Trading for News: an Examination of Intraday Trading Behaviour of Australian Treasury-Bond Futures Markets

Liping Zou[1] and Ying Zhang

Massey University at Albany, Private Bag 102904, Auckland, New Zealand

November 2005

Abstract

The intraday relative bid-ask, trading volume and volatility patterns for the 3-Year and 10-Year Australian T-Bond futures traded at the Sydney Futures Exchange are investigated. Australian scheduled macroeconomic announcements affect Australian bond prices, and the impact of these announcements is also examined. It is concluded that Australian macroeconomic news releases cause wider bid-ask spreads, greater trading volume and higher return volatility for the 10-Year Australian T-Bond futures market. For the 3-Year T-Bond futures market, however, little evidence was found of wider bid-ask spreads resulting from major Australian macroeconomic announcements, even though there is statistical evidence which shows that Australian macroeconomic announcements do cause greater trading volume and higher volatility for the 3-Year T-Bond futures market.

Key Words

Microstructure, Trading Behaviour, Treasury-Bond, Macroeconomic Announcements

[1] Corresponding author: Dr Liping Zou, Department of Commerce, Massey University, Private Bay 102 904, North Shore MSC, Auckland, New Zealand, Tel: 0064-9-4140800 ext. 9475, Fax: 0064-9-4418177, Email: L.Zou@massey.ac.nz

Trading for News: an Examination of Intraday Trading Behaviour of Australian Treasury-Bond Futures Markets

Introduction

Treasury bonds are the most important Australian Government bonds traded on the Australian market. The ability to hedge the risk associated with changes in the interest rates of these instruments is of paramount importance to investors. Futures contracts are one of the primary means of hedging this risk during normal trading hours. Nevertheless, significant movement of interest rates can occur outside normal trading hours. For example, major economic announcements may have a major impact on Australian interest rates. This paper seeks to investigate the intraday market trading behaviour of Australian Treasury-Bond futures around major, scheduled macroeconomic announcements.

Bond holders have utilised more and more low cost financial products, such as futures contracts, to hedge their underlying positions. These products can be used to hedge short term exposure, expose positions from event risk (i.e., investors often take their positions before the Australian markets open, particularly for those days with scheduled macroeconomic news releases) and profit from anticipating short term price movements in the bond market.

There are three microstructure characteristics of major interest to investors; bid-ask spread, return volatility and trading volume. The bid-ask spread represents the difference between the price of buying and the price of selling for a particular trade. This is an important element in any financial market. Many previous researches on bid-ask spreads have reported the existence of a U-shaped pattern. Demsetz (1968) was one of the first to provide a theory for bid-ask spread patterns. This was done by placing bid and ask prices in a demand and supply framework, thus modelling the spread as a transaction cost paid by a trader for the opportunity to trade immediately. Chan, Chung and Johnson (1995) provided a good analysis of the factors affecting bid-ask spreads. They argued that one reason they observed U-shaped bid-ask spread patterns was the lower volumes of trading during the middle of the day. Ho and Stoll (1983) used the inventory of the market maker to explain the spreads, while

Hasbrouck (1988) proposed a theory based on information uncertainty. Lee, Mucklow and Ready (1993) found that the intensity of trading activity was the decisive factor.

Traditional patterns of intra-day trading volume and intra-day return volatility follow U-shaped patterns, which are similar to bid-ask spread pattern, for many financial time series. In this paper, we are going to examine whether the patterns observed in previous studies apply in our case. It is argued that greater trading volumes narrow bid-ask spreads in many financial time series, and that greater trading volumes also generate greater volatility. Previous studies have found that intra-day trading volume and intra-day volatility follow U-shaped patterns, similar to bid-ask spread patterns. An analysis of intra-night trading volume and volatility patterns will enable us to determine whether previous findings hold for the Australian Treasury-Bond futures markets.

An important motivation for trading in the bond futures market is to hedge exposure to interest rate risk. This is particularly so on days with major Australian macroeconomic news releases. Ederington and Lee (1993) found that scheduled macroeconomic news releases; such as the employment report, the consumer price index (CPI) and the producer price index (PPI); have a major impact on financial markets (also see, Ederington and Lee, 1995; Frino and Hill, 2001). Thus, in this paper, we use the CPI, PPI and the employment report as our indicators for the Australian macroeconomic announcements.

Literature Review

Intra-day activities in financial markets have attracted broad academic interest in many countries, and for various markets. Microstructure models can be classified as inventory models, specialist market power models, or asymmetric information models, and present differing market structures. In the presence of adverse selection problems, as a provider of liquidity the market maker always quotes prices for transactions and faces the possibility of trading with agents who have superior information. Consequently, trading with informed investors is expected to result in a loss, but an expected gain arises from trading with liquidity investors. It is necessary to set a spread between the bid and ask prices to compensate for this adverse selection problem. The bid-ask spreads must remain wide enough so that the gains from trading with the uninformed, compensates for the losses to the informed.

Market microstructure literature has used three types of model to explain the shape of bid-ask spreads. These are the inventory model, the specialist market power model and the information asymmetry model. The main influences of the inventory model on bid-ask spread are dealers' costs of holding inventories, dealers' market power and the dealers' risk aversion. Under this framework, due to the implication that the size of the spread is inversely related to the volume of inventory, the spread exists to compensate market makers for bearing the risk of undesired inventory. The market maker uses the bid-ask spread as a tool to keep inventory at the optimal level in order to always stand at the desired position. Thus, the market maker can adjust the bid-ask spread to attract orders and return back to his optimal inventory position if there exists an order imbalance which might move the market maker away from his desired inventory position.

