US Economic Announcements: Do They Convey Information to the Australian Share Market?

Ian Hyland
Sean Chinnery
John Evans
Curtin University of Technology

Abstract

This study covers the period from January 2000 to June 2005 and examines the 'announcement effect' of economic news releases in the United States (US) on returns in the Australian share market. Using previously developed models and professional surveys as proxies for expected components of the announcements, the study analyses how the Australian market reacts to both expected and unexpected components. Three types of US economic announcements are analysed in this study, namely discount rate changes, inflation and real economic activity. Results show that significant relationships occur for each of the three types of economic announcements. These findings provide empirical proof that Australian investors regard US economic news as containing information relevant in the pricing of Australian equities. This has consequences for investors and fund managers throughout Australia who need to consider the impact of US and global economic conditions when developing investment strategies.

Introduction

Australia's financial structure, with a deregulated financial system, floating exchange rate and lack of exchange controls, places it in a situation where its financial markets are potentially exposed to the effects of market-moving events in many of the world's other leading economies (Campbell & Lewis, 1998). Given the United States' (US) standing as the world's leading economy, the main hypothesis of this paper is that there will be significant reactions in the Australian share market to announcements regarding the performance of the US economy.

Campbell and Lewis (1998) provide a comprehensive study into how economic announcements have impacted on Australian financial markets. Analysing the volatility of fixed-interest markets in Australia around economic news releases, they show that US economic announcements have substantial effects on yields in Australia – even to the extent that yields were more responsive to US news than domestic. Monetary policy announcements, Consumer Price Index (CPI) releases and information concerning the labour force are the foremost announcements shown to have a regular impact on yields in

Australia. This study will build upon Campbell and Lewis' paper by analysing the 'announcement effect' of economic news releases in the US on equity prices in the Australian share market. Of the many economic announcements made in the US, this paper will focus on those concerning the Federal Reserve's discount rate, inflation and real economic activity due to their standing as 'major' economic announcements.

An important facet of research in this area is in separating announcements into components that are expected and unexpected by the market. Under efficient market theory, equity prices should only react to those parts of announcements that are unexpected.[1] At the time of the announcement the expected components should not be new 'news' to the market, and hence their effect should have already been factored into equity prices. This theory also predicts that the price reaction to news should occur as close to instantaneously as feasible. Pearce and Roley's (1985) study provided an examination of market efficiency in the US stock market. Using survey data on market participants' expectations, they examined the announcement effect of US economic announcements on US stock prices. Their results showed that the US market was efficient in that stock prices did not react to parts of announcements that were anticipated. In general, any reaction was complete by the end of the announcement day.

This study will utilise both survey data and models from past research to break down the announcements into expected and unexpected components. By examining the reaction of the All Ordinaries Index on the six days surrounding each announcement, conclusions can be drawn as to whether the Australian share market is efficient in processing new information releases.

As Australian economic conditions are greatly influenced by those prevailing in the US, this paper will examine whether the Australian market considers US economic news to contain any information that is relevant in the pricing of Australian equities. Significant relationships between returns on the All Ordinaries Index and expected or unexpected components will provide empirical evidence that the Australian market does consider the US announcements to contain pertinent information. Over a period from 1 January 2000 until 30 June 2005 the results show that the Australian share market has exhibited significant reactions to both expected and unexpected components of US economic announcements. While the findings indicate the Australian market may not always react in an 'efficient' manner, they do indicate that it regards the US news releases as containing significant new information. It must be noted that a potential weakness of this study is that it was not always possible to disentangle noise created by significant economic announcements in the Australian market around US economic releases. [2]

The rest of the paper is structured as follows. Section 2 introduces the three types of economic announcements, namely the Federal Reserve discount rate, inflation and real economic activity, which form the basis of this study. Incorporated in Section 2 is a review of relevant literature. Section 3 outlines the hypotheses while Section 4 describes the data and methodology. In Section 5 the results of the study are articulated. Section 6 concludes the paper by looking at some implications of the findings and presenting ideas for future research.

Economic Announcements

In this section the three types of US economic announcements that form the basis of this study, in particular the Federal Reserve discount rate, inflation and real economic activity, are introduced. Possible links between share prices and the economic announcements are discussed along with a review of relevant literature.

Discount Rate

The discount rate is one of the three tools available to the Federal Reserve in its implementation of monetary policy and as such its effect on financial markets has been subject to much research in financial literature.[3] This study will build on past research by examining the announcement effect of discount rate changes on prices in the Australian share market. It will also add to the debate as to whether discount rate changes are exogenous or endogenous by looking at whether the rate changes are partially predictable through publicly available information.

Discount rate changes have significant implications for a number of financial variables including market interest rates, asset prices and exchange rates (Choi, 1999). In regards to how they affect equity prices a study by Waud (1970) noted that discount rate changes alter the expectations of business people, financial institutions and various other economic participants in regards to the future course of the economy. He reasons that this change in expectations should be reflected publicly through a revision of equity prices, due to the fact that discount rate changes will alter future cash flows and hence the discounted present values of firms in general. Waud found that there was a significant announcement effect in response to discount rate changes and that this effect was different for both rate increases and rate decreases. Rate increases were shown to have a negative impact on share prices, while rate decreases caused significantly positive price reactions. Waud interpreted both the differing signs and significance of the results as an indication that there was a general market consensus as to the information contained within the rate announcements.

A share's value is determined as the present value of the future stream of earnings per share, where the discount rate is the investor's required rate of return, or:

$$\text{Share Value} = \sum (E_i / (1+R)^i)$$
$$\text{where } i = 1\ldots\ldots\infty$$
$$E_i = \text{earnings per share for period } i$$
$$R = \text{required rate of return}$$

It is clear that a share's value can be affected through either a change in the denominator term, numerator term or both in the above equation. As noted previously a discount rate change will have an impact upon both the future earning stream of a firm and the rate of return demanded by its shareholders, hence analysis of how the numerator and denominator terms respond gives a clearer insight into why share prices react to discount rate changes. Waud (1970) first noted that as we can only observe the price reaction of equities to rate changes we have no way of knowing whether this represents an inflationary or deflationary response to the change by the market, given that the

numerator and denominator terms could work in opposite directions. A study by Nissim and Penman (2003) provides insight into the numerator-denominator problem by investigating the relationship between interest rates and both future earnings and required rates of return. They found a significant positive relationship between interest rates and future earnings; however, the increase in the future earnings (numerator term) is more than offset by an increase in required rates of return demanded by investors (denominator term). They concluded that their findings are consistent with that of past research in that there is a negative relationship between interest rates and stock prices.

As noted previously there has been great debate and conflicting evidence as to the question of whether discount rate changes are endogenous, exogenous or a combination of both. A decision on whether a discount rate change is endogenous or exogenous has implications in regards to market efficiency. For example, an author who finds an announcement effect to rate changes whilst operating under an endogenous assumption, faces having to rationalise why a market would respond to an event that has been assumed as expected by the market. A paper by Lombra and Torto (1977) found evidence in support of endogenous discount rate changes. Using lagged values of both the federal funds-discount rate spread and levels of borrowing at the discount window, Lombra and Torto (1977) showed that these variables explained over 95% of the variability in the discount rate, and hence support the notion of an endogenous discount rate. Waud (1970) also found support for a partially predicted discount rate by finding a market reaction five to seven days prior to discount rate announcements. He contributed his finding to a leakage of information from the Federal Open Market Committee meetings.

Smirlock and Yawitz (1985) provided a combined discussion into discount rate endogeneity and the well detailed announcement effects associated with their changes. The unique aspect of their paper was in the separation of individual rate changes into different classes depending upon their purpose. Changes were classified as being either technical (conducted purely to bring the discount rate in-line with market interest rates) or non-technical (containing informative policy implications). Results indicated that announcement effects were observed only for non-technical changes in the discount rate, as would be expected in an efficient market. Smirlock and Yawitz's findings showed that through consideration of the reasoning behind discount rate changes it is inappropriate to class the changes as being purely endogenous or exogenous as has been the assumption under which many past papers have operated. Smirlock and Yawitz (1985) also noted that their findings indicated that the discount rate can still be considered as a useful tool in implementing macroeconomic policy. Waud (1970) had previously said that the market may misinterpret the changes by reacting to changes that are purely technical; however, Smirlock and Yawitz (1985) showed that the market only reacted to the non-technical or policy changing announcements, as would be expected in an efficient market.

Previous research into the US economy's spill-over effects into Australia, including that by Kortian and O'Regan (1996), found that the Australian bond and equity markets display a significant dependence on their US counterpart markets. To highlight this dependence they showed that the Australian share market is more dependent upon the US share market than the Australian bond market, and that the Australian bond market is more dependent upon the US bond market than the Australian share market. Campbell

and Lewis (1998) had similar findings in that they showed bond yields in Australia were more reactive to US economic announcements than domestic. Akin to the findings of both of these papers Conover, Jensen and Johnson (1999) looked into how the monetary environment in the US influenced returns on stocks in foreign countries. They found that stock returns in the foreign countries were higher when the US was under an expansive monetary policy versus a restrictive policy, and it was also noted that several countries displayed greater correlation with US monetary conditions than those in their own country.

Inflation

Extensive research into the impact of inflation has shown an inverse relationship between ex post real equity returns and inflation. Jaffe and Mandelker (1976), Nelson (1976), Fama (1981) and Kim and In (2005) have shown this relationship to hold empirically and, hence, question the Fisherian belief that holding equity provides a partial hedge against inflation. Irving Fisher (1930) provided the basis for debate as to how asset markets compensate investors for the loss in purchasing power they suffer due to inflation. His theory was that nominal interest rates could be considered as consisting of two separate components: a portion that provided a real rate of return to the investor and a portion that compensated them for the inflation rate observed over the period. It was Fisher's belief that the portion compensating the investor for inflation moved in a one-to-one relationship with the actual inflation rate while the real rate of return for the investor remained constant.

While Fisher's hypothesis indicates that there should be a positive relationship between inflation and stock returns, there are equally compelling arguments that would lean towards a negative price reaction. Schwert (1981) noted that an unexpectedly high inflation announcement could raise the expectations of the inflation rates likely to prevail in the future. This in turn could result in the government changing its fiscal or monetary policy in order to combat the expected higher inflation. Schwert noted that reactions of this type impacted upon investment and equilibrium real returns to assets and, as such, supported the belief that inflation is 'bad for business'. A second theory as to why inflation announcements may affect stock prices is concerned with the structure of US tax laws. Feldstein (1980) argued that both the use of 'historic' or original cost depreciation and the tax on artificial capital gains caused by inflation serve to lower the real return that investors can expect to receive on their investments. Hess and Lee (1999) suggested that the relationship between equity returns and inflation can be accounted for by two separate disturbances: supply shocks and demand shocks. Supply shocks reflect real output shocks and produce a negative price reaction while demand shocks are due to monetary shocks and produce a positive price reaction. Using data from a number of countries Hess and Lee show that the reaction of equity prices to inflation is dependent upon which type of shock is prevalent at the time.

