprises on financial assets has well been documented. For example, Fleming and Remolona (1997), Bollerslev et al. (2000), Furfine (2001), Balduzzi et al. (2001), and Green (2004) find that news surprises from GDP, inflation rate, unemployment rate, or consumer confidence are significantly related to changes in Treasury yields especially around the time of the announcements. Similarly, Chen et al. (1986), Flannery and Protopapadakis (2002), Bomfim (2003), and Brenner et al. (2005) report that the same economic surprises affect stock prices albeit through a more complicated mechanism due to potential changes in expected cash flows, the discount rate, the risk premium, or a combination of these three pricing factors. In addition, Almeida et al. (1998), Anderson and Bollerslev (1998), Anderson et al. (2003), and Simpson et al. (2005) find that announcements related to interest rate and inflation have significant impact on the exchange rate.

In this study, we extend the literature as follows. First, we introduce a state contingent framework to examine whether the news announcements have the same influence in both periods of economic expansion and contraction. A rise in inflation rate during expansion, for example, may be more influential than an increase in money supply growth because Reserve Bank may need to respond to the rising inflation by raising interest rate whereas the same rise of inflation may have

less effect on interest rate during contractions. The state contingent framework therefore allows us to investigate the interaction of the risk factors where they may vary across different phase of the business cycles. As evidenced by Boyd et al. (2005) that information provided by the news arrivals may be interpreted differently depending on the state of the economy.[1] They find that stock market is more responsive to rising unemployment news during expansions but not during contractions.

Second, using an exponential generalized autoregressive conditional heteroscedasticity (EGARCH) specification in our analysis, we address whether the macroeconomic surprises (positive or negative) have an asymmetric effect on the conditional variance of both the equity and debt markets within each state of the economy. Third, unlike earlier studies that only identify surprise arrivals, our study takes into account both the direction and size of the unexpected component of a news announcement, an improvement that we believe will better capture the impact of news surprises.

To conduct empirical analysis on the impact of news announcements, we examine news arrivals of money supply growth, unemployment rate and consumer price index (CPI) from Australia. We choose these three macroeconomic news variables because they are the most closely watched economic indicators and are well documented to offer insight into the intrinsic health of the economy, the future direction of interest rates and performance of financial markets. In addition, a broad consensus has also been reached that only a small number of macroeconomic factors have a significant impact on pricing and returns. Unlike in U.S., some macroeconomic news announcements are not available in Australia and some tend to provide similar information on the economy, hence, we restrict our analysis to the 3 types of macroeconomic news as mentioned above.

[1] Boyd et al. (2005) examine only the unemployment rate news announcements compared with 3 news announcements in this study.

Our analysis yields several key results. First, we find that the process of price formation in the Australian financial markets appears to be driven by economic fundamentals. In particular, news about inflation rate dominates other news announcements on both stock and bond markets over the full sample period and during economic expansions. Since most of the business cycles are in expansion phase, the results in the full sample period seem to be driven by those during expansions. We also find that 90-day bank bills are more responsive to changes in unemployment rate news during expansions. Information revealed by the unemployment news therefore appears to relate to short-term interest rate while those from CPI news tend to associate with long-term interest rate and perhaps corporate earnings. Our findings further suggest that information about interest rate dominates corporate earnings related information in the stock market. Finally, past innovations appear to have an asymmetric impact on the conditional volatility of the financial market returns within each state of the economy. Shocks to both stock and bond markets also appear to be highly persistent.

The remainder of the paper proceeds as follows: Section 2 describes the data set for the macroeconomic announcements and the financial markets, and reports their summary statistics. Section 3 discusses the methodology for estimating the impact of these 'news' events. Section 4 reports the empirical results. The last section concludes the paper.

2. Data and Descriptive Statistics

For the daily return series of stock and bonds, we use the Australian Ordinary Index (AOI) from Datastream, and the 90-day bank bill and 10-year government bond index from Reserve Bank of Australia (RBA). The sample period covers from January 1990 to December 2004 and provides more than 3800 observations on average for the returns of each series. The daily stock index returns and the 10-year government bond returns are calculated from the first difference of the logarithm of

the indices multiplied by 100. For the 90-day bank bill, the yields are first converted to prices before computing its returns.[2]

Table 1 reports some descriptive statistics of the daily returns over the sample period. As expected, stocks have the highest average daily return accompanied by the largest daily volatility while long-term bonds have higher average returns and higher risk than bank bills. Both returns of stock and bond indices also exhibit negative skewness, suggesting that negative returns are larger than positive returns. All 3 types of financial assets are further characterized by large kurtosis in their return distribution. Confirming the non-normality in their return series, the Jarque-Bera test for normality is rejected at the 1 percent level.

Since no single measure of activity is adequately comprehensive or timely, we use 3 macroeconomic news announcement that are considered newsworthy and influential on interest rate and equity markets (see Urich and Wachtel (1981), Pearce and Roley (1985), Boyd et al. (2005)). They are money supply (M1 and M3), unemployment rate and consumer price index announcements. Monthly unemployment rate is compiled by the Australian Bureau of Statistics and released at 11:30am on every second Thursday of the month, information on the money supply growth is announced at 11:30 am on the first Friday of the month by the Reserve Bank of Australia, and, quarterly consumer price index is made public at 11:30 am on the last Wednesday of the month following every quarter (for example, March quarter CPI is released on the last Wednesday of April). Table 2 summarizes the macroeconomic announcements in this study.

Table 3 further provides some summary statistics of the macroeconomic announcements. The unemployment rate over the full sample period averaged 7.8% and ranged from 5.1% to 10.9%. This period (except from 1990 to 1992) is often characterized by high growth especially in the last several years where the unemployment rate stays at a low of 5.1%. Money supply (M1) also grew at

[2] $P = FV / (1+y*(90/365))$, where P is the price, FV is the future value and y is the yield. 365 days rather than 360 days are used to compute the price.

an average rate above 0.7% per month although with high variability. The kurtosis of 38.47 shows heavy tails in the distribution of money supply growth and suggests that it is highly responsive to changes in economic activities. The Australian economy also experienced low inflation environment over the same period in which quarterly inflation rate averaged 0.65% or 2.8% annually. Along with low unemployment rate, inflation rate has also been low and kept within 3% target band established by the Reserve Bank.

Comparing the money supply growth between the periods of contraction and expansion, it grew at a faster rate during expansions as expected. The average monthly money supply growth for M1 and M3 are 0.80% and 0.73% per month respectively during economic expansions compared to 0.72% and 0.59% during economic contractions. Likewise, the unemployment rate is 0.26% lower on average during expansions. However, inflation rate tends to be higher during contractions rather than during expansions by an average of 0.09% per quarter. We suspect that the higher inflation rate during contractions may be related to Reserve Bank's monetary policy. The monetary policy tends to be more accommodating during contractions and therefore a higher average inflation rate is no little concern to the Reserve Bank.

As suggested in Table 3 that economic activities tend to vary widely over business cycles, one primary question of interest in this study is whether the responses of financial assets to changes in macroeconomic fundamentals also vary systematically over time. In other words, could the same information be interpreted differently on different states of the economy as the news arrives? To test this alternative hypothesis, we first need to classify the level of economic activities into two different states - expansions and contractions over the business cycles.

A business cycle is a graphic representation of the fluctuations in the level of economic activity. The curves of the cycle extend over a number of years, fluctuating through periods of expansions and contractions. These fluctuations are the result of changes in the levels of production, spending and employment. Expansions and contractions are defined as periods of rising and falling

levels of economic activity respectively. Burns and Mitchell (1946) define business cycles as "*a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at the same time in many economic activities followed by similar general recessions, contractions and revivals which merge in the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic…*"

Following the description of business cycles, we measure the economic expansions and contractions using the local maxima and minima of the sample path of Gross Domestic Product (GDP), the natural measurement of the level of economic activities.[3] With the business cycle reference dates of the Australian Bureau of Statistics (1992), we are able to identify peaks and troughs in Australia's business cycle from 1990 to 2004. We denote the period from trough to peak as expansions and from peak to trough as contractions. Table 4 shows the dates of turning points in the Australian business cycles together with the duration of each phase of cycle. As expected, we find that there are more expansions (123 months) than contractions (57 months) periods. The economy had particularly been doing well from 1995 to 2000 during which contractions took place for only 3 months out of the 5-year period. Figure 1 further shows different stages of the economy as it moves through the business cycle during the sample period.

3. Methodology

For our purpose of testing the impact of news announcements on stock and bond markets, we use the news surprise, the information that deviates from market forecasts, to regress on stock and bond returns. News surprise is important because it remains to be incorporated into security prices and therefore provide new information to the market. In contrast, the expected component of news announcements carries no new information since it has largely been absorbed in the current

[3] The chain volume measure of GDP is used.

price.[4] We measure the news surprise as the difference between the values of macroeconomic data and its forecasts. We also normalize the news surprise variable to compare the extent of the impact from different news announcements. Therefore,

$$S_{k,t} = (A_{k,t} - E_{k,t}) / \sigma_k \quad (1)$$

Where $S_{k,t}$ of the announcement k is the news surprise, $A_{k,t}$ is the actual announcement, $E_{k,t}$ is the forecast of the announcement, and σ_k is the sample standard deviation of each announcement.[5] Since consensus estimates on the macroeconomic news data are not available in Australia as they are in the U.S. (from Money Market Services International (MMS)), we use three alternative specifications of time-series models, ARIMA, Moving averages and Exponential smoothing, to forecast expected economic announcements.[6]

The GARCH specification proposed by Bollerslev (1986) and its univariate and multivariate extensions are among the most widely used models to describe time-varying volatility and co-variances in high frequency financial return series (see Kim and McKenzie 2004; Brenner et al. 2005). To capture the asymmetric shocks on volatility, we use an exponential GARCH model, MA-EGARCH (1,1). An advantage of the MA-EGARCH model over other asymmetric models is that it allows negative coefficients in the conditional variance equation. It also facilitates cross equation comparisons of macroeconomic surprise effects on the returns. We further normalize each

[4] Fama (1971) first formalized the relationship between information arrival and the price formation process by making use of the efficient market hypothesis to assert that asset prices immediately reach an equilibrium state reflecting the arrival of new information in the marketplace.

[5] This approach has the additional advantage of allowing the aggregation of news across macroeconomic variables, while preserving the magnitude of the news.

[6] Other time series forecasting models such as moving averages (3 & 5) and exponential moving average are also considered. Results based on MSE and MAD indicate ARIMA is a more appropriate model. This forecasting model is also used in previous studies such as Urich and Watchel (1981) and Singh (1993).

news surprise by its standard deviation that allows us to directly compare the magnitude of regression coefficients associated with the surprises across different announcements without affecting the significance of the estimates.