The specialist market power model examines the reaction of a monopolistic specialist to the inelastic transaction demand that occurs at the open and close of trading. Brock and Kleidon (1992) found a model whereby the market maker has monopolistic power. This model also shows that transaction demand at the open and close is greater, and is less elastic than at other times of the trading day. The reasoning underlying this framework is as follows. Firstly, there is an accumulation of overnight information prior to opening. Secondly, there is also the possibility that optimal portfolios at the close may differ from which portfolios are optimal during the continuous trading period. This is due to the imminent non-trading period after the close. Brock and Kleidon's (1992) analysis supposed a monopolist market maker, which is appropriate for a specialist, but not for competing market makers. Thus, we should distinguish the intra-day behaviour of bid-ask spreads in markets with a monopolistic specialist (NYSE), from the competing market makers (CBOE). The U-shape pattern in bid-ask spreads is documented by McInish and Wood (1992) and Brock and Kleidon (1992). Nevertheless, Chan, Chung and Johnson (1995) found that the bid-ask spread on the CBOE narrows near the close.

Market makers observe aggregate demand, but not the identity of each trader. Thus, the market price reflects information, however this information is only partially observed due to its asymmetric nature. The information asymmetry model is based on the theory that the bid-ask spread is a purely informational phenomenon. There are three parties under this framework; the market makers, the informed investors and the uninformed investors. Suppose that the market makers receive orders sequentially, but cannot distinguish informed from uninformed investors. Informed investors will profit at the expense of the market makers but, on average, market makers always retain an unchangeable position when trading with informed investors. Hence, market makers quote ask prices which are higher than bid prices due to the imperfect nature of their information. Due to the activity of the informed investors, whose profits are paid by the uninformed investors, trading costs in this type of model rise slowly. These models could give the optimal equilibrium behaviour of the models' traders.

Historically, the bid–ask spread has been identified as a function of order processing and inventory costs. More recent financial research has introduced adverse selection and informed trading to the explanation. Theoretical work on intraday processes dates back to the late 1980s. Admati and Pfleiderer (1988) developed a model in which trades are concentrated as a result of strategic behaviour of informed and liquidity traders. Hasbrouck (1988) found that information uncertainty affected the spread. The inventory risk of the market maker led to the observance of a U-shaped pattern in trading volume in NYSE stocks (see, Ho and Stoll, 1983; Jain and Joh, 1988). Earlier studies suggested that the share of this type of trading is significant. For example, Stoll (1989), using a sample of NASDAQ stocks, reported that 43% of the quoted spread was due to adverse selection. On the other hand, George et al. (1991) estimated a much smaller share for adverse selection. In a sample of NYSE, AMEX and NASDAQ stocks, they put this share in the range of 8 to 13%. Huang and Stoll (1997) developed a general model to offer two ways of decomposing the spread and also estimated two values of this share, namely 9.6 and 21.5%. These differences in the estimated shares due to adverse selection are difficult to explain, as the cited studies differ both in data and estimation methodology. Overall, the more recent studies appear to suggest that the share of the adverse selection component is rather low in developed markets. Stoll and Whaley (1990) discussed that, in many exchanges, only the specialist can get through the order books at the open. They also suggest that the specialist will extract monopolistic profits through any opening order imbalance and any consequent higher price volatility. Brock and Kleidon (1992), however, attributed this concentration to the increased and inelastic demand for transactions during some periods of the day, namely session openings and closings, without referring to informational asymmetry. They presented the result that transaction demand at the open and close is greater, and less elastic, than at other times of the trading day.

It is also well known that bond markets traders need to hedge exposure to interest rate risk on the days when major macroeconomic information releases occur. Recent studies around macroeconomic announcements have investigated volatility and return in US and London futures markets. For example, Ederington and Lee (1993) found that macroeconomic announcements; such as real GDP, consumer price index (CPI), employment and merchandise imports; can have a dramatic effect on the US financial markets. Crain and Lee (1995) provided evidence to support the theory that volatility remains higher than normal, lasting for several hours, while price adjustment occurs within the first hour. Leng (1996) also investigated the impact of major and minor announcements on the financial market. The results showed that such effects could last for at least one hour based from the impact of a major macroeconomic announcement, while there is little impact from a minor announcement. Frino and Hill (2001) found that the bid-ask spreads widen significantly in the twenty seconds prior to announcements, and remain greatly widened for thirty seconds following announcements, based on the Sydney Futures Exchange (SFE). They found that the adjustment of price volatility, trading volume and quoted bid-ask spreads to announcement releases occurs rapidly, which includes the abnormal behaviour ahead of the new information releases and four minutes afterwards for major announcements. Zou, Rose and Pinfold (forthcoming 2006) also investigated the impact of US macroeconomic news releases on overnight options markets participants. They found that US macroeconomic news releases may cause greater volatility and higher trading volume in intra-night trading behaviour, but that the bid-ask spread patterns remain unchanged. The result implies that investors may use overnight options to hedge US economic announcements by taking positions during days with US news releases.

There are also some papers which have examined the area of intraday patterns during recent latest years. Among the few intraday studies on the Istanbul Stock Exchange, Bildik (2001) uncovered the ‘W’ shape of index returns and the ‘L’ shape of volatility. Yüksel (2002) compared the volume-volatility relationship before and after the Russian Crisis. His findings are similar to Bildik’s, but for individual stocks, rather than the overall market.

Data

This paper uses the intraday tick data starting from 1st March, 2000 to 31st December, 2004. The Security Industry Research Centre of Asia-Pacific (SIRCA) provided Reuters data for the 3-Year and 10-Year Australian Treasury-Bond Futures contracts. Two types of data are used; the quotation and the trade data. The quote data contains the date, the time in seconds, the expiration month, the bid price and the ask price. The trade data contains the date, the time of the trade, the trade price and the trading volume.

The Australian macroeconomic news releases used in this research are the days with Australian macroeconomic announcements. The macroeconomic announcements contain the producer price index (PPI), the consumer price index (CPI) and the employment reports. This database was collected by the Australian Bureau of Statistics (www.abs.gov.au). The news releases cover the period from 1st March 2000 to 31st December 2004.

Methodology

The following methodology is used in this paper. First, a relative bid-ask spread is calculated for each quote of the night[2]. This was accomplished by taking the difference in ask and bid quotes divided by the average of the bid and the ask price for each second of the day where a quote occurred. This is shown in Equation (1).

$$X = \left[(ask - bid)/(ask + bid)/2\right] \tag{1}$$

The intraday, mean, relative bid-ask spreads were calculated over fifteen-minute intervals from 8:30am to 4:30pm. This gives thirty-two, fifteen-minute intervals within each trading day.

We use the trade data to calculate the trading volumes for the thirty-two, fifteen-minute time intervals, by taking the sum of the trading volume within a particular time interval.

Next, bid-ask midpoints are used to measure the return volatility. We use bid-ask midpoints instead of transaction prices in order to avoid a bid-ask bounce problem. This method has been suggested in many previous studies (see for example, McInish and Wood, 1992). We first obtain the bid-ask midpoint for each quotation as in Equation (2).

$$\text{Bid-Ask Midpoint} = (\text{Bid} + \text{Ask})/2 \tag{2}$$

Once we obtain the bid-ask midpoint for each quotation, we follow the Chan, Chung and Johnson (1995) approach in order to calculate the standard deviation of the bid-ask midpoint. This allows us to then obtain the intra-day bid-ask midpoint volatility for the thirty-two, fifteen-minute time intervals. Finally we take the absolute value of the standardised bid-ask midpoint's volatility, and use this figure as a proxy for the intra-night return volatility.

A linear regression model was also used to investigate whether bid-ask spreads, trading volume and return volatility are statistically different between the four

[2] Quotes with either bid or ask prices equal to zero are eliminated, as are quotes where the bid-ask spread is less than, or equal to zero.

intervals made up of the first two intervals and the last two intervals during the trading day. As shown in Table 1 (See Appendix), the three microstructure characteristics, which are bid-ask spreads, trading volume and volatility data series, exhibit heteroskedasticity.

Thus, the GMM model should be applied to deal with this heteroskedasticity. Following Foster and Viswanathan (1993) and Chan, Christie and Schultz (1995), intraday variation can be tested by using Hansen's (1982) GMM procedure. As the method suggested by Newey and West (1987), it is known that serial correlation also needs to be adjusted. It is also widely know that GMM estimates are robust in the presence of heteroskedasticity and autocorrelations. The GMM model is shown in Equation (3) as follows:

$$V_i = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \varepsilon_t \qquad (3)$$

where V_i is the dependent variable representing the ith observation of the intraday relative bid-ask spreads, trading volume and bid-ask midpoint volatility, respectively. D_1 through D_4 are dummy variables displaying the first and the last two fifteen-minutes time intervals:

D_1 = 1 if the time interval is 8:30am – 8:45am, and 0 otherwise;

D_2 = 1 if the time intervals is 8:45am – 9:00am, and 0 otherwise;

D_3 = 1 if the time intervals is 4:00pm – 4:15pm, and 0 otherwise; and

D_4 = 1 if the time intervals is 4:15pm – 4:30pm, and 0 otherwise.

The coefficients for the dummy variables, α_1 through α_4, measure the variations of the variable during the intervals immediately after the open and immediately prior to close, relative to other intervals during the trading day, for each dependent variable. That is, a significantly positive, or negative, α_1 for the bid-ask spread's dependent variable would indicate that the bid-ask spread is statistically different immediately after the open from at any other time interval during the trading day.

Glosten and Milgrom (1985) indicated that, as spreads decrease, the trading volume will increase, and volatility and price will decrease. In order to investigate whether the bid-ask spreads for the 3-Year and 10-Year T-Bond futures can be explained by the change in prices, volumes and volatility, the following regression model is used to determine whether there is a significant effect of the variables of price, trading volume and volatility on the dependent variable.

$$RBAS = \alpha_0 + \alpha_1 Price + \alpha_2 Volume + \alpha_3 Volatility + \varepsilon_t \qquad (4)$$

where the dependent variable is relative bid-ask spread. Volatility is the return variance, which is estimated with the midpoint of the bid and ask quotes, instead of the transaction prices as suggested by Mcinish and Wood (1992). The aim is to avoid a bid-ask bounce problem.

The following regression model is used to measure the differences between the bid-ask spreads, trading volume and volatility for the time intervals of 11:15am - 11: 30am, 11:30am - 11:45am and 11:45am - 12:00am on days with Australian macroeconomic news releases, and days without Australian news releases.

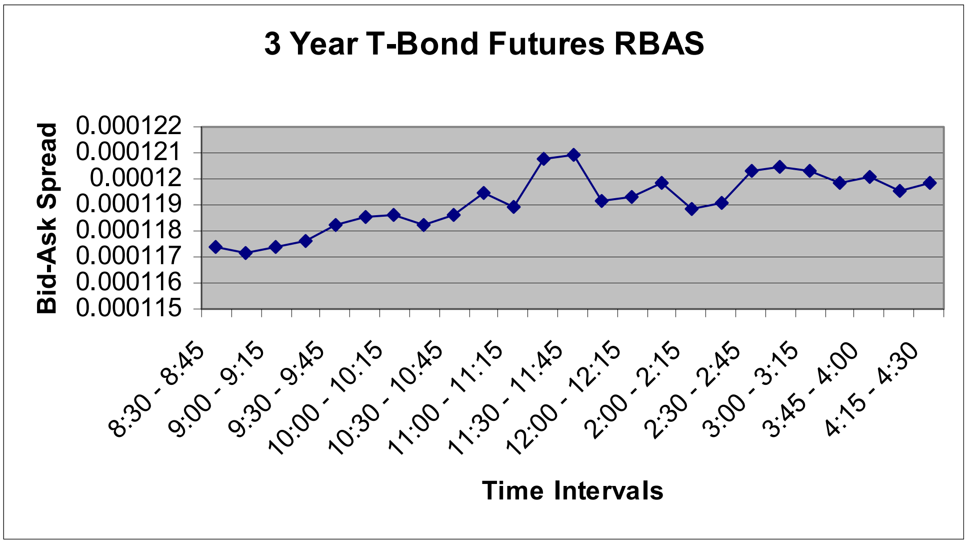
$$V_i = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \varepsilon_t \qquad (5)$$

where $D_1 = D_2 = D_3 = 1$ if there are Australian macroeconomic news releases on the day, and 0 otherwise. V_i is the dependent variable displaying the ith observation of the intra day relative bid-ask spreads, trading volume and bid-ask midpoint volatity. D_1 through D_3 are dummy variables displaying different time intervals (fifteen-minute intervals).

Analysis

The following two graphs illustrate the relative bid-ask spreads for the 3-Year and 10-Year T-Bond futures, respectively.

Figure 1: Intra-Day Relative Bid-Ask Spreads Patterns for 3-Year and 10-Year T-Bond Futures



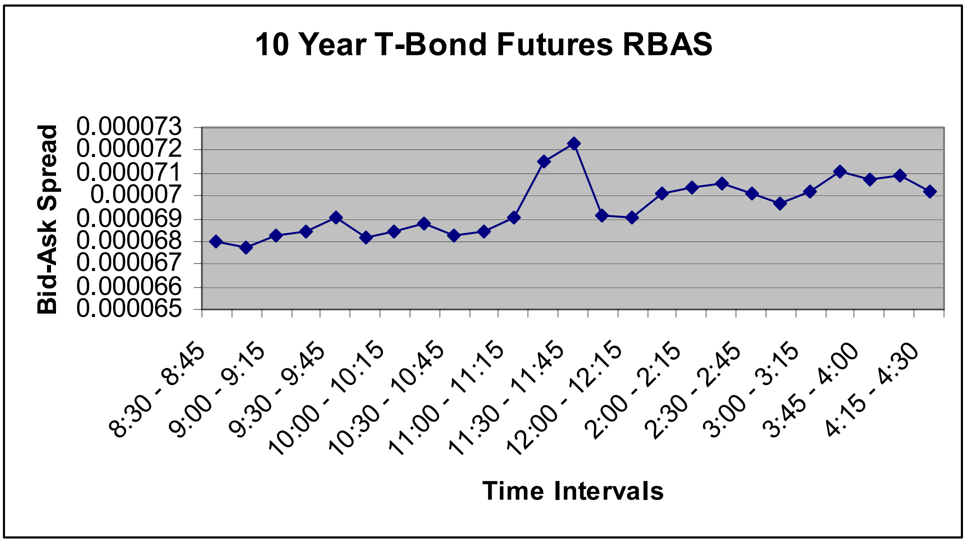


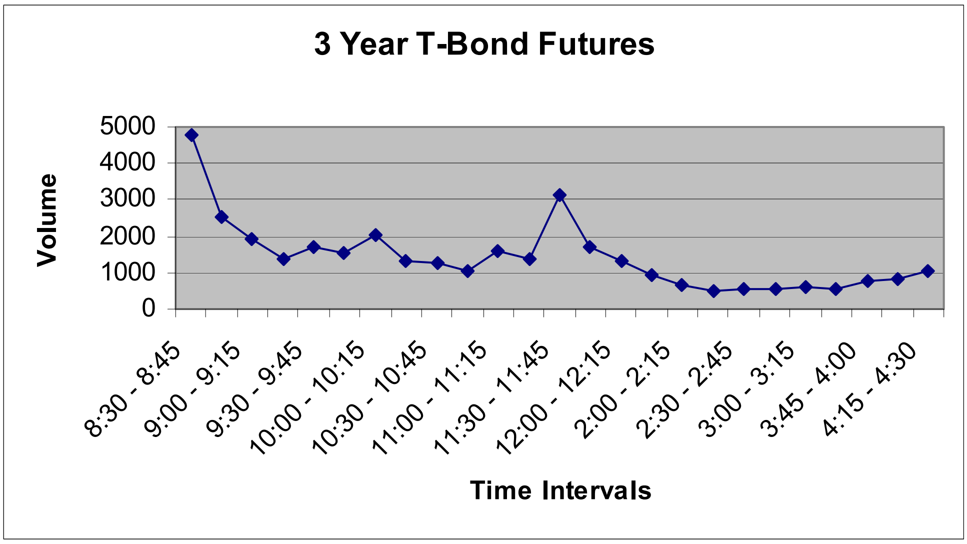
Figure 1 shows that the bid-ask spreads for the Australian 3-Year and 10-Year T-Bond futures start at a low level and fluctuates little until the 11:30 to 11:45am interval.

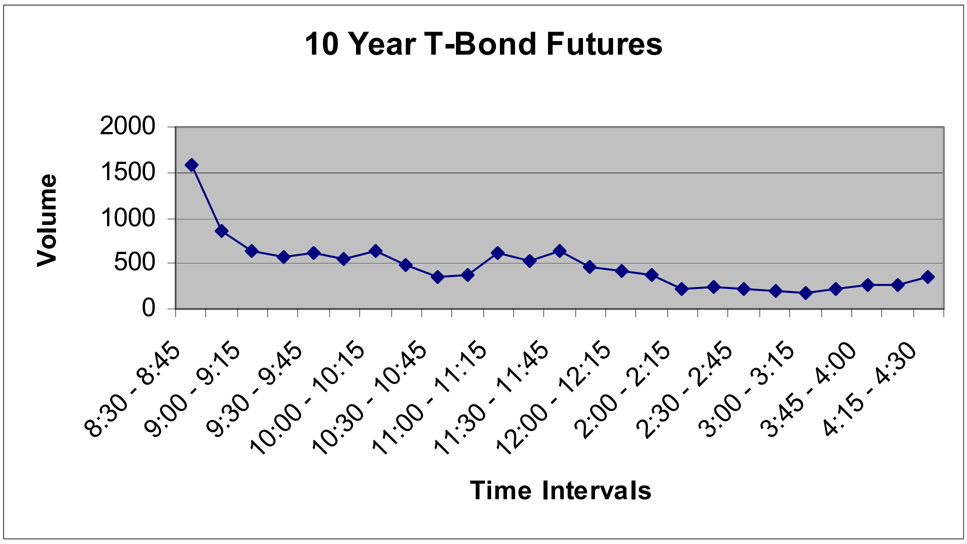
Peaks are observed at around the 11:30 to 11:45am time interval, for both the 3-Year and 10-Year T-Bond futures relative bid ask spreads. This is the time interval when Australian macroeconomic news releases occur. This may indicate that during this time period of the trading day, the relative bid ask spreads for the Australian bond futures contracts are wider than at other time intervals during the day. The results will be verified later in the analysis by regression analysis. These patterns appear inconsistent with previous studies, in which the existence of U-shaped patterns in spreads are documented in Brock and Kleidon (1992) and Chan, Chung and Johnson (1995).

It seems that the monopolistic behaviour of the SFE specialist is not the explanation for the observed intraday patterns in the bid-ask spreads for the 3-Year and 10-Year T-Bond futures. This finding may indicate that Australian bond futures traders tend to face higher transactions costs when Australian major macroeconomic announcements are released. This is consistent with the asymmetry information model, which indicates that informed investors have an informational advantage before the announcement, such that market makers have to widen their bid-ask spreads in order to compensate for the losses in dealing with those informed traders. This result implies that the Australian macroeconomic announcements do have an effect on the bid-ask spreads, and that traders may face higher transaction costs for days of macroeconomic news releases.

Figure 2 illustrates the 3-Year and 10-Year Australian Treasury-Bond futures intraday mean trading volume patterns. The 3-Year and 10-Year T-Bond futures exhibit intra-day trading volume patterns similar to the traditional U-shape. Intraday refers to the trading volume patterns for the 3-Year and the 10-Year T-Bond futures, which start higher at the market's open, gradually decrease during the first half of the trading day, and then increased during the 11:30 to 11:45am time interval for both the 3-Year and 10-Year T-Bond futures contracts.

Figure 2: Intra-Day Patterns of Mean Trading Volume for 3-Year and 10-Year T-Bond Futures

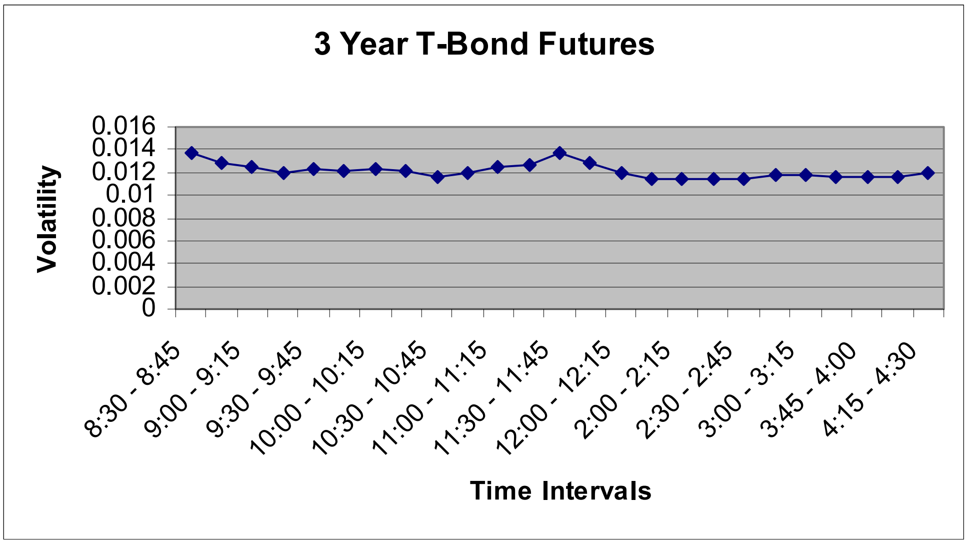


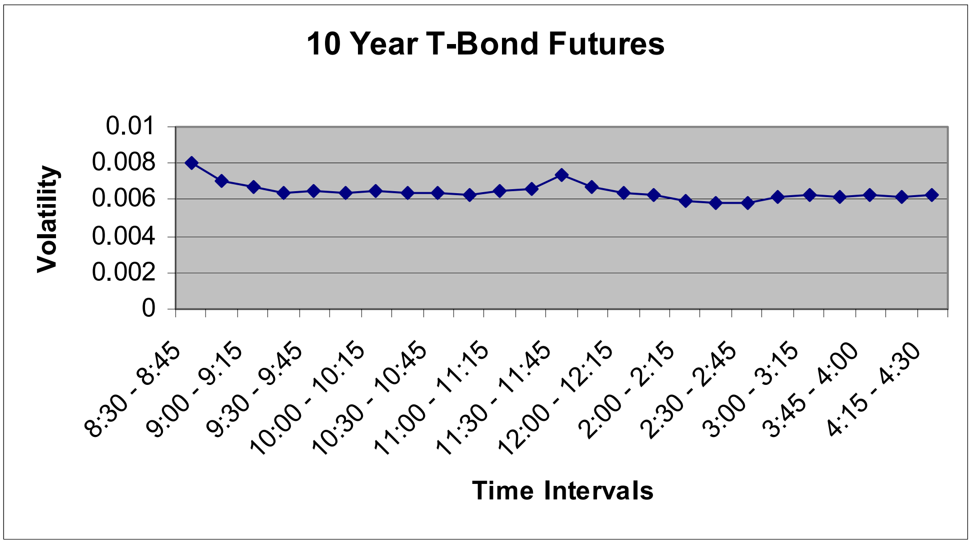


The higher volume immediately after the market open is consistent with the argument that investors and hedgers take positions during the beginning of the trading session, as a result of the overnight information accumulation. The observed jumps at time interval 11:30 to 11:45am indicate that trading volumes increase over this time period due to major Australian macroeconomic news releases.

Figure 3 exhibits the intra-day volatility patterns for the 3-Year T-Bond and 10-Year T-Bond futures. These patterns exhibit similar patterns as to those found regarding the intraday trading volumes. They start with a relatively higher volatility and jump during the 11:30 to 11:45am time interval.

Figure 3: Intra-Day Patterns of volatility for 3-Year and 10-Year T-Bond Futures





These findings are again consistent with many previous studies of a U-shaped volatility pattern. The greater volatility during the 11:30 to 11:45am time interval indicates that volatility increases with Australian major macroeconomic announcements. It implies that Australian major macroeconomic announcements may have large impacts on return volatility.

GMM is now used to investigate relative bid-ask spreads, trading volume and return volatility for the first two, and the last two, fifteen-minute time intervals within a trading day. Whether or not bid-ask spreads, trading volume and return volatility are statistically different between the four specific intervals, and any other intervals during the day, is now examined.

Table 2 Generalised Method of Moments (GMM) Estimations of the Intraday Bid-Ask Spreads, Trading Volume and Volatility Patterns

We use the following regression model (Equation (5)) to carry the GMM test to examine the intraday trading behaviour for the 3-Year and 10-Year T-Bond futures:

$$V_i = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \varepsilon_t \qquad (5)$$

where V_i is the dependent variable representing the ith observation of the intra day relative bid-ask spreads, trading volume and bid-ask midpoint volatility during the fifteen-minute interval.

D_1 = 1 if the time interval is 8:30 – 8:45am, and 0 otherwise;

D_2 = 1 if the time interval is 8:45 – 9:00am, and 0 otherwise;

D_3 = 1 if the time interval is 4:00 – 4:15pm, and 0 otherwise;

D_4 = 1 if the time interval is 4:15 – 4:30pm, and 0 otherwise.

ε_t is a random error.

The coefficients for the dummy variables, α_1 through α_4, measure the variations of the variable during the intervals immediately after the open, and prior to midday, relative to other intervals during the trading day. Asymptotic t-statistics are in parentheses.

Panel A Bid-Ask Spreads

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	-0.000002 (-1.68)*	-0.000002 (-1.39)
α_2	-0.000002 (-1.97)**	-0.000002 (-1.58)
α_3	0.000001 (0.91)	0.000001 (1.1)
α_4	0.000001 (1.01)	0.000001 (0.53)

Table 2 continued on next page.

Table 2 continued from previous page.

Panel B Trading Volume

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	3424 (35.23)***	1160 (27.36)***
α_2	1160 (11.93)***	420 (9.88)***
α_3	-427 (-4.21)***	-164 (-3.79)***
α_4	-185 (-1.88)*	-71.9 (-1.68)*

Panel C Volatility

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	0.000923 (1.23)	0.00168 (5.32)***
α_2	0.000277 (0.37)	0.000635 (2.02)**
α_3	-0.000412 (-0.52)	-0.000213 (-0.67)
α_4	-0.000490 (-0.63)	-0.000122 (-0.39)

*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A in Table 2 presents the GMM estimation results for intra-day relative bid-ask spreads. The coefficient for α_1 is significant at the 10% level for 3-Year T-Bond futures. This implies that the intra-day relative bid-ask spread is significantly different immediately after the open of the session for the 3-Year T-Bond futures. The coefficient for α_2 is also significant at the 5% level for 3-Year T-Bond futures, which indicates that the intra-day relative bid-ask spreads between 8:45am and 9:00am differ from all other intervals during the session for the 3-Year T-Bond futures.

For 10-Year T-Bond futures, all of the coefficients (α_1 through α_4) are statistically insignificant, which implies that there is no significant variation in intra-day relative bid-ask spread. The GMM model results are consistent with our earlier analysis that there exists no U-shaped, or reversed J-shaped pattern of intra-day relative bid-ask spreads for the 3-Year and 10-Year T-Bond futures.

Panel B in Table 2 indicates the relevant statistics from the GMM estimation results for the intra-day trading volume. For 3-Year and 10-Year T-Bond futures, the coefficients (α_1 through α_3) are statistically significant at the 1% level. The coefficients for α_4 are significant at the 10% level for 3-Year and 10-Year T-Bond futures. This indicates that the intra-day trading volume is significantly different immediately before the end of the session for 3-Year and 10-Year T-Bond futures. This is consistent with our earlier analysis, which reported a U shape pattern for 3-Year T-Bond futures, and a traditional reversed J shape pattern for 10-Year T-Bond futures.

Panel C reports the GMM results for intra-day midpoint volatility. It can be observed from the above table that, for both 3-Year T-Bond futures and 10-Year T-Bond futures, all coefficients are statistically insignificant during the day session. This is consistent with our earlier analysis that did not find any U shape, or reverse J shape, patterns for intra-day midpoint volatility.

Table 3 examines the relationship between the relative intraday bid-ask spreads and the intraday trading price, the intraday trading volume, and the intraday return volatility.

Table 3 Regression Analysis to Examine the Determinants of the Relative BAS

The following regression was carried out to examine the relationship between the bid-ask spread to the trading price, the trading volume, and the return volatility.

$$RBAS = \alpha_0 + \alpha_1 Price + \alpha_2 Volume + \alpha_3 Volatility + \varepsilon_t \quad (4)$$

where ε_t is a random error. The coefficients α_1 through α_3 measure the variations of the variable price, trading volume and midpoint volatility, respectively. Asymptotic t-statistics are in the parentheses.

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
Intercept	0.000781 (21.92)*	0.00132 (26.08)*
Price	-0.000007 (-18.75)*	-0.000013 (-24.86)*
Volume	-0.000000 (-8.74)*	-0.000000 (-10.89)*
Volatility	0.000580 (70.06)*	0.00131 (62.12)*

* denotes significance at the 1% level.

As shown in Table 3, the coefficients for both the intercept and the explanatory variables of price, trading volume and volatility are all significant at the 1% level, which implies that the determinants of the intraday relative bid-ask spreads are the trading price, the trading volume and the return volatility. This indicates that price, trading volume and return volatility have influence on the relative bid-ask spread. It also indicates that the variables of price and volume are negatively correlated to the bid-ask spread, whereas the variable of volatility is positively correlated to the bid-ask spread. As price is equal to 100 minus the return, the price is negatively related to the return and also has a negative relationship with the relative bid-ask spread. From the above regression analysis it is found that the adjusted R^2s are 17.9% and 15.4% for the 3-Year and 10-Year T-Bond futures, respectively.

Finally, a detailed analysis of information flows needs be taken into account in order to obtain a more complete picture of the patterns associated with major Australian macroeconomic news releases. As mentioned earlier, futures markets' participants should consider the informational content from major macroeconomic announcements. Thus, the sample is partitioned into two groups, based on days with scheduled Australian macroeconomic news releases and days without Australian macroeconomic news releases. Three, fifteen-minute time intervals are chosen for comparison with all other time intervals within the trading day. The chosen intervals are 11:15 to 11:30am, 11:30 to 11:45am and 11:45am to 12:00pm.

Table 4 presents the results from the application of Equation 5 for relative bid-ask spreads, trading volume and return volatility of the three time intervals for 3-Year and 10-Year T-Bond futures. The coefficients (α_1 through α_4) are statistically insignificant, which implies that there is no evidence of any significant difference for the bid-ask spread for 3-Year T-Bond futures. For 10-Year T-Bond futures, bid-ask spread is significant at the 5% level on days with Australian macroeconomic news releases.

It can also be observed from Panel B that the coefficients (α_2 through α_3) are statistically significant at the 1% level for 3-Year and 10-Year T-Bond futures, which implies that trading volume is significantly greater on days with major Australian macroeconomic announcements

Table 4 Regression Analysis of Variations in the Intra-Day Bid-Ask Spreads, Trading Volume and Volatility Patterns, With and Without Australian Macroeconomic News Releases, for 3-Year and 10-Year T-Bond Futures

The following equation is used to measure the bid-ask spreads, trading volume and volatility for the time intervals of 11:15am - 11:30am, 11:30am - 11:45am and 11:45am - 12:00pm on days with no Australian macroeconomic news releases and days with Australian news releases.

$$V_i = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \varepsilon_t \quad (5)$$

where V_i is the dependent variable which displays the ith observation of the intra day relative bid-ask spreads, trading volume and bid-ask midpoint volatility.

$D_1 = D_2 = D_3 = 1$ if there is Australian macroeconomic news release on that particular date, and 0 otherwise.

The CPI, PPI and employment rate are used as indicators of announcements.

Panel A Bid-Ask Spreads

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	0.000004 (1.54)	0.000000 (0.15)
α_2	0.000002 (0.82)	0.000002 (0.84)
α_3	-0.000003 (-0.94)	-0.000006 (-2.05)*

Panel B Trading Volume

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	270 (1.11)	134 (1.25)
α_2	6628 (27.47)**	750 (7.09)**
α_3	1779 (7.33)**	260 (2.45)**

Table 4 continued on next page

Table 4 continued from previous page

Panel C Volatility

Variable	3-Year T-Bond Futures	10-Year T-Bond Futures
α_1	-0.00039 (-0.21)	-0.000058 (-0.07)
α_2	0.00227 (1.24)	0.00238 (3.06)*
α_3	0.00038 (0.21)	0.000162 (0.21)

* and ** denote significance at the 5% and 1% levels, respectively.

Panel C indicates that there is no significant difference for the return volatility for 3-Year T-Bond futures. Nevertheless, for 10-Year T-Bond futures, the coefficients for α_2 are statistically significant at the 1% level, which implies that volatility is significantly greater on days with Australian macroeconomic news releases.

It is concluded that Australian macroeconomic news releases cause wider bid-ask spreads, greater trading volume and higher return volatility for the 10-Year Australian T-Bond futures market. For the 3-Year T-Bond futures market, however, little evidence was found of wider bid-ask spreads and higher volatility with major Australian macroeconomic announcements. Nevertheless, there is statistical evidence that Australian macroeconomic announcements do cause greater trading volume for the 3-Year T-Bond futures market.

Conclusion

This study investigates the intraday market trading behaviour on the 3-Year and 10-Year Australian Treasury-Bond futures contracts traded on the Sydney Futures Exchange (SFE). The intraday patterns for the mean relative bid-ask spreads, the trading volume and the bid-ask midpoint return volatility for the fifteen-minute time intervals within a trading day, are investigated.

An analysis of the graphical representations of the intraday bid-ask spreads, trading volume and volatility for 3-Year and 10-Year T-Bond futures contracts shows that they conform reasonably well to traditional patterns in terms of the intraday trading volume and intraday volatility, but to a lesser extent for the intraday relative bid-ask spreads patterns.

The regression analysis indicates that price, trading volume and return volatility have influences on the relative bid-ask spread. It also indicates that the variables of price and volume are negatively correlated to the bid-ask spread, whereas the variable of volatility is positively correlated to the bid-ask spread. As price is equal to 100 minus the return, thus, price is negatively related to return, and also has a negative relationship with the relative bid-ask spread. From the regression analysis, the adjusted R^2 is 17.9% and 15.4% for the 3-Year and 10-Year T-Bond futures, respectively.

The effect of scheduled Australian macroeconomic announcements is useful in explaining these observed patterns. To confirm this statistically, the mean relative bid-ask spreads, trading volume and volatility on days with, and without, Australian macroeconomic news releases were regressed. Generally, macroeconomic news announcements are found to be positively related to trading volume and volatility. There is, however, no evidence of any significant impact on the mean bid-ask spreads for the 3-Year T-Bond future, but there is evidence to support the significantly wider relative bid-ask spreads for the 10-Year T-Bond bid-ask spreads for days with the Australian macroeconomic news releases.

It is concluded that Australian macroeconomic news releases cause wider bid-ask spreads, greater trading volume and higher return volatility for the 10-Year Australian T-Bond futures market. For the 3-Year T-Bond futures market, however, little evidence was found regarding wider bid-ask spreads and higher volatility with major Australian macroeconomic announcements. Nevertheless, there is statistical evidence which shows that Australian macroeconomic announcements do cause greater trading volume for the 3-Year T-Bond futures market

References

Admati, A. and Pfleiderer, P. (1988). A Theory of Intraday Patterns: Volume and Price Variability. *The Review of Financial Studies*, 1, 3-40.

Bildik, R. (2001). Intra-Day Seasonalities on Stock Returns: Evidence from the Turkish Stock Market. *Emerging Markets Review*, 2, 387-417.

Brock, W. and Kleidon, A. (1992). Periodic Market Closure and Trading Volume: A Model of Intraday Bids and Asks. *Journal of Economic Dynamics and Control*, 16, 451-489.

Chan, K., Christie, W. and Schultz, P. (1995). Market Structure and the Intraday Pattern of Bid-Ask Spreads for NASDAQ Securities. *Journal of Financial and Quantitative Analysis*, 30, 329-346.

Chan, K., Chung, Y. and Johnson, H. (1995). The Intraday Behavior of Bid-Ask Spreads for NYSE and CBOE Options. *Journal of Finance and Quantitative Analysis*, 30, 329-346.

Crain, S. and Lee, J. (1995). Intraday Volatility in Interest Rate and Foreign Exchange Spot and Futures Markets. *Journal of Futures Markets*, 15, 395-421.

Demstetz, H. (1968). The Cost of Transacting. *Quarterly Jounal of Economics*, 82, 33-53.

Ederington, L. and Lee, J. (1993). How Markets Process Information: News Releases and Volatility. *Journal of Finance*, 48, 1161-1191.

Ederington, L. and Lee, J. (199). The Short-Run Dynamic of the Price Adjustment to New Information. *Journal of Financial and Quantitative Analysis*, 30, 117-134.

Foster, F. and Viswanathan, S. (1993). Variations in Trading Volume, Return Volatility and Trading Costs: Evidence on Recent Price Formation Models. *Journal of Finance,* 48, 187-211.

Frino, A. and Hill, A. (2001). Intraday Futures Market Behaviour Around Major Scheduled Macroeconomic Announcement: Australian evidence. *Journal of Banking & Finance*, 25, 1319-1337.

George, J., Kaul, G. and Nimalendran, M. (1991). Estimation of The Bid–Ask Spread and Its Components: A New Approach. *Review of Financial Studies,* 4, 623–656.

Glosten, L.R. and Milgrom, P.R. (1985). Bid, Ask, and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders. *Journal of Financial Economics,* 14, 71-100.

Hansen, L. (1982). Large Sample Properties of Generalized Method of Moment Estimator. *Econometrica*, 50, 1029-1054.

Hasbrouck, J. (1988). Trades, Quotes, Inventories and Information. *Journal of Financial Economics*, 22, 229-252.

Ho, T. and Stoll, H. (1983). Optimal Dealer Pricing under Transactions and Return Uncertainty. *Journal of Financial Economics*, 9, 47-73.

Huang, R. D. and Stoll, H. R. (1997). The components of the bid–ask spread: A general approach. *Review of Financial Studies*, 10, 995–1034.

Jain, C. and Joh, H. (1988). The Dependence between Hourly Prices and Trading Volume. *Journal of Financial and Quantitative Analysis*, 23, 269-283.

Lee, C., Mucklow, B. and Ready, M. (1993). Spreads, Depths, and the Impact of Earnings Information: An Intraday Analysis. *The Review of Financial Studies*, 6, 345-374.

Leng, H. (1996). Announcement versus Nonannouncement: A Study of Intraday Transaction Price Paths of Deutsche Mark and Japanese Yen Futures. *Journal of Futures Markets*, 16, 829-857.

Mcinish, T. and Wood, R. (1992). An Analysis of Intraday Patterns in Bid/Ask Spreads for NYSE Stocks. *Journal of Finance*, 47,753-764.

Newey, W. and West, K. (1987). Hypothesis Testing with Efficient Method of Moments Estimation. *International Economic Review*, 28, 777-787.

Stoll, H. and Whaley, R. (1990). Stock market structure and volatility. *Review of Financial Studies*, 3, 37-71.

Stoll, R. (1989). Inferring the Components of The Bid–Ask spread: Theory and Empirical Tests. *Journal of Finance*, 44, 115–134.

Yüksel, A. (2002). The Performance of the Istanbul Stock Exchange During the Russian Crisis. *Emerging Markets Finance and Trade*, 38, 78-99.

Zou, L., Rose, L. and Pinfold, J. (forthcoming 2006). Intra-Night Trading Behaviour of the Australian Treasury-Bond Futures Overnight Options. *International Review of Financial Analysis*.

Appendix

Table 1 Descriptive Statistics for Relative Bid-Ask Spreads, Trading Volume and Volatility for 3-Year and 10-Year T-Bond Futures

Descriptive Statistics for the 3-Year and 10-Year T-Bond Futures are shown below. These include sample size, mean, standard deviation, skewness, kurtosis and the Jarque-Berra normality test.

Index	Sample Size	Mean	Standard Deviation	Skewness	Kurtosis	Normality Test [a]
Bid-Ask Spreads						
3-Year Futures	25755	0.0001	3.52E-05	5.2032	41.2612	25754**
10-Year Futures	28657	6.95E-05	3.86E-05	4.6661	27.2981	28654**
Trading Volume						
3-Year Futures	25755	1497.8120	3275.6982	10.5990	199.5720	25753**
10-Year Futures	28657	485.3723	1415.6699	14.5220	325.6100	26965**
Bid-Ask Midpoint						
3-Year Futures	25755	0.0124	2.4572	2.8886	8.2045	25412**
10-Year Futures	28657	0.0065	1.0464	3.2654	12.3125	28186**

[a] Jarque-Berra normality test.

* Significant at the 5% level.

** Significant at the 1% level.