Whilst many studies have tested for the relationship between returns on equity and inflation levels over a period, relatively few have examined the market's response when announcements containing inflation information are released. Studies by Pearce and Roley (1985) and Schwert (1981) both scrutinised the reaction of US equity prices around the

announcement date of the CPI. Schwert's findings indicated that there was a significant negative relationship between unexpected inflation and equity returns for the 15 days surrounding the announcement date rather than a single reaction on the day of the announcement. He attributes the prolonged reaction to a leakage of information prior to the official release date; given that the CPI is announced some two to three weeks subsequent to the data being collected, a leakage of information is certainly not out of the question. He does note, however, that this 15 day period is after the data collection period for the CPI and as such the release of the CPI does provide information that the market believes is relevant in the pricing of equities. Pearce and Roley's study found only a very weak negative reaction of equity prices to unexpected inflation on the day of the announcement.

Real Economic Activity

The industrial production index and national unemployment rate are two of the most widely used proxies for real economic activity and as such are the two measures used in this paper. As previously discussed many prior studies have documented a negative relationship between inflation and equity returns which is in contradiction to the Fisherian belief that holding equity should provide at least a partial hedge against the effects of inflation. In trying to rationalise this finding many researchers have looked at the relationships between inflation, real activity and equity returns as a possible explanation.

A number of past papers have tried to account for the inflation-equity return relationship by examining the causal effects of real activity on equity returns as a possible explanation. Papers by Cozier and Rahman (1988) and Fama (1981) both show that the observed negative relationship between inflation and equity returns is proxying for fundamental relations between real equity returns and real activity, and inflation and real activity. Fama demonstrated both a positive relationship between real equity returns and real activity and a negative relationship between inflation and real activity. Most importantly he showed that the measures of real activity dominated those of inflation when used in a regression to account for real returns on equity. Cozier and Rahman also added strength to the theory by using Canadian data to show that real equity returns are exogenous with respect to inflation.

Pearce and Roley (1985) used industrial production and unemployment data to represent real economic activity and examine the announcement effect each had on equity prices in the US. They noted that the direction of the announcement effect could not be determined *a priori*. A positive announcement could lead to forecasts of higher economic growth in the future making equities more attractive and hence a positive price reaction. On the other hand a positive announcement could induce the Federal Reserve to try and curb economic growth by increasing interest rates and hence lower equity prices. The results of Pearce and Roley indicated, however, that there was no significant relationship between announcements concerning real activity and equity prices, at least on the day of the announcement. Campbell and Lewis (1998) did find some evidence, however, of a reaction to announcements concerning real activity. Looking at the reaction of Australian fixed interest markets they found that announcements concerning building approvals,

retail trade, imports and the financial aggregate contained significant information for the market.

Hypotheses

The theory states that a market is efficient in a semi-strong form sense if prices reflect all currently available public information and react quickly to all news releases that have information relevant in the pricing of equities. The first hypothesis of this paper is that the Australian equity market will react to portions of US economic announcements deemed expected with a lead effect and portions deemed unexpected with a lagged effect. Also, the reaction to the unexpected components should be essentially complete by the end of the first day after information becomes available to Australian investors.

The second set of hypotheses relate to the direction of the relationships that are expected to be observed between equity prices and the individual economic announcements. Based on the preceding discussion, Table 1 lists each of the announcements together with the expected impact an increase in the variable will have on equity prices.

Table 1: Announcement Type and Expected Relationship

Announcement Type	Expected Relationship
Discount Rate	Negative
Inflation	Negative
Industrial Production	Positive
Unemployment	Negative

Source: Original table.

Section 2 provides the reasoning behind the expected directions of the relationships between equity returns and discount rate changes and inflation rate announcements respectively. Despite arguments for positive relationships, the overwhelming consensus of past research into both announcements is that they have negative consequences in regards to equity prices. Expectations for the relationship between equity prices and the proxies for real economic activity are based upon papers by Cozier and Rahman (1988) and Fama (1981) who both found significant support for a positive relationship between share prices and industrial production. They attribute the strength of their findings to the fact that these announcements contain information that is fundamental in the pricing of equities. Given this, it is expected that the results will show a positive relationship between equity prices and changes in the industrial production index and a negative relationship with the national unemployment rate. The expectation of a negative relationship between the unemployment rate and equity prices is due to the fact that an unexpectedly high unemployment rate would reflect either a reduction in the number of employment opportunities in the economy or an inability to create sufficient jobs to meet demand - conditions that should not promote share price growth.

The final hypothesis of this study is that the results will display significant relationships between equity returns in Australia and the release of economic information

in the US on the days surrounding the announcements. Support for this hypothesis will imply that US economic announcements do contain information that is relevant in the pricing of Australian equities.

Data and Methodology

This study examines the impact that announcements of various economic variables in the US have on prices in the Australian equity market over a period from 1 January 2000 to 30 June 2005. In order to discuss the nature of the impact on Australian equity prices, closing prices from the All Ordinaries Index are used. The All Ordinaries Index comprises of the 500 largest companies listed on the Australian Stock Exchange and hence provides the best indication as to the Australian market's response as a whole. All Ordinaries closing prices were obtained from the Datastream database.

Announcement Data

Announcement data was obtained from a number of sources including the Federal Reserve Boards website and the Bureau of Labor and Statistics. Firstly, daily data on the discount rate was obtained from the Federal Reserve website at www.federalreserve.gov in order to determine the exact date that discount rate changes were effected. The second announcement type, those concerning inflation in the US, was represented by annualised percentage changes in the monthly CPI. As noted previously CPI announcements, as released by the Bureau of Labor and Statistics, are made two to three weeks after the data collection period. For example, the CPI level for March would not be released officially until mid-April. Due to this it was necessary to check the individual reports on CPI releases in order to ascertain the exact release date and hence the day when the information became available to the Australian public. Data on real economic activity in the US was obtained from the Federal Reserve website (Industrial Production Index) and the Bureau of Labor and Statistics (Unemployment rate), with each of the releases occurring on a monthly basis. The Industrial Production Index is similar to the Consumer Price Index in that its release is made some two to three weeks following the month the data corresponds too. The unemployment rate is announced with greater speed and is generally made on the first Friday of each month. As with the CPI announcements individual reports of each announcement were checked to determine when Australian investors were first able to trade on the information contained in them.

Survey of Professional Forecasters

There are three main methods - normal, interest rate time-series models and professional surveys - used in forecasting inflation. Because of the ambiguity of past forecasting accuracy, forecasts published in the Survey of Professional Forecasters, as released by the Federal Reserve Bank of Philadelphia, was deemed the most suitable method. The Survey of Professional Forecasters contains the median forecasts of 40 professionals from the business world and Wall Street regarding their beliefs on the future course of many economic variables. Given the large number of forecasters in the survey and their standing as professionals, their combined views provide a good measure as to the level of inflation expected by market participants. The survey also provides forecasts

for both the industrial production index and unemployment rate and therefore will also be used to obtain expected components for these variables.

Methodology

Discount Rate

To determine whether discount rate announcements contain information relevant in the pricing of Australian equities the market reaction was initially tested under the assumption of an exogenous discount rate. Following this the exogeneity assumption was be relaxed and tests carried out to see if discount rate changes could be partially predicted through publicly available information. Results from this test were then used to see how the Australian market reacts to both expected and unexpected components of the change.

As previously mentioned, numerous studies have assumed that changes in the discount rate are totally unexpected by investors. Using the methods of Pearce and Roley (1985) the following model was developed:

$$\Delta AO_{i,t} = \alpha + \beta \Delta BP_t + \varepsilon_t \qquad (1)$$

where $\Delta AO_{i,t}$ is the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t. ΔBP_t is the change in the discount rate measured in basis points. In order to comment on the relationship between Australian equity prices and the discount rate ΔBP_t is regressed against $\Delta AO_{i,t}$ for a period covering from the day before the announcement up until four days after the announcement. Given that the assumption of this section is that the discount rate is exogenous it would be expected that there should not be a significant β coefficient for the day before the announcement. A significant coefficient would imply that the market is responding to information that is not known at the time which is contradictory with the efficient market hypothesis. Significant β coefficients (irrespective of the sign) on any of the other days would imply that the Australian equity market is gaining new information from the US discount rate changes. It is expected, however, that given the reasons detailed in the introduction and conclusions from past research, the relationship between equity prices and discount rate changes should be negative.

In order to do this methods developed by Smirlock and Yawitz (1985), who used lagged changes in both the federal funds-discount rate spread and changes in weekly bank borrowings, are used.[4] The model is defined as follows:

$$\Delta DR = \alpha + \beta_1 SD_{t-1} + \beta_2 SD_{t-2} + \beta_3 SD_{t-3} + \beta_4 SD_{t-4} + \beta_5 \Delta BW_{t-1} + \beta_6 \Delta BW_{t-2} + B_7 \Delta BW_{t-3} + \beta_8 \Delta BW_{t-4} + \varepsilon_t \qquad (2)$$

where ΔBW_t is the change in the amount of money borrowed by US depository institutions for fortnight t. SD_t is the federal funds discount rate spread for week t and ΔDR is the change in the discount rate measured in basis points. In order to run the above model some additional information was required from the Federal Reserve website.

Firstly, weekly figures for the discount rate and federal funds rate were used to construct the discount rate-federal funds rate spreads. Seasonally adjusted borrowings of US depository institutions are also taken from the H.3 Table 6 'Memorandum Items' release in order to represent the changes in money borrowings.

Equation 2 was run twice, firstly using all the independent variables shown above and then again using only those found to be significant in the initial regression. From this second regression the predicted values and residuals were saved and used to represent the expected and unexpected components of the discount rate change respectively. With the expected and unexpected components saved, the following model was used to test the Australian equity markets response to each:

$$\Delta AO_{i,t} = \beta_1 \Delta EX_{t+n} + \beta_2 \Delta UNEX_{t+n} + \varepsilon_t.$$
$$n = -1....4 \qquad\qquad (3)$$

where $\Delta AO_{i,t}$ is as described in Equation 1, ΔEX_{t+n} and $\Delta UNEX_{t+n}$ represent the change of the discount rate deemed expected and unexpected respectively. Significant coefficients on the ΔEX_{t+n} terms will show that the Australian market is both predicting and reacting to parts of the discount rate deemed expected, while significant coefficients on the $\Delta UNEX_{t+n}$ terms lend support towards an unexpected discount rate change. According to efficient market theory the expected components should react to rate changes with a lead effect while the unexpected components should be significant with a lagged effect.

The period of study included a number of events that warrant attention in terms of the effect each may have on the models being tested. Firstly, the terrorist attacks in the US of 11 September 2001. The attacks preceded a 230-time increase in borrowing at the discount window, with borrowing increasing from $US195 million a week before the attack to $US45.6 billion on 12 September 2001. The effect of this skewed the results of Equation 2 which included the lagged change in borrowings of US depository institution terms. To this end three discount rate changes that occurred in the period subsequent to the attacks were deleted from the sample (Kahn, 2001).

January 9, 2003 saw the Federal Reserve undertake a change in the way that it conducts its discount window programs by shifting from an adjustment credit operation to primary credit. The difference in the methods being that adjustment credit was offered at below market rates while primary credit was to be set at a rate above the federal funds rate. Given the aforementioned difference in the two methods a 150 basis point increase in the discount rate occurred on the day the adjustment credit program was implemented; this necessitated two adjustments. First, this particular discount rate increase was totally expected by the market given the forewarning of the adjustment credit program and as such this rate change was deleted from the sample. Second, the change in discount borrowing being offered at above market rates as compared to below market changed the relationship between the discount rate change and the federal funds-discount rate spread. To combat this, a structural break was implemented in the data as from 9 January 2003 in order to preserve the relationship over the study period.

Inflation and Real Economic Activity

The methods used to examine the reaction of Australian equity prices to inflation and real economic activity announcements in the US are identical. The All Ordinaries Index to expected and unexpected inflation is analysed through the following model:

$$\Delta AO_{i,t} = \alpha + \beta_1 EX_{t+n} + \beta_2 UNEX_{t+n} + \varepsilon_t$$
$$n = -1 \ldots 4 \qquad\qquad\qquad (4)$$

where $\Delta AO_{i,t}$ represents the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t. The regression is conducted for six days covering from the day before the announcement until four days after the announcement. EX_t and $UNEX_t$ represent the portion of the announcement deemed expected and unexpected respectively. As mentioned previously the expected components are from the Survey of Professional Forecasters and the unexpected component is computed as actual less expected. Again, it is hypothesised that the results of this model will show that the Australian market responds in accordance with efficient market theory.

Results

Discount Rate

The study period from 1 January 2000 to 30 June 2005 witnessed the Federal Reserve conduct 27 changes in the level of the discount rate. After deletion of four of these rate changes for the reasons previously mentioned, the sample consisted of 23 discount rate changes with which to analyse the Australian equity markets response. Table 2 provides a summary of the distribution of the sizes of these rate changes on an overall as well as year-by-year basis.

Breakdown of the discount rate changes into a year by year format shows that the study period included two different phases of discount rate activity. In 2001 the Federal Reserve decreased the discount rate in nine consecutive periods as it fought to reduce the effects of an impending recession and to stimulate growth post 11 September 2001. Conversely the period from 2004 to mid-2005 has seen the Federal Reserve conduct nine consecutive discount rate increases each of 25 basis points. These changes were made amid concerns about rising inflation levels primarily due to large increases in oil prices. It is to the advantage of this study that the study period covers two cycles of discount rate behaviour.

The approach undertaken in this study to examine the relationship between discount rate changes and prices in the Australian equity market was threefold. First, under the assumptions of Pearce and Roley (1985) and Roley and Troll (1984) the reaction of equity prices to discount rate changes were tested as if the change was totally unexpected. Equation 1 provides an initial indication as to whether discount rate changes contain information relevant in the pricing of Australian equities. Second, under the methods of Smirlock and Yawitz (1985), Equation 2 was used to see if the discount could be partially predicted through publicly available information. Then using the predicted values and

residuals from this regression Equation 3 was used to see how the Australian market responds to components deemed expected and unexpected. This provided an indication of how efficient the market is in responding to the discount rate changes. The results for Equation 1 are displayed in Table 3.

Table 2: Discount Rate Changes

Discount Rate Changes (1/1/00 to 30/6/05)

Change*	-50	-25	25	50	Total	Mean	St Dev
# Obs.	5	6	11	1	23	-3.26	33.97

Year by Year Discount Rate Changes (1/1/00 to 30/6/05)

Change*	-50	-25	25	50
Year				
2000	0	0	2	1
2001	4	5	0	0
2002	1	0	0	0
2003	0	1	0	0
2004	0	0	5	0
2005	0	0	4	0
Total Observtions	5	6	11	1

Source: Original tables. Note: *Changes are measured in basis points.

Results from the regression indicate that the first significant relationship between the All Ordinaries Index and the announced discount rate change occurred on the third day after information became available to the Australian public. Interestingly this relationship, which is significant at the one percent level, is shown to be positive for day t+3 which is in contradiction to what was expected according to theory and past research. This positive reaction is partially offset, however, by a negative relationship on day t+4. Regardless of the direction of the relationship the results have confirmed the study's primary hypothesis that discount rate announcements do convey information that is relevant in the pricing of Australian equities.

Given that the results in Table 3 have shown that US discount rate changes do affect Australian equity prices the next set of regressions will provide insight into whether they are partially predictable through publicly available information. Table 4 gives the results of the regression shown by Equation 2.

The results indicate support for a partially endogenous discount rate announcement with the first lagged federal funds discount rate spread being significant at the five percent level of significance. The next step was to run this regression again, this time using only the independent variables shown to be significant in the initial regression. The results are shown in Table 5.

Table 3: Discount Rate (Exogenous)

Equation 1→ $\Delta AOi,t = \alpha + \beta\Delta BPt + \varepsilon t$

Day	Constant	t-Stat	Coeff	t-Stat	Adj R Sqr	F-Stat
t-1	$-7.1*10^{-5}$	-.0399	$4.09*10^{-6}$	0.766	-0.019	.587
T	0.000	1.523	$-4.9*10^{-6}$	-1.041	0.004	1.083
t+1	$-3.2*10^{-5}$	-0.144	$-2.8*10^{-6}$	-0.429	-0.039	0.184
t+2	$-7.4*10^{-5}$	-0.375	$1.61*10^{-6}$	0.272	-0.044	0.074
t+3	0.000	-1.907*	$1.4*10^{-5}$	3.068***	0.277	9.414***
t+4	$5.55*10^{-5}$	0.579	$-6.3*10^{-6}$	-2.195**	0.148	4.818**

Source: Original table. Notes: $\Delta AOi,t$ = the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t, $\beta\Delta BPt$ = the change in the discount rate measured in basis points, *=significant at 1%, **=significant at 5%, ***=significant at 10%.

Table 4: Results of Regression Analysis

Equation 2→ $\Delta DR = \alpha + \beta_1 SDt\text{-}1 + \beta_2 SDt\text{-}2 + \beta_3 SDt\text{-}3 + \beta_4 SDt\text{-}4 + \beta_5\Delta BWt\text{-}1 + \beta_6\Delta BWt\text{-}2 + \beta_7\Delta BWt\text{-}3 + \beta_8\Delta BWt\text{-}4 + \varepsilon t$

Variable	Const	SDt-1	SDt-2	SDt-3	SDt-4	BWt-1	BWt-2	BWt-3	BWt-4
Coef	-352.24	3.857	.697	2.516	-0.25	1.32	2.296	-1.224	-3.317
t-Stat	-2.265**	2.161**	.492	1.652	-0.678	0.481	1.678	-0.51	-1.106

Source: Original table. Note: Adj. R Sqr = 0.233, F-Test = 1.837, ΔBWt = change in the amount of money borrowed by US depository institutions for fortnight t, SDt = federal funds discount rate spread for week t, ΔDR = change in the discount rate measured in basis points, *=significant at 1%, **=significant at 5%, ***=significant at 10%.

Table 5: Results of Amended Regression Analysis

$\Delta DR = \alpha + \beta_1 SDt\text{-}1 + \varepsilon t$

Variable	Const	SDt-1
Coef	-181.03	3.559
T_Stat	-2.746**	2.709**

Source: Original table. Note: Adj. R Sqr = .224 F-Test = 7.337**, SDt = federal funds discount rate spread for week t, ΔDR = change in the discount rate measured in basis points, *=significant at 1%, **=significant at 5%, ***=significant at 10%.

As would be expected the results in Table 5 provide even stronger support for a partially endogenous discount rate announcement and also provide a basis for getting a measure of the expected and unexpected components of the announcements. The predicted values and residuals are saved and regressed against the change in the value of the All Ordinaries Index, as shown by Equation 3.[5] Prior to conducting the regression it was expected that if the discount rate changes did convey new information to the

Australian market the coefficients on expected components should be significant with a lead effect. In addition, the coefficients to the unexpected components were expected to be significant with a lagged effect. The results from this regression are shown in Table 6.

Table 6: Discount Rate (Endogenous)

Equation 3 → $\Delta AO_{i,t} = \beta_1 \Delta EX_{t+n} + \beta_2 \Delta UNEX_{t+n} + \varepsilon_t$

Day	Constant	T-Stat	Ex. Coef	T-Stat	Unex. Coef	t-Stat	Adj R Sqr	F-Stat
t-1	-9.7*10^-5	-.532	-3.8*10^-6	-0.36	6.84*10^-6	1.097	-0.031	0.666
t	0.000	1.401	-8.5*10^-6	-0.91	-3.6*10^-6	-0.649	-0.035	0.623
t+1	0.000	-0.558	-2.8*10^-5	-2.37**	5.84*10^-6	0.847	0.165	3.176*
t+2	-9.3*10^-5	-0.455	-4.1*10^-6	-0.35	3.61*10^-6	0.517	-0.079	0.195
t+3	0.000	-0.27**	7.57*10^-7	0.09	1.86*10^-5	3.698***	0.347	6.843***
t+4	5.68*10^-5	0.571	-5.9*10^-6	-1.02	-6.4*10^-6	-1.887*	0.106	2.299

Source: Original table. Note: ΔEX_{t+n} and $\Delta UNEX_{t+n}$ = change in the discount rate that was deemed expected and unexpected respectively, $\Delta AO_{i,t}$ = the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t, *=significant at 1%, **=significant at 5%, ***=significant at 10%.

Table 6 shows that the Australian equity market does exhibit a significant reaction to those parts of the discount rate changes that are expected and unexpected. The first significant coefficient to be observed was from the expected coefficient on day t+1. The fact that a market reaction occurs to the expected component with a lagged effect is in contradiction with efficient market theory and may indicate that Australian investors are not making full use of publicly available information in order to anticipate discount rate changes. The negative relationship is consistent, however, with what was predicted. Significant relationships with the unexpected components are not observed until the third day after the announcement was made. The third day after the announcement saw a highly significant positive relationship which was partly offset by a negative relationship the following day.[6] These results raise questions in regard to the impact of discount rate changes on equity prices as the positive relationship on day t+3 is in contradiction with what had been expected. The fact that a significant reaction was not observed until the third day after the announcement also indicates that the Australian markets response to US discount rate changes lingers beyond the announcement day, contrary to the efficient market hypothesis which predicts any announcement effect would be complete by the end of the first trading day after information becomes available.[7]

Inflation

Table 7 contains some simple summary statistics on the level of inflation in the US over the study period covering from 1 January 2000 to 30 June 2005. The inflation rate is calculated as the annualised percentage change in the monthly CPI release.

Table 7: Summary Statistics: Inflation in the US (1 January 2000 – 30 June 2005)

Total Obs.	Minimum	Maximum	Mean	St. Deviation
66	-0.05	0.17	0.0294	0.04199

Source: Original table.

Table 8: Inflation

Equation 4 $\rightarrow \Delta AO_{i,t} = \alpha + \beta_1 EX_{t+n} + \beta_2 UNEX_{t+n} + \varepsilon_t$

Day	Constant	t-Stat	Ex. Coef	t-Stat	Unex. Coef	t-Stat	Adj. R Sqr	F-Stat
t-1	$-3.2*10^{-5}$	-0.406	-0.001	-0.029	0.001	0.347	-0.03	0.06
T	0.000	0.473	-0.025	-0.616	-0.004	-1.102	-0.006	0.796
T+1	$1.33*10^{-5}$	0.019	0.003	0.108	0.001	0.386	-0.029	0.08
T+2	0.000	-0.453	0.018	0.598	0.005	2.116**	0.042	2.414*
T+3	0.001	1.683*	-0.044	-1.8*	0.000	-0.173	0.019	1.634
T+4	-0.001	-0.949	0.03	1.031	-.001	-0.378	-0.012	0.604

Source: Original table. Note: EX_{t+n} and $UNEX_{t+n}$ = components of the inflation rate that were deemed to be expected and unexpected respectively, $\Delta AO_{i,t}$ = the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t, *=significant at 10%, **=significant at 5%, ***=significant at 1%.

The section entitled Inflation and Real Economic Activity contains details on the equations used in testing for the relationship between announcements concerning inflation in the US and equity returns in Australia. Table 8 contains the results for Equation 4. The first significant relationship occurs on the second day following the announcement when the All Ordinaries Index displays a positive relationship with the unexpected component of the inflation announcement. The positive relationship empirically dismissed the hypothesis of a negative relationship between unexpected inflation and equity returns. This positive relationship was partially offset, however, by a negative relationship between expected inflation and equity returns on day t+3. This relationship is surprising as the market should have already reacted to the expected component of the inflation announcement before the release date. While the results have raised some questions in regards to the efficiency of the Australian market they have provided evidence that inflation announcements in the US contain information relevant in the pricing of Australian equities. They also support the findings of Schwert (1981) in that there are significant relationships in the days following the CPI announcement. This shows that the Bureau of Labor and Statistics provides new information to the market by summarising observable market prices into a single index figure, even though they release their findings two to three weeks after the period to which the data corresponds.

Real Economic Activity

Table 9 provides summary statistics for the 66 monthly announcements of the annualised percentage changes in the Industrial Production Index (IPI) and the national unemployment rate.

Table 9: Summary Statistics: IPI and National Unemployment Rate (1 Jan 2000 – 30 Jun 2005)

	N	Minimum	Maximum	Mean	St. Deviation
Ind. Production	66	-0.11	0.14	0.012	0.0586
Unemployment	66	3.9	6.4	5.209	0.752

Source: Original table.

As discussed in the previous section, Equation 4 will be used to examine whether the All Ordinaries Index displays a significant reaction to expected and unexpected components of announcements concerning the Industrial Production Index and national unemployment rate. Tables 10 and 11 display the results for the running of Equation 4 for both Industrial Production Index and unemployment rate announcements respectively.

Table 10: Industrial Production Index

Equation 4 → $\Delta AO_{i,t} = \alpha + \beta_1 EX_{t+n} + \beta_2 UNEX_{t+n} + \varepsilon_t$

Day	Constant	t-Stat	Ex. Coeff	t-Stat	Unex. Coef	t-Stat	Adj. R Sqr	F-Stat
t-1	-0.131	-0.42	5.767	0.717	-0.572	-0.271	-0.023	0.26
T	-0.892	-1.803*	18.689	1.458	-2.121	-0.63	0.003	1.094
t+1	0.62	1.836*	-7.207	-0.825	2.03	0.884	-0.013	0.577
t+2	0.36	1.321	-8.228	-1.165	1.91	1.029	-0.001	0.956
t+3	-0.018	-0.063	0.413	0.056	1.335	0.689	-0.023	0.268
t+4	0.209	0.704	-7.092	-0.922	-0.111	-0.055	-0.016	0.474

Source: Original table. Note: EX_{t+n} and $UNEX_{t+n}$ = components of the Industrial Production Index that were deemed to be expected and unexpected respectively, $\Delta AO_{i,t}$ = the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t, *=significant at 10%, **=significant at 5%, ***=significant at 1%.

The results in Table 10 show that no significant relationships occur between the continuous returns on the All Ordinaries Index and both expected and unexpected components of the annualised changes in the Industrial Production Index. This result indicates that the release of this information by the Federal Reserve provides no significant information to Australian investors. The results for Equation 4 do, however, display a significant relationship between the continuous returns on the All Ordinaries Index and the national unemployment rate. These results show that the expected coefficient is significant at the five percent level on the second day after the information became available to the Australian market.

The implications of these findings are that Australian investors consider the release of information concerning the national unemployment rate in the US to contain information relevant in the pricing of Australian equities. They also show that the Australian market is partly predicting the level of unemployment and responding to the information in it accordingly. The positive relationship on the significant variable is in opposition to what had been expected as it implies that a higher unemployment rate in the US has a positive effect on equity prices in Australia. The fact that the Australian market reacts to the unemployment rate and not the Industrial Production Index could be a reflection on how the two announcements are released to the public. If both announcements are close proxies for the level of real economic activity the fact that the market reacts to the announcement that is made earlier (always the unemployment rate) could be explained by efficient market theory.

Table 11: Unemployment Rate

Equation 4 → $\Delta AO_{i,t} = \alpha + \beta_1 EX_{t+n} + \beta_2 UNEX_{t+n} + \varepsilon_t$

Day	Constant	t-Stat	Ex. Coeff	t-Stat	Unex. Coef	t-Stat	Adj. R Sqr	F-Stat
t-1	1.077	1.172*	-0.191	-1.597	0.033	0.081	0.012	1.411
T	0.396	0.568	-0.072	-0.547	-0.647	-1.415	0.001	1.017
t+1	0.019	0.035	-0.019	-0.183	0.45	1.263	-0.002	0.942
t+2	-1.884	-2.264**	0.331	2.095**	-0.301	-0.551	0.054	2.852*
t+3	0.126	0.185	-0.051	-0.394	0.634	1.425	0.01	1.335
t+4	-0.378	-0.592	0.074	0.609	0.318	0.758	-0.02	0.377

Source: Original table. Note: EX_{t+n} and $UNEX_{t+n}$ = components of the unemployment rate that were deemed to be expected and unexpected respectively, $\Delta AO_{i,t}$ = the change in the value of the All Ordinaries Index calculated as the continuous return from the close of trading on day t-1 to day t, *=significant at 10%, **=significant at 5%, ***=significant at 1%.

Conclusion

The objective of this paper is to test whether announcements concerning economic activity in the US have any impact on returns in the Australian share market. Given the well documented similarities in economic performance between the two countries and the structure of Australia's financial system it was the main hypothesis of this paper that the results would confirm significant announcement effects exist on the days surrounding major economic news releases in the US.

Results given provide strong support for the hypothesis of significant announcement effects. Announcements concerning discount rate changes, inflation and the national unemployment rate in the US were all shown to have significant effects on returns on the All Ordinaries Index for days surrounding the announcements. The only announcement not to show any significant relationships was that concerning the level of the Industrial Production Index. The implication of these significant relationships is that it confirms Australian investors regard US economic news releases as containing information relevant in the pricing of Australian equities.

This study also provides additional insight into whether the Australian market is efficient in the way it responds to new information. In this regard the results showed that the market was efficient in the broadest sense in that it was responsive to the release of new information. There are a number of aspects of the results, however, that are in opposition to what efficient market theory would predict. Theory says that equity prices should reflect all currently available information and only react to new information that was previously unknown to the market. The results indicate, however, that the Australian share market displayed significant reactions after the release date to components of announcements that were expected. This information should have already been factored into equity prices. Significant reactions to unexpected components were also observed up to four days after release dates; efficient market theory predicts any announcement effects should be complete by the end of the first trading day after new information becomes available.

Much debate throughout this paper has been given to predicting the direction of relationships between equity prices and the individual economic announcements. Using past research as a basis for these predictions, many results throughout the paper were surprising in that the direction of the observed relationships were different to what was expected. This indicates that there is scope for future research looking further into the direction of relationships between news releases in foreign countries and returns on the Australian share market. The Introduction noted that a weakness of this study is an inability to disentangle all noise created by market changing announcements in Australia around the dates of release of information in the US market.

The findings of this study emphasise the need for investors and funds managers to be aware of the impacts that economic announcements in the US, such as changes in the discount rate, inflation and unemployment rates, can have on equity prices in the Australian market. In summary, this study has shown that significant relationships exist between the release of economic data in the US and returns in the Australian equity market, therefore confirming the widely reported fact that Australian investors react to both expected and unexpected components of news releases in the US.

Appendix 1: Tests for Unbiasedness

Sign Test

An efficient forecasting method should be equally likely to produce a positive or negative error term when compared to the actual value observed. The sign test tests whether the observed number of positive deviations is too high or too low given the total sample size. In this case a two-tailed test was used.

Steven's Test for Grouping

This test looks for signs of excessive grouping of negative or positive error terms. An efficient forecasting method should have error terms whose sign (+ive or –ive) is independent of the preceding errors sign. By testing whether the number of positive groups is less than expected for each survey we are able to make further comment on their efficiency. This test is one-tailed as it doesn't matter if the number of positive groups is greater than expected.

Under the null hypothesis the number of positive groups, g, follows a hypergeometric distribution but we are again able to approximate this to a normal distribution given the sample sizes involved:

Results

The results for the two tests are displayed in Table 1.

Table 1

Forecast Variable	T Stat. for Sign Test	T Stat. for Steven's Test
Discount Rate	0	-3.106*
Inflation	0	-1.728*
Industrial Production	-2.34*	3.53
Unemployment	-1.84	-3.92*

Source: Original table. Note: * = fails test at the 5% level of significance.

The above results show that for each of the announcements used in this study the methods for forecasting the expected component pass at least one test each for unbiasedness. The error terms for the discount rate, inflation and unemployment all pass the sign test at the five percent level, while the Industrial Production error series passes Steven's test for grouping at the five percent level. Table 1 does show, however, that the three announcements that passed the sign test all fail Steven's test at the five percent level. This indicates that the methods used to gain the expected components of announcements in this paper have consistently over- or under-estimated the actual experience in the study period. The Industrial Production series also failed the sign test on the negative side, indicating that there was a tendency to over-predict the rate of growth on this variable.

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Notes

[1] Fama (1970, 1991) provides an in-depth look at market efficiency. The sections of greatest interest are those on semi-strong form efficiency which look at how quickly security prices react to public information announcements.

² An example of this occurred on 2 February 2000 when the Federal Reserve and Reserve Bank of Australia both increased the discount rate and target cash rate respectively. In this situation the increase in the target cash rate would have influenced share prices in the Australian market over and above that caused by the Federal Reserve's discount rate change.

³ Open market operations and the setting of reserve requirements are the two other tools the Federal Reserve uses to implement its monetary policy.

⁴ Lombra and Torto (1977) and Froyen (1975) also use similar methods of anticipating discount rate changes as Smirlock and Yawitz.

⁵ Appendix 1 contains tests looking at the unbiasedness of this method of anticipating discount rate changes. It also contains tests for the inflation rate, industrial production and unemployment rate forecasts.

⁶ R-squared values for the discount rate equation and those in future results are generally low indicating that the announcements do not account for much of the variability in returns. They are, however, consistent with that of previous research.

⁷ The date of the announcement day is different for the US and Australia due to the fact that announcements in the US are made while the Australian market is closed. All results have been adjusted by one day to account for this difference.