In our analysis, we first examine the surprise effects of the news arrivals on each return and its conditional volatility over the full sample period, and then investigate the effects in each state of economy. On the full sample analysis, we run the following MA-EGARCH model,

$$
\begin{aligned}
R_{i,t} &= \alpha_{i,c} + \varepsilon_t + \sum_{k=1}^{q} \alpha_{i,k} . \varepsilon_{i,t-k} + \alpha_{i,N} NEWS_{N,t} \\
\varepsilon_{i,t} &= z_{i,t} \sqrt{h_t} \sim (0, h_{i,t}), z_{i,t} \sim iid(0,1) \\
\ln(h_{i,t}) &= \beta_{i,0} + \beta_{i,1} . \ln(h_{i,t-1}) + \beta_{i,2} \frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,3} . \left(\frac{| \varepsilon_{i,t-1} |}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}} \right) + \beta_{i,N} | NEWS_{N,t} |
\end{aligned}
\tag{1}
$$

Where

$R_{i,t}$ = the returns of asset *i* (*i*=stock index, bank bill and bond index)

ε_t = The error term is assumed ~ (0, h_t);

$h_{i,t}$ = Conditional return volatility for asset *i*;

q = Number of moving average terms included in the conditional mean equation to remove serial correlation in the estimated standardized errors, z_t;

$\beta_{i,2}$ = Measures the sign effect where a negative shock increases volatility if $\beta_{i,2} < -1$, and a positive shock reduces volatility if $\beta_{i,2} > -1$;

$NEWS_{N,t}$ = The unexpected component of each macroeconomic announcement (*N* = *M1, M3*, *UE*, *CPI*) as measured by the difference between the announced figures and the expected value forecasted by an ARIMA model. These monthly and quarterly surprise variables are assigned a

value of zero for days without the particular macroeconomic announcement and the magnitude of the surprises for days with announcements.

To test whether the state of economy changes the news announcement effects, we modify equation 1 by multiplying the unexpected news $NEWS_{N,t}$, with a dummy variable D_e that captures the state of the economy.[7] Therefore, the model becomes,

$$
\begin{aligned}
&R_{i,t} = \alpha_{i,0} + \varepsilon_t + \sum_{k=1}^{q} \alpha_{i,k} . \varepsilon_{i,t-k} + \delta_{i,N} D_e * NEWS_{N,t} \\
&\varepsilon_{i,t} = z_{i,t} \sqrt{h_t} \sim (0, h_{i,t}), z_{i,t} \sim iid(0,1) \\
&\ln(h_{i,t}) = \beta_{i,0} + \beta_{i,1} . \ln(h_{i,t-1}) + \beta_{i,2} \frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,3} . \left(\frac{|\varepsilon_{i,t-1}|}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}} \right) + \rho_{i,N} D_e * |NEWS_{N,t}|
\end{aligned}
\qquad (2)
$$

Where the variables are as defined in Equation 1.

4. Empirical Results

4.1 The Effects of News Arrivals Over Full Sample Period

4.1.1 All Ordinary Index

We first estimate the effect of the news arrival on the conditional mean and variance of the stock and bond indices over the full sample period according to equation 1. On the stock index return, Panel A of Table 5 shows that CPI is the only explanatory variable that is significant at the 5 percent level. A one standard deviation of unexpected increase in CPI is associated with a 15.6% fall in the stock market return also suggests that the CPI inflation rate surprises are economically significant. The result supports the expected inflation hypothesis which argues that a higher than

[7] We define separate state of economy dummy variables for contraction and expansion which each take on a value of unity on the state of economy to which they are assigned and zero otherwise.

expected inflation rate raises the level of expected inflation and in turn increases the discount rate (see Cornell (1983), and Fama and Schwert (1977)).

However, Inflation surprises could also affect the financial market through channels other than inflationary expectation changes. That is, an unexpected higher inflation rate may lead to the expectation of a contractionary monetary policy, which in turn could lower real economic activities, and therefore reduce cash flows and earnings. This alternative mechanism could cause lower stock return. Our results on the unexpected change in the money supply, M1 and M3, and unemployment rate however do not support such argument. We fail to find any significance on either of the money supply and unemployment rate announcements. Our preliminary evidence thus far does not support the anticipation hypothesis.[8] Furthermore, as indicated by the significance of $\beta_{i,1}$ and $\beta_{i,2}$ in Panel B of Table 5, shocks to the stock market appear to be highly persistent and asymmetric. With the exception of M3 news announcement however, the impact from the arrivals of macroeconomic news on the conditional return volatility is often economically and statistically insignificant.[9]

4.1.2 90-Day Bank Accepted Bill

We next report the announcement effect on the short-term debt. Among the news announcements, M1 is found to have statistically and some economic impact with a small 0.13% fall in the bank bill return for every standard deviation of increase in the unexpected money supply. Both unemployment rate and inflation rate bear no statistical significance on the short-term rate. The positive effect on interest rates (negative coefficient) due to unanticipated money supply changes is consistent with Urich and Watchel (1981) and can be interpreted as an inflationary expectations effect. The unanticipated change in M1 may exert an upward pressured on interest rate

[8] Re-estimating the EGARCH models with the unexpected announced changes in the macroeconomic variables independently produces similar results. The estimated coefficients for M1, M3, and UE remain insignificant.

[9] Appendix A provides some results of the diagnostic test of the model specification.

as the Reserve Bank may engage in open market operations that tightens the supply of reserves to offset the unexpected change.

One possible explanation that money supply announcement takes precedence over CPI and unemployment rate is that money supply growth is announced at the start of each month, while other announcements are released later. Since it is the first news announcement during each period, the market may respond more strongly to the early indication of current levels of inflation in the economy, and less to the subsequent indicators (CPI and UE) as they tend to reaffirm the initial money supply announcement. This may explain to some extent the ability of money supply driving the results over the full sample period. Furthermore, the release of the CPI information may relate more closely to expected inflation on long-term interest rates while unemployment rate tends to associate with real economic activities. In sum, our findings are consistent with earlier studies documented in the U.S. (see Ederington and Lee (1993), Roley (1983)). Unlike shocks to the stock market, the impact of negative surprises and positive surprises are not asymmetric as shown in Panel B of Table 5. Nonetheless, the impact remains persistence and the shocks from the news announcements with the exception of M3 growth are significant on the conditional volatility of the short-term rates. The result shows that the unemployment rate surprise has a negative effect on the conditional volatility of the short-term rates while the CPI surprise has a positive effect on the conditional volatility.

4.1.3 10-Year Government Bond Index

On the long-term interest rate over the full sample period reported in Table 5, Panel A shows that contrary to the short-term rate, the arrivals of CPI news have the greatest effect on the government bond market in both economical and statistical sense. The impact is similar to those in the stock market. A one standard deviation in unanticipated change in CPI corresponds to 11.38% in the bond returns, about ten-fold of the impact of money supply on short-term rate. Despite the

fact that the money supply news is announced at the beginning of each month and comes before the CPI news, M1 has only marginal effect on the long-term bond market. Our full sample results on the debt markets seem to suggest that different news announcements play a distinct role on different segments of the yield curve. That is, the short-term rate tends to react to the money supply news (M1) while the long-term rate pays more attend to the CPI news.

On a further note, we find that the responses to the news announcements differ in magnitude according to the maturity of the debt instrument. For example, the size of the M1 surprise coefficient increases from -0.13% for the 90-day bank bill to -7.79% for the 10-year bond. Similarly, the coefficient increases from –0.27% to -11.38% for the CPI surprises. The same macroeconomic surprise will have a larger effect on the long-term bond than on the short-term debt. Our estimates therefore invariably capture the maturity risk embedded in the long-term rate.

Turning our attention to the return volatility in Panel B of Table 7, the EGARCH parameters in the conditional variance equation are statistically significant. The shocks to the long-term rates are both persistent and asymmetric. The results further show that both M3 ($\beta_{M3} = 0.1011$) and CPI ($\beta_{CPI} = 0.1976$) are influential on the conditional volatility of the bond market. The fact that unemployment news announcement does not affect volatility in the bond market illustrates that within our sample period, there is no long run effects of the news information on the interest rates.

4.2 Effects of News Arrival During Economic Contractions and Expansions

4.2.1 All Ordinary Index

To examine the impact of the news announcements in different economic environments, we sort the full sample period into contraction and expansion periods. We then repeat the same time-series analysis as in the full sample period to assess if the same macroeconomic news maintains the similar influence on the stock and bond markets over the business cycles. Such analysis should shed

more light on the importance of the news announcement in a particular economic environment and enhance our understanding on why the news impact might differ.

Table 6 and Table 7 report the time-series results over the contraction and expansionary periods respectively. On the stock index, Money Supply growth (M1) is the only news announcement that is statistically significant at the 5 percent level during contractions. As shown in Panel A of Table 6, its economic impact is also substantial as one standard deviation in the surprise corresponds to a 23.57% stock index return. The finding here therefore contradicts the full sample result since CPI news play a more dominant role overall. Since the sign of the coefficient is positive, an unexpected increase (decrease) in M1 is considered good (bad) news for the stock market during economic contractions (expansions). We interpret this as a shock to the real economic activities since a shock to the interest rate should have a negative effect on the stock index return. Therefore the unanticipated money supply change should associate with revised expectations on aggregate corporate earnings and dividends.

When we examine the effect of the same news arrivals during economic expansions, we find that the unanticipated CPI is the most important news surprise, thus consistent with the full sample results. Panel A of Table 7 shows that the inflation surprise is the only explanatory variable significant at the 5 percent level. The significance also translates into 25.75% decrease in the stock index return for one standard deviation of shock. This substantial economic impact on the return suggests that information about interest rate is most influential during expansions. Since most of the business cycles in the sample period are in expansions, we suspect the significance of the CPI news surprises during expansion also drive the results in the full sample period.

Overall, the evidence of the impact of macroeconomic news surprises on the stock index returns seem to be in line with Boyd et al. (2005) who document that information about future corporate earnings and dividends tend to dominate during contractions but information about interest rate tends to be more influential during expansions. What's different from our findings is

that news announcements about inflation and money supply growth rather than unemployment rate are more relevant to the stock markets. Nevertheless, the basic thrust of the findings remains the same. Market participants are more concerned about interest rate shocks during expansions and earning shocks during contractions. Since an economy is more often in expansions than contractions, news announcements that contain interest rate information are more influential in explaining stock returns. Our full sample results reported earlier are consistent with such argument. Our analysis on the conditional volatility of the stock index return reveals that effects of the macroeconomic news are limited only during expansions. While shocks to the stock markets remain persistent and asymmetric, only M1 and M3 have significant impact on the stock return volatility.

4.2.2 90-Day Bank Accepted Bill

Note that in the full sample period, our results indicate that money supply news (M1) is the only influential factor on short-term interest rate. However, when we segregate the sample into contractions and expansions reported in Panel As of Table 6 and 7, the influence of the money supply announcement disappears. In fact, none of the news arrivals we examine here is significant during contractions. We suspect that macroeconomic news carry little influence in this business cycle phase because market participants are more indifferent to information about future interest rate. In contrast, we find that unemployment rate news is statistically significant (at the 1 percent level) in explaining bank bill return during expansions. A declining unemployment appears unfavourable to the bank bill prices as higher expected inflation increases upward pressure on the short-term rate. These findings seem to provide some support for the expected inflation hypothesis only during expansions where inflationary pressure becomes more of a concern.

Unlike the results on the mean equation, Panel Bs of Table 6 and 7 show that macroeconomic news surprises have significant effect on the volatility of the short-term rate across different states of economy. During contractions, unanticipated money supply change (M1) reduces

volatility of the short-term returns but unexpected CPI has the opposite impact. During expansions, we continue to find unexpected CPI affect the short-term rate in a similar fashion. The difference in this phase is that unemployment rather than becomes the significant factor in reducing conditional volatility of the returns.

4.2.3 10-year Government Bond Index

In our final analysis, we address how macroeconomic news arrivals affect the long-term bond index returns in each of the business cycle phase. Similar to what we find on the short-term rate, news arrivals fail to have any impact on the long-term rate during contractions. The findings are perhaps not surprising given that if these news arrivals are not important on the short-term rate, it is unlikely that they would have much impact on the long-term rate. Our overall evidence on both short-term and long-term debt returns is consistent with Boyd at al. (2005) who report that bond prices are not responsive to unemployment rate news during contractions. In our case, we find that in addition to the unemployment rate news, other types of macroeconomic news announcements we examine also fail to have any influence on the bond markets.

On the contrary, Panel A of Table 7 shows that CPI news is significant in the long-term bond market during expansions. The finding follows from the similar full sample results reported in Table 5 where CPI news is the only important information to the long-term rate. Our findings on the impact of news announcements reveal that different markets do respond to different news announcements and also behave differently depending on the state of the economy. While no news announcements seem to be relevant to the debt markets overall during contractions, unemployment rate news appear to contain information that are important to the short-term debt market and CPI news to the long-term market during expansions.

On the conditional volatility of the long-term rate, none of the macroeconomic variables as expected is significant during contractions. The finding is consistent with the result on the long-term debt return where we fail any significant impact during the business cycle phase. However, Panel B of Table 7 shows that all economic news variables except the unemployment rate are significant in affecting volatility of the long-term rate. Specifically, M1 money supply has a dampening effect while M3 and the CPI have the opposing effect.

5. Conclusions

The investigation of the extent to which prices in financial markets incorporate fundamental economic information is central to the theoretical and empirical finance literature. To this effect our paper uses simple macroeconomic policy arguments to choose a set of economic variables that contain such information. Our study contributes to the literature by providing a comprehensive analysis of the impact of important Australian macroeconomic news releases on the process of price formation in the equity, bond, and money markets. For that purpose, we use the EGARCH models, which allows us to simultaneously identify the effects of news arrivals on conditional mean returns, and return volatility.

Overall, our empirical findings suggest that the arrival of scheduled macroeconomic news has a statistically significant impact on the Australian financial markets, but also that this impact provides an interesting array of responses across asset classes. Our results show that the debt markets are more responsive to macroeconomic news surprises as compared to the stock market, hence confirming the notion that the main source of interest rate movements is macroeconomic news, whereas the stock market might be more influenced by news of a firm-specific or industry-specific nature. Further more these effects are seemingly asymmetric in nature, with their sign and magnitude conditional on the state of the economy.

In conclusion, we have presented evidence that macroeconomic fundamentals are indeed an important driving force behind financial market returns. That is, the overall picture is one of a quick and significant impact effect of macroeconomic surprises. However, this impact may be seen as quantitatively small, and the overall effect of our macroeconomic surprises only form a part of the systematic risk factors that are relevant in the process of price formation. The approach used in the study is relatively novel for the analysis of financial markets in that we look at the role of news surprises about fundamentals in each phase of the business cycles and the asymmetric impact they might have on the financial markets. Market participants seem to respond in a sophisticated and rational manner, indicating that news releases are a source of tradable information which investors use to make informed decisions, and not just an act of releasing economic figures.

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Table 1. Descriptive Statistics of the Stock and Bond Index Daily Returns

This table reports summary statistics for the time series of daily returns of the All Ordinaries stock Index (AOI), 90-day bank accepted bills (BB), and the 10-year government bond index (BOND) for the sample period from January 2, 1990 to December 31, 2004. A ** and *** indicate significance at the 5 and 1% levels respectively. P-values are provided in the parentheses.

	AOI	BB	BOND
Panel A: Summary statistics			
Mean	0.0236	0.0008	0.0112
Variance	0.6103	0.0001	0.2773
Skewness	-0.4083	2.9168	-0.3046
Excess kurtosis	8.2258	38.5644	5.6634
Jarque-Bera	4429*** (0.00)	205652*** (0.00)	1217*** (0.00)
Observations	3800	3800	3914

Table 2. Australian Macroeconomic Announcements

This table summarizes the monthly and quarterly macroeconomic news announcements from January, 1990, to December, 2004.

	Economic Variable	Frequency	Unit of Measurement [a]	Time: GMT+10	Starting Period [b]	N
1	Money Supply	Monthly	% change in M1 & M3	11:30am	January 5, 1990	180
2	Unemployment Rate (UE)	Monthly	Unemployment Rate %	11:30am	January 11, 1990	180
3	Consumer Price Index (CPI)	Quarterly	% change in CPI	11:30am	January 31, 1990	60

Notes:

[a] All percentage changes are relative to the previous period (month or quarter).

[b] Note that these are the first *announcement* dates, with figures actually related to the previous period's state of affairs.

Table 3. Summary Statistics of Macroeconomic Events

Panel A reports summary statistics for the monthly and quarterly news release in percentage over the full sample. Panel B reports descriptive statistics over the contractionary phase of sample. Lastly Panel C examines the statistics relating to the expansionary phase. The sample period is from January 2, 1990 to December 31, 2004. A *, ** and *** indicate significance at the 10, 5 and 1% levels, respectively. P-values are provided parentheses.

	Money Supply (M1)	Money Supply (M3)	Unemployment Rate (UE)	Consumer Price Index (CPI)
Panel A: Full Sample				
Mean	0.7736	0.6858	7.7961	0.6540
Median	0.8400	0.6775	7.7500	0.5668
Standard deviation	1.6426	0.6649	1.5875	0.6611
Minimum	-13.7018	-2.9979	5.1000	-0.4160
Maximum	8.1772	4.1397	10.9000	3.7242
Skewness	-3.6945	-0.5344	0.4119	2.0730
Excess Kurtosis	38.4735	11.8586	2.0659	10.0692
Observations	180	180	180	60
Panel B: Augmented Dickey-Fuller unit root test [(a)]				
Trend and constant	-8.8954***	-9.5525***	-5.8373***	-9.2826***
	(-4.04)	(-4.03)	(-4.03)	(-4.21)
Lags	3	2	1	0
Panel C: Contraction				
Mean	0.7183	0.5895	7.9702	0.7134
Median	0.9072	0.5747	8.1000	0.6295
Standard deviation	1.4144	0.5871	1.8559	0.6870
Minimum	-5.7941	-1.7456	5.5000	-0.4160
Maximum	3.7752	2.1252	10.8000	2.6137
Skewness	-2.1511	-0.9783	0.0831	1.0599
Excess Kurtosis	10.7400	6.7936	1.5054	4.4930
Observations	57	57	57	19
Panel D: Expansion				
Mean	0.7993	0.7305	7.7155	0.6265
Median	0.8261	0.7328	7.7000	0.5662
Standard deviation	1.7431	0.6957	1.4478	0.6557
Minimum	-13.7018	-2.9979	5.1000	-0.2788
Maximum	8.1772	4.1397	10.9000	3.7242
Skewness	-4.0323	-0.4726	0.6119	2.5979
Excess Kurtosis	42.6821	12.8937	2.5589	13.3166
Observations	123	123	123	41

Notes:
[(a)] For the Augmented Dickey-Fuller unit root test, the sample period examined is from January, 1980 to December, 1989. This was the 120 months data prior to the study's sample period. That is the approach adopted by studies which have used ARIMA models as a source of expectations is to estimate the structural model using 120 months data up to period t-1. This model is then used to obtain a post sample forecast for the period 1990-01 to 2000-12. Box-Jenkins ARIMA methodology requires data to exhibit properties of stationarity, for this purpose the Augmented Dickey-Fuller test was used to test whether the first different of the economic data were stationary. The appropriate lag length is set by the Schwartz Information Criterion. The Mackinnon (1996) critical value at the 1% level of significance is in parentheses.

Table 4. Australian Business Cycle

The table describes the stages of the economy as it moves through the business cycle, during the sample period. For our sample period, from 1990 to 2004, there were 123 expansion months and 57 contraction months.

Turning Point		Duration in Months	
Peak	**Trough**	**Contraction (Peak – Trough)**	**Expansion (Trough – Peak)**
1990.01	1991.06	18	18
1992.12	1993.09	9	3
1993.12	1994.12	12	30
1997.06	1997.09	3	33
2000.06	2000.12	6	36
2003.12	2004.09	9	3

Table 5. The Announcement Effect of Macroeconomic News Announcements on the Australian Stock and Bond Returns: Full Sample

This table reports quasi-maximum likelihood (QML) estimate results (models are estimated using Bollerslev-Wooldridge Heteroskedasticity consistent covariance, and the Marquardt optimization algorithm) for the EGARCH (1,1) model of Equation 1:

$$R_{i,t} = \alpha_{i,c} + \varepsilon_{i,t} + \sum_{k=1}^{q} \alpha_{i,k}.\varepsilon_{i,t-k} + \alpha_{i,N} NEWS_{N,t}$$

$$\varepsilon_{i,t} = z_{i,t}\sqrt{h_t} \sim (0, h_{i,t}), z_{i,t} \sim iid(0,1)$$

$$\ln(h_{i,t}) = \beta_{i,0} + \beta_{i,1}.\ln(h_{i,t-1}) + \beta_{i,2}\frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,3}.\left(\frac{|\varepsilon_{i,t-1}|}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}}\right) + \beta_{i,N} \mid NEWS_{N,t} \mid$$

Where $R_{i,t}$ is the returns on the markets under consideration. $NEWS_{N,t}$ denotes the news variables (N) which were transformed into daily variables by assigning the value of zero for days without the particular news announcement and the magnitude of the news for announcement days. q is the number of MA lags required to remove serial correlations and sign bias of $z_{i,t}$. $\varepsilon_{i,t}$ denotes the error term which is assumed to be ~ (0, $h_{i,t}$). $h_{i,t}$ is the conditional return volatility of $R_{i,t}$ Equation 1 is estimated over a sample from January, 1990 to December, 2004. A *, ** and *** indicate significance at the 10, 5, and 1% levels respectively. P-values are provided in the parentheses.

	AOI		90-Day Bank Accepted Bill		10-Year Government Bond Index	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Panel A: Conditional Mean						
α_c	0.0155	(0.19)	0.0001	(0.27)	0.0147	(0.05)**
α_{M1}	0.0470	(0.49)	-0.0013	(0.02)**	-0.0779	(0.06)*
α_{M3}	-0.0108	(0.83)	0.0000	(0.91)	-0.0429	(0.34)
α_{UE}	0.0332	(0.49)	-0.0001	(0.56)	0.0260	(0.34)
α_{CPI}	-0.1558	(0.02)**	-0.0027	(0.13)	-0.1138	(0.04)**
Panel B: Conditional Variance						
β_0	-0.1254	(0.00)***	-0.5076	(0.00)***	-0.1272	(0.00)***
β_1	0.9631	(0.00)***	0.9694	(0.00)***	0.9608	(0.00)***
β_2	-0.0870	(0.00)***	-0.0060	(0.24)	-0.0308	(0.00)***
β_3	0.1366	(0.00)***	0.3621	(0.00)***	0.0955	(0.00)***
β_{M1}	0.0483	(0.49)	-0.1716	(0.00)***	-0.0871	(0.10)
β_{M3}	-0.1456	(0.03)**	0.0097	(0.84)	0.1011	(0.02)**
β_{UE}	-0.0081	(0.90)	-0.1674	(0.00)***	0.0000	(0.10)
β_{CPI}	0.0212	(0.78)	0.7092	(0.00)***	0.1976	(0.00)***

Table 6. The Announcement Effect of Macroeconomics News Announcements on Stock and Bond Returns: Contraction Periods

This table reports quasi-maximum likelihood (QML) estimate results (models are estimated using Bollerslev-Wooldridge Heteroskedasticity consistent covariance, and the Marquardt optimization algorithm) for the EGARCH (1,1) model of Equation 2:

$$R_{i,t} = \alpha_{i,0} + \varepsilon_{i,t} + \sum_{k=1}^{q} \alpha_{i,k}.\varepsilon_{i,t-k} + \alpha_{i,N} D_e * NEWS_{N,t}$$

$$\varepsilon_{i,t} = z_{i,t}\sqrt{h_t} \sim (0, h_{i,t}), z_{i,t} \sim iid(0,1)$$

$$\ln(h_{i,t}) = \beta_{i,0} + \beta_{i,1}.\ln(h_{i,t-1}) + \beta_{i,2}\frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,3}.\left(\frac{|\varepsilon_{i,t-1}|}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}}\right) + \beta_{i,N} D_e * |NEWS_{N,t}|$$

Where $R_{i,t}$ is the returns on the markets under consideration. D_e is a dummy variable included to capture the state of economy, which take on a value of unity on the state of economy to which they are assigned (contraction in this case) and zero otherwise. $NEWS_{N,t}$ denotes the news variables (N) which were transformed into daily variables by assigning the value of zero for days without the particular news announcement and the magnitude of the news for announcement days. q is the number of MA lags required to remove serial correlations and sign bias of $z_{i,t}$. $\varepsilon_{i,t}$ denotes the error term which is assumed to be ~ (0, $h_{i,t}$). $h_{i,t}$ is the conditional return volatility of $R_{i,t}$ Equation 2 is estimated over a sample from January, 1990 to December, 2004. A *, ** and *** indicate significance at the 10, 5, and 1% levels respectively. P-values are provided in the parentheses.

	AOI		90-day Bank Accepted Bill		10-year Government Bond Index	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Panel A: Conditional Mean						
α_c	0.0174	(0.16)	0.0001	(0.02)**	0.0148	(0.05)**
α_{M1}	0.2357	(0.04)**	-0.0010	(0.56)	0.0800	(0.24)
α_{M3}	-0.0424	(0.73)	0.0006	(0.49)	-0.0948	(0.30)
α_{UE}	0.1083	(0.35)	-0.0006	(0.48)	0.0753	(0.08)*
α_{CPI}	-0.0584	(0.81)	-0.0041	(0.23)	-0.0332	(0.79)
Panel B: Conditional Variance						
β_0	-0.1252	(0.00)***	-0.6121	(0.00)***	-0.1165	(0.00)***
β_1	0.9646	(0.00)***	0.9603	(0.00)***	0.9640	(0.00)***
β_2	-0.0881	(0.00)***	0.0095	(0.04)**	-0.0257	(0.00)***
β_3	0.1324	(0.00)***	0.3958	(0.00)***	0.0916	(0.00)***
β_{M1}	-0.1583	(0.14)	-0.3504	(0.00)***	0.0449	(0.65)
β_{M3}	0.1045	(0.41)	-0.2110	(0.05)**	-0.0194	(0.83)
β_{UE}	0.0215	(0.76)	-0.0811	(0.14)	-0.0045	(0.93)
β_{CPI}	0.0953	(0.23)	0.6936	(0.00)***	0.0800	(0.15)

Table 7. The Announcement Effect of Macroeconomics News Announcements on Stock and Bond Returns: Expansionary Periods

This table reports quasi-maximum likelihood (QML) estimate results (models are estimated using Bollerslev-Wooldridge Heteroskedasticity consistent covariance, and the Marquardt optimization algorithm) for the EGARCH (1,1) model of Equation 2:

$$R_{i,t} = \alpha_{i,0} + \varepsilon_{i,t} + \sum_{k=1}^{q} \alpha_{i,k} . \varepsilon_{i,t-k} + \alpha_{i,N} D_e * NEWS_{N,t}$$

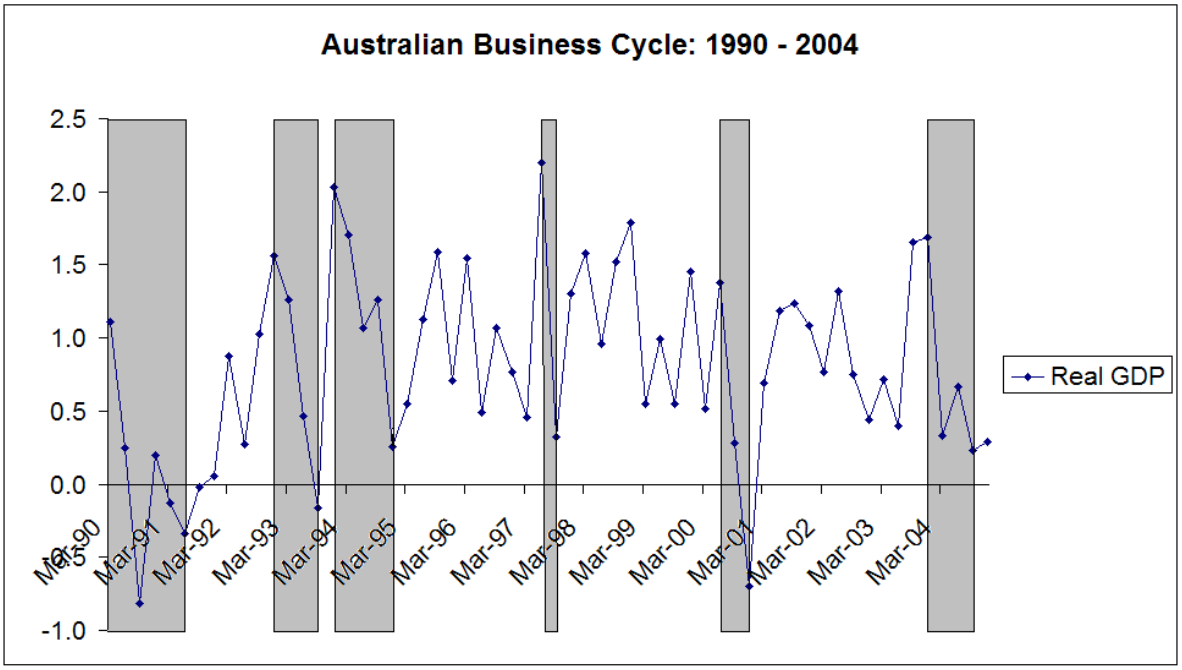
$$\varepsilon_{i,t} = z_{i,t}\sqrt{h_t} \sim (0, h_{i,t}), z_{i,t} \sim iid(0,1)$$

$$\ln(h_{i,t}) = \beta_{i,0} + \beta_{i,1} . \ln(h_{i,t-1}) + \beta_{i,2} \frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,3} . \left(\frac{|\varepsilon_{i,t-1}|}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}} \right) + \beta_{i,N} D_e * |NEWS_{N,t}|$$

Where $R_{i,t}$ is the returns on the markets under consideration. D_e is a dummy variable included to capture the state of economy, which take on a value of unity on the state of economy to which they are assigned (expansion in this case) and zero otherwise. $NEWS_{N,t}$ denotes the news variables (N) which were transformed into daily variables by assigning the value of zero for days without the particular news announcement and the magnitude of the news for announcement days. q is the number of MA lags required to remove serial correlations and sign bias of $z_{i,t}$. $\varepsilon_{i,t}$ denotes the error term which is assumed to be ~ (0, $h_{i,t}$). $h_{i,t}$ is the conditional return volatility of $R_{i,t}$. Equation 2 is estimated over a sample from January, 1990 to December, 2004. A *, ** and *** indicate significance at the 10, 5 and 1% levels, respectively. P-values are provided parentheses.

	AOI		**90-day Bank Accepted Bill**		**10-year Government Bond Index**	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
			Panel A: Conditional Mean			
α_c	0.0147	(0.23)	0.0001	(0.65)	0.0142	(0.06)*
α_{M1}	-0.0278	(0.71)	-0.0012	(0.16)	0.0666	(0.20)
α_{M3}	0.0551	(0.40)	-0.0007	(0.06)*	-0.0090	(0.87)
α_{UE}	-0.0117	(0.86)	0.0009	(0.00)***	-0.0077	(0.83)
α_{CPI}	-0.2575	(0.01)**	0.0014	(0.44)	-0.2133	(0.00)***
			Panel B: Conditional Variance			
β_0	-0.1232	(0.00)***	-0.5230	(0.00)***	-0.1177	(0.00)***
β_1	0.9623	(0.00)***	0.9676	(0.00)***	0.9636	(0.00)***
β_2	-0.0874	(0.00)***	-0.0008	(0.89)	-0.0249	(0.00)***
β_3	0.1349	(0.00)***	0.3693	(0.00)***	0.0922	(0.00)***
β_{M1}	0.1474	(0.04)**	-0.0898	(0.15)	-0.1400	(0.03)**
β_{M3}	-0.2823	(0.00)***	0.0269	(0.63)	0.1141	(0.02)**
β_{UE}	-0.0165	(0.79)	-0.3665	(0.00)***	-0.0567	(0.20)
β_{CPI}	-0.0979	(0.28)	0.7416	(0.00)***	0.2237	(0.01)***

Figure 1. Australian Business Cycle from 1990 to 2004.



Note: The shaded area denotes the contraction phase in the business cycle.

Appendix A. Diagnostic Tests of the MA-EGARCH Model Specification

	AOI		90-Day Bank Accepted Bill		10-Year Government Bond Index	
Log-L[(a)]	-4190.2900		12432.5600		-2917.766	
q	1		1		2	
	Tests of white noise for z_t [(b)]					
DW	2.0325		1.8267		2.0407	
Q(20)	19.8050	(0.4060)	45.8770	(0.0010)***	24.9820	(0.1250)
$Q^2(20)$	16.2920	(0.6380)	3.6091	(0.9998)	18.4220	(0.4280)
	Engle and Ng (1993) Sign Bias Test [(c)]					
Sign bias	-0.0887	(0.4081)	0.0077	(0.9744)	-0.0177	(0.8563)
Negative size bias	-0.0731	(0.4500)	-0.1824	(0.3839)	0.0188	(0.7753)
Positive size bias	0.0492	(0.4891)	0.2316	(0.1083)	-0.1104	(0.1301)
Joint Test: $X^2(3)$	3.0696		3.4153		2.9418	

Note:

[(a)] Log-L is the value of the log likelihood function of Equation 1 at convergence.
[(b)] Q(20) and $Q^2(20)$ are Q-tests of serial correlations of z_t and z^2_t respectively.
[(c)] To conduct the joint test we consider the following regression:
$z^2_t = a + b_1 S^-_{t-1}\ b_2 S^-_{t-1} \cdot z_{t-1} + b_3 S^+_{t-1} \cdot z_{t-1} + \varepsilon_t$

Where a, b_1, b_2, and b_3 are constant coefficients. The *t*-ratios for b_1, b_2, and b_3 are the sign bias, the negative size bias, and the positive size bias test statistics, respectively. The test statistic for the joint test is the LM test, which is equal to *T* times the *R*-squared from the regression. If the volatility model being used is correct, then $H_0 : b_1 = b_2 = b_3 = 0$ and ε_t is i.i.d. Thus the *t*-statistics and the LM test statistic have the standard limiting distributions. In particular, the LM test statistics follows a chi-square distribution with three degrees of freedom. These diagnostic test statistics can also be used as summary statistics on the raw data to explore the nature of time-varying volatility in the data series, without first imposing a volatility model. In this case, $z_t = (R_t - \mu)/\sigma$, where μ and σ are the conditional mean and variance of the daily returns. The *t*-statistics and the LM test statistic, which are both scale invariant, will give us the three individual tests and the joint test.
[(d)] LM-test statistic reported. The LM test statistic is asymptotically distributed as chi-square with *m* degrees of freedom when the null hypothesis is true, *m* is the number of parameter restrictions. It is asymptotically equivalent to the likelihood ratio test and hence is also asymptotically the most powerful test. The chi-square critical value is 6.25 at the 10% level of significance.