Closing call auctions and liquidity

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Abstract
This paper examines the impact of closing call auctions on liquidity. It exploits the natural experiment offered by the introduction of a closing call auction on the Australian Stock Exchange on 10 February, 1997. The introduction of the closing call auction is associated with a reduction in trading volume at the close of continuous trading. However, bid ask spreads during continuous trading are largely unaffected by the introduction of the closing call auction. Therefore, closing call auctions consolidate liquidity at a single point in time without having any adverse effect on the cost of trading.

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1 INTRODUCTION

Previous literature examining the use of call auctions in equities markets suggest that this trading mechanism offers a number of benefits. First, by consolidating order flow at a single point in time, the accuracy of price discovery is enhanced. Further, all investors have the opportunity to trade at these "better discovered" prices (Schwartz, 2001). Second, Economides (1995) argues that the enhanced price discovery is due to the fact that there is an opportunity for order entry, amendment and withdrawal without execution, followed by a batch execution. As a result, volatility is reduced as order arrival time does not affect prices (Schwartz, 2001). Third, periodic call auctions overcome information asymmetry problems by providing all traders with access to the same prices (Madhavan, 1992). This mechanism is therefore attractive to uninformed investors, which gives rise to an increase in liquidity. Finally, transaction costs are expected to be lower due to the fact that there are no bid ask spreads present in call auctions and batching of orders should reduce market impact costs (Economides and Schwartz, 1995a).

Economides and Schwartz (1995a) advocate the use of call auctions to handle order imbalances at the beginning and end of each trading day. However, the empirical literature on call auctions has tended to focus on the use of this trading mechanism to open trading (see for example Amihud and Mendelson (1987, 1991), Amihud, Mendelson and Murgia (1990)). This is due to the fact that while the use of call auctions at the open have been common in equities markets for a long time, the use of call auctions at other times of the day is a relatively new phenomenon.

The potential benefits of call auctions outlined above, however, are particularly important at the end of the day due to the significance of the closing price. The closing price, which is the most commonly quoted price, is used for portfolio valuations and hence for evaluating fund

performance and is typically used for daily margining and the settlement of derivatives contracts at expiration. As a result there are obvious incentives for market participants to attempt to manipulate the closing price of a stock, particularly at the end of month and quarter.[1] Closing call auctions arguably reduce the possibility of manipulation by concentrating liquidity at this time.

On 10 February 1997, the Australian Stock Exchange (ASX) became one of the first equities markets in the world to use a call auction at the end of the trading day to set the closing price. There are a number of factors that motivated the introduction of a closing call auction at this time. First, growth in arbitrage and institutional trading activity, particularly passive funds, increased the demand for trading at the closing price.[2] The introduction of a closing call auction allowed the ASX to meet this demand. Second, there was an increase in participation by overseas investors who have a preference for trading at the close or at the volume weighted average price. Third, high levels of volatility in closing prices particularly on quarter end and derivative expiration days suggested the need for an alternative closing mechanism. These high levels of volatility were typically driven by relatively small orders. By consolidating liquidity at a single point in time, at the close, the possibility of high volatility driven by small orders is reduced. Finally, a high profile case of market manipulation on the expiry of the March 1996 index futures contract may also have been a contributing factor.[3]

This paper uses the natural experiment offered by the introduction of the closing call auction on the ASX to examine the impact of closing call auctions on market liquidity. In particular, it considers the impact on bid ask spreads and trading activity. This research is important for

[1] Carhart, Kaniel, Musto and Reed (2002) find evidence that fund managers 'mark up' stocks which they hold at the end of the quarter by aggressively trading these stocks.
[2] A study by Douglas and Thomas (2001) indicates that 47 percent of Australian institutional investors "regularly" or "frequently" instruct brokers to trade at the closing price.
[3] Trading by Nomura Securities during the last 40 minutes of 29 March 1996, resulted in a one percent decline in the value of the All Ordinaries Index. See Latimer (2000) for a detailed description of this case.

two main reasons. First, since 1997, many equities markets around the world have also adopted closing call auctions. Second, the closing call auction has become a critical component of trading on the ASX.

Since 1997, closing call auctions have become the "close of choice" for electronic equity markets around the world.[4] Despite this, there is a surprising lack of research examining their impact on trading activity. A notable exception to this lack of research is Pagano and Schwartz (2003) which examines the introduction of a closing call auction on price discovery on Euronext Paris. They find that the closing call auction "sharpened price discovery" with prices being more synchronous after the implementation of the closing call. This paper builds on the work of Pagano and Schwartz by analysing the impact of the introduction of the closing call auction on another key measure of market quality, namely liquidity.

At first glance, the closing call auction may appear to be relatively insignificant. During the period analysed only two and a half percent of daily volume was traded using this mechanism. However, this figure underestimates the importance of this trading mechanism to ASX participants. This is supported by a number of factors. First, the volume traded at the closing call auction has increased substantially since its introduction and currently represents approximately four percent of average daily volume in the S&P/ASX 200 stocks. Volumes on quarter end days are considerably higher at approximately 10 percent of daily volume. Second, recent ASX consultation with market participants, which considered changes in the closing mechanism revealed an overwhelming level of support for the continued operation of the closing call auction.[5]

[4] For example the Paris Bourse introduced a closing call auction for less liquid stocks in May 1996 and for liquid stocks in June 1998 and the Singapore Exchanges introduced both an opening and closing call auction in August 2000.

The remainder of the paper is structured as follows. Section 2 provides an overview of the institutional features of the ASX and describes the call auction implementation. Section 3 provides the theoretical framework and develops the hypotheses. Sections 4 and 5 describe the data and method used. Section 6 reports the results and section 7 concludes.

2 INSTITUTIONAL DETAIL

The Australian Stock Exchange operates using the *Stock Exchange Automated Trading System* (*SEATS*). *SEATS* is a competitive and transparent electronic order book. The trading mechanism used by ASX during the period considered in this paper is described in detail in Comerton-Forde (1999).[6]

In November 1996, the ASX resolved to conduct a series of trials of different market mechanisms as adjuncts to *SEATS*. The first of these trials involved the introduction of a single price call auction market with current *SEATS* order disclosure rules. This auction was to operate for a short period after the end of the continuous SEATS trading day, with the aim of concentrating liquidity at this time (ASX Circular to Member Organisations 278/97, 10 July 1997).[7]

On 10 February, 1997 the ASX implemented the first trial. At 16:00 the market re-enters *pre-open* mode. During the *pre-open*, orders may be entered, amended and withdrawn but not executed. At 16:15 there is a call auction at which time all overlapping orders are executed.

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[5] See ASX (2001a) for a discussion of the proposed changes and ASX (2001b) for a discussion of the outcome of the consultation.

[6] Since this time the ASX has made two changes to the opening algorithm. The first which occurred on 9 June 1998 saw the adoption of a single price algorithm. The opening price was calculated as a volume weighted average price of the last two orders in the bid ask schedule which are executed before the market ceases to overlap. The second change took place on 18 March 2002. The current algorithm is based on four principles which aim to maximise the volume traded at the auction and minimise the surplus. These changes provide an opportunity for further research to understand the impact of the design of the auction algorithm.

[7] A second trial involved a basic matching facility (called ASX Match) as an adjunct to SEATS, to operate as an undisclosed fixed price matching market at one or more times during the day. There is no price discovery in this facility as the price is set to the normal market closing price. This trial began on 11 August 1997 but was quickly abandoned.

These orders are executed using a single volume weighted average price algorithm.[8] On May 5, 1997 the call auction was moved to 16:10 and then on 7 July, 1997 it was moved to 16:05.[9] The change in the call times occurred as part of the trial and was a precursor to the introduction of ASX Match which was due to run in the 16:15 time slot.

Unlike the closing call auction used at Euronext Paris, examined by Pagano and Schwartz (2003), the ASX does not display indicative prices or volumes. While the full order book is displayed by ASX throughout the *pre-open*, the existence of undisclosed orders makes it difficult for market participants to estimate the auction price and volume. While this creates greater uncertainty about the probability of execution at the closing call auction, this was done to reduce the possibility of parties second guessing the value of undisclosed orders. [10]

3 THEORETICAL CONSIDERATIONS

The primary role of a call auction is to consolidate liquidity at a given point in time. This has a number of benefits for market participants. First, by batching orders at the call auction, the trade price will reflect the view of many market participants, rather than just two (Madhavan, 1992). This is thought to reduce adverse selection costs with the direct consequence that the probability of trading with an informed trader is reduced. The call may also result in a reduction in the market impact costs associated with large trades (Economides and Schwartz, 1995b). However, this assumes that there is sufficient volume traded at the call. Second, if the order book is open prior to the call, it facilitates price discovery. Finally, the use of a call auction at the end of the day is attractive to traders that want to trade at the closing price, such as passive index funds and arbitrageurs.

[8] Details of this algorithm are provided in Appendix A of Comerton-Forde (1999).
[9] On 18 January 1999 the timing of the call became random, taking place anytime between 16:05 and 16:06. The motivation for this change was to further limit the ability to manipulate the closing price. This change is not examined in this paper as the opening procedure also changed on 9 June 1998 making it difficult to isolate the impact of each of these changes.
[10] It is noteworthy that the ASX introduced this feature to their market on 18 March 2002. This provides an opportunity to examine the impact of transparency on auction behaviour.

The introduction of the closing call auction provides investors with an opportunity to choose between two alternative trading mechanisms: a continuous auction or a call auction. Research by Steil (2001) suggests informed traders with value relevant information and investors wishing to trade with certainty will trade in the continuous market rather than delay their trading to the call. In contrast, call auctions are particularly attractive to passive fund managers; limit order traders and liquidity traders whose demand for cash is not immediate. These traders are likely to delay their trading to the call auction in order to reduce their trading costs, reduce the risk of adverse selection and ensure that their orders are transacted at the closing price. Further, Admati and Pfleiderer (1988) suggest that discretionary liquidity traders will pool their trades in order to protect themselves against informed traders. Therefore, the concentration of liquidity at the call may encourage these investors to trade at this time.

The introduction of a closing call auction may affect liquidity in one of three ways. First, it may bring new investors or new order flow into the market at the time of the auction. If new liquidity comes into the market, total trading volume will increase. This increase in trading activity will also give rise to a reduction in bid ask spreads across the trading day. Second, the introduction of the closing call auction may not create any new trading activity but simply cause existing traders to delay their trading until the closing call auction. Under this scenario, there is no increase in trading activity, but rather a redistribution of trading from one time period to another. The decline in trading activity in these periods will also give rise to increases in bid ask spreads. Third, in the worst case, the redistribution of trading between the two different trading mechanisms may also give rise to an overall decrease in volume.

In a survey of Australian institutional investors, Douglas and Thomas (2001), found that institutional investors were prepared to sacrifice immediacy in order to reduce transactions costs and obtain better prices. They report that 44 percent of traders would delay their trading by up to one hour if it reduced transaction costs by half a percent. This percentage rose to 70 percent if savings of one percent could be obtained. However, the number of institutional investors willing to delay their trading in order to reduce transactions costs fell substantially if they were required to wait three hours or more before executing these trades. Only 37 (51) percent of investors were prepared to wait three hours in order to reduce transaction costs by half a (one) percent. These results are instructive for identifying the likely impact of the introduction of the closing call auction on institutional trading behaviour. The results suggest that institutional traders may delay their trading in order to execute trades at the closing call auction; however, they will not delay trades indefinitely. It is anticipated that only those trades which would otherwise have been executed during the last one to two hours of trading will be delayed to the closing call auction.

Hence there are three alternate hypotheses to explain the impact of the introduction of a closing call auction on liquidity. First, the introduction of a closing call auction may result in new liquidity coming into the market. Second, the introduction of a closing call auction may result in a redistribution of existing liquidity away from continuous trading at the end of the day toward the closing call auction. Third, it introduction of the closing call auction may reduce liquidity. It is possible to discriminate between these three possible effects by examining changes in intraday patterns in volume and bid ask spreads on the ASX.

4 DATA

The data used in this study is taken from the *SEATS* databases maintained by the *Securities Industry Research Centre of Asia-Pacific* (*SIRCA*). The *SEATS* database provides complete

details of all order and trade records placed on the ASX. These records provide details of price, volume, date, time and broker for every order and trade.

A period six months before and after the introduction of the closing call auction is used in the analysis. This covers the period 9 August 1996 to 10 August 1997.[11] The period prior to the introduction of the call on 10 February 1997 is referred to as the *pre period* and the subsequent period is referred to as the *post period*.

The sample includes the top 200 stocks (by turnover) included in the All Ordinaries Index. These stocks are selected as they are actively traded and frequently use the closing call auction. These stocks represent in excess of 90 percent of total turnover on the ASX during the sample period. Stocks outside this sample trade infrequently and seldom use the closing call auction making any meaningful analysis of these stocks difficult.

The sample is partitioned into three groups, based on total turnover, in order to examine whether the impact of the introduction of the closing call differs across stocks with different levels of liquidity.[12] Table 1 presents descriptive statistics of market capitalisation, trading activity and the use of the closing call auction in the each group during the pre and post periods. This illustrates that there is considerable variation in the liquidity across the groups. Stocks in group one are on average 10 times larger and have turnover 25 times higher than stocks in group three. Table 1 also illustrates that the market capitalisation and trading activity increased for all groups from the pre to post period. This suggests that there is a need to control for this general increase in trading activity when analysing the impact of the

[11] Limiting the analysis to six months after the introduction of the closing call auction ensures that other changes made to the market structure such as the introduction of ASX Match on 11 August 1997 and the change in the auction algorithm on 9 June 1998 do not influence the results. An analysis of the impact of these changes is left to future research.

[12] The sample is also partitioned into three groups based on stock volatility; however, the results are consistent across all groups and therefore are not reported.

introduction of the closing call auction.[13] It also noteworthy that usage of the closing call auction varies significantly across the groups. There is trading at the closing call auction on approximately 80 percent of days in group one, 44 percent in group two and only 25 percent of days in group three.

5 METHOD

The paper examines the impact of the introduction of the closing call auction on trading volume and bid ask spreads. Trading volume is examined to determine the impact of the call on the decision to trade and the timing of trades. Bid ask spreads are examined as they capture an important element of the cost of trading immediately (Amihud and Mendelson, 1986). It is possible to discriminate between the three alternative hypotheses outlined in section 3 by examining the intraday patterns in volume and bid ask spreads on the ASX.

Previous research by Stoll and Whaley (1990) suggests that end of day trading is unusual on options and futures expiry days. For this reason these days are excluded from the main analysis and are considered separately.

5.1 Trading volume

The impact of the closing call auction on trading volume is considered by examining the changes in intraday patterns in trading volume during the pre and post periods.[14] The trading day is divided into 14 intervals: the opening call auction, the closing call auction and 12 half-hour intervals between 10:00 and 16:00.

To control for differences in trading activity across stocks and across time, trading activity is measured using the volume traded in each of the 14 intervals on a given day *t*, divided by the

[13] An analysis of monthly trading activity statistics indicates that there is no systematic variation in trading activity across months and therefore it is not necessary to control for seasonality in trading activity.

total trading volume (including call volume) on day *t*. This measure is referred to as relative volume.

If the introduction of the closing call auction creates new liquidity, the percentage of daily volume traded in each of the other intervals during continuous trading is expected to decline proportionately across the day. That is, the intraday pattern in relative volume will not change. This is best illustrated through an example. Assume that average daily volume in the pre-period is 100,000 shares. This is distributed across the period of continuous trading in a typical U-shaped pattern[15]. Also assume that the closing call auction created new volume of 2,500 shares. As a result, the relative volume traded in each interval across the day would decline insignificantly from $\frac{volume_i}{100,000}$ to $\frac{volume_i}{102,500}$.

In contrast, if the closing call auction has not created new volume, but merely redistributed it, the decline in trading activity is expected to be concentrated toward the end of the day. As a result, a change in the intraday pattern in volume is anticipated. Relative volume at the end of the trading day would exhibit a significant decline as this volume is shifted to the call auction.

5.2 Bid ask spreads

Time weighted relative bid ask spreads are examined for each half-hour during the trading day. In order to control for potential changes in spreads from the pre to the post period which are unrelated to the introduction of the closing call auction, the measure is standardised by examining the change in the relative spread from one half-hour interval to the next. For example, if the relative spread between 10:00 and 10:30 is 0.5 and the relative spread between 10:30 and 11:00 is 0.4, then the change in the relative spread from the first to the second half

[14] Sensitivity tests are conducted using trading value rather than volume with no significant difference in the results.

hour interval is 0.1. If the closing call auction has resulted in investors postponing their trading until the closing call auction then spreads may be expected to increase toward the end of the day.

6 RESULTS

6.1 Trading volume

Table 2 documents the change in intra-day trading behaviour following the introduction of the closing call auction. Options and futures expiration days are excluded from this analysis. These results illustrate that on average approximately two and a half percent of daily activity is executed at the closing call auction for the most liquid group of stocks. The relative volume traded at the closing call auction increases as stock liquidity decreases. For the most liquid group of stocks, the closing auction appears to be more popular than the opening auction which only attracts approximately 1.6 percent of daily activity. However, the volumes traded at the opening auction are significantly higher in the less liquid groups of stocks.

The results also indicate a statistically significant decline in relative trading volume during the last hour of trading across all groups of stocks. The decline in relative volume during the last hour is largest in the most liquid group of stocks, representing approximately 2.16 percent of daily activity. This declines to only 1.07 percent for the least liquid group of stocks. No other intervals exhibit statistically significant changes in relative trading volume.

These results suggest that the availability of a closing call auction encourages investors to delay trades that they would otherwise have executed during the last hour, to the closing call auction. That is, the introduction of the call has shifted trading volume to later in the day,

[15] A large number of empirical papers have documented U-shaped patterns in trading volume. See for example

rather than created new volume. Consistent with Douglas and Thomas (2001), the results suggest that investors will not delay their trading indefinitely. However, investors are prepared to delay their trading for up to one hour in order to obtain the benefits offered by trading at the closing call auction.

Option expiry and quarter end days are also examined separately. Option expiry days exhibit consistent results with other trading days. However, the percentage of activity executed at the closing call auction on quarter end days is significantly higher on these days, rising to between five and eight percent of daily activity. This is likely to be driven by arbitrage traders that wish to close out their positions at the futures contract settlement price[16] and passive index fund managers trying to execute at the closing price.

It is also noteworthy that there is no significant shift in relative volume from the last hour of trading on these days. Rather, there is a small but statistically insignificant reduction in the relative volume in most intervals across the day. This result is consistent with the notion that the volume traded at the closing call auction on these days is new liquidity which would not have been present in the absence of the auction. However, these results only capture two quarter end days in the pre and post periods. Further analysis over a longer time period is required to confirm this result.

6.2 Regression analysis

The univariate results presented in section 6.1 and the extant literature suggest that there are a number of factors that may influence the volume traded in a closing call auction. These factors include options and futures expiry, day of the week, trading volume and volatility. For

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Chan, Christie and Schultz (1995) and Brockman and Chung (1998).

[16] It is noteworthy that the SFE moved the settlement price of its Share Price Index (SPI 200™) Futures Contract from the close to the open on 31 December 2001. After this time arbitrage traders no longer have an incentive to trade at the closing price.

this reason regression analysis is undertaken to examine the combined influence of these factors.

First, the impact of options and futures expiry is examined. Stoll and Whaley (1990) suggest that end of day activity is unusual on these days. Arbitrage traders will typically seek to unwind their positions at the close of trading on these days. Trading at the closing auction is particularly attractive for these traders as the settlement of the contracts occurs at the closing price. Therefore it is anticipated that there will be a large increase in the percentage of trading at the closing call auction on these days. During the sample period, the expiry of futures contracts on the Sydney Futures Exchange (SFE) occurred on the last trading day of the quarter. This trading day is also expected to attract a large volume of business from fund managers, particularly index funds because portfolio returns and net asset values are computed using closing prices (Cushing and Madhavan, 2000). Therefore, these investors will also seek to obtain the closing price. This will also contribute to the increase in activity at the closing call auction on these days.

Second, the well documented day of the week and time of day effects are considered. Brock and Kleidon (1992) argue that volume increases at the end of the trading day are due to the fact that the cost of holding stock increases during the overnight non-trading period. Therefore, some traders close out their positions prior to the end of the day. The introduction of the closing call auction is expected to facilitate this trading as it gives traders another opportunity to execute their trades. The extended non-trading period over the weekend is argued to result in greater activity at the end of the day on Friday. For the same reason, a higher level of participation is expected at the closing call auction on Fridays.

Douglas and Thomas (2001) provide evidence to suggest that institutional traders are prepared to delay execution in order to obtain better prices. However, they are not prepared to delay execution indefinitely. The univariate results suggest that there is a shift in liquidity from the last hour of trading to the closing call auction. Therefore the relationship between the percentage of daily business executed in the closing call auction and each hour of the trading day is examined. It is anticipated that there will be a negative relationship between the activity at the closing call auction and the last hour or two of trading. Trading earlier in the day is expected to be unaffected.

Fourth, the relationship between the volume of trading activity during the trading day and the percentage executed at the closing call auction is analysed. Given that the volume traded at the closing call increases as stock liquidity decreases, a negative relationship is anticipated between daily trading volume and the percentage traded at the closing call auction.

Finally, the decision to delay trading until the closing call auction will also be influenced by the level of volatility. Theory suggests that call auctions improve price discovery and reduce volatility (Madhavan, 1992). If volatility is high, investors may be more willing to delay their trading to take advantage of the multi-lateral execution offered by the call. Therefore the influence of daily volatility on call auction volume is examined. Daily volatility is proxied by the log of the highest best ask price and the lowest best bid price over the trading day.[17]

To examine the relationship between these variables and the percentage of daily trading volume executed at the closing call auction the following regression is estimated:

[17] Sensitivity tests to this choice of measure were conducted by calculating volatility as the log of the high and low trading price for the interval with no significant difference in results.

$$Closingcall_{i,t} = \alpha + \beta_1 Qtrend_t + \beta_2 Optexp_t + \beta_3 Monday_t + \beta_4 Tuesday_t + \beta_5 Thursday_t + \beta_6 Friday_t + \beta_7 Hour6_{i,t} + \beta_8 Hour5_{i,t} + \beta_9 Hour4_{i,t} + \beta_{10} Dailyvol_{i,t} + \beta_{11} Volatility_{i,t} \quad (1)$$

where *Closingcall* is the volume traded at the closing call auction in stock *i* on a given day *t* as a percentage of the total volume traded in stock *i* on day *t*, *Qtrend* is a dummy variable which takes a value of 1 on quarter end days and 0 on other days, *Optexp* is a dummy variable which takes a value of 1 on option expiry days and 0 on other days, *Monday* is a dummy variable which is 1 on Mondays and 0 on other days, *Tuesday* is a dummy variable which is 1 on Tuesdays and 0 on other days, *Thursday* is a dummy variable which is 1 on Thursdays and 0 on other days, *Friday* is a dummy variable which is 1 on Fridays and 0 on other days, *Hour6, Hour5 and Hour4* are the volume traded between 15:00 and 16:00; 14:00 and 15:00; and 13:00 and 14:00 in stock *i* on day *t* as a percentage of the total volume traded in stock *i* on day *t*, *Dailyvol* is the volume of shares traded in stock *i* on day *t*, *Volatility* is the log of the highest best ask price and the lowest best bid price in stock *i* over trading day *t*.[18]

Table 3 provides the results of the regression analysis. The results are generally consistent across the three groups of stocks. There is a significant increase in the percentage of daily activity traded at the closing call auction on quarter end days. This is likely to be due to the demand for achieving execution at the closing price from arbitrage traders and passive index fund managers. In contrast, option expiry days do not have an impact on the activity at the closing call auction.

There is a significant increase in activity at the closing call on Friday for group one and group two stocks. No other days of the week exert any influence on the activity at the closing call.

[18] Additional variables for the percentage of activity traded during the remainder of the trading day are also included, however, these variables are statistically insignificant and do not add to the explanatory power of the model. Therefore this analysis is not presented.

Consistent with the univariate results, there is a significant negative relationship between the percentage traded during the last hour of the day and the closing call auction. After controlling for other factors, there is also a significant negative relationship between trading at the closing call auction and the second last hour of the trading day. No other time of the day intervals exhibit a relationship with the closing call auction. This result suggests that traders are only prepared to delay their trading for up to two hours to obtain the benefits of the closing call auction.

Table 3 also illustrates that there is a small but statistically significant negative relationship between the daily trading volume and the percentage traded at the call. This result indicates that increases in daily activity lead to a reduction in the percentage traded at the closing call auction. Surprisingly, no relationship is found between volatility and the level of activity at the closing call auction.

The F-statistics indicate that the model is statistically significant for the three groups of stocks. The adjusted R^2 values are relatively small and suggest that there are other factors influencing the volume traded at the closing call auction. An analysis of the Variance Inflation Factors indicates that there are no multicollinearity problems associated with the model.

6.3 Bid ask spreads

Given that trading volume has shifted from the end of continuous trading to the closing call auction, it is important to understand the impact this has had on intra-day bid ask spreads. It is possible that by shifting trading activity to the call, the cost of trading during normal trading hours increases, particularly in the last half-hour period which experiences the greatest decrease in trading volume. For this reason intra-day changes in time-weighted relative bid

ask spreads during the pre and post periods are examined. Over the sample period, average relative spreads declined across the day for the three groups of stocks. Group one exhibited a decline in average relative spreads from 0.51 percent during the pre period to 0.46 percent in the post period. Group two (three) also experienced reductions in spreads from 0.96 (1.81) percent to 0.91 (1.73) percent. Therefore, to control for factors affecting the spread other than the closing call auction the change in the relative spread from one interval to the next is considered, rather than examining the absolute values.

The results presented in Table 4 document the average change in relative spreads in each half hour interval during the pre and post periods for the three groups of stocks. Differences in the change in spread, from the pre to the post period, for each half hour interval are examined. Only the most liquid stocks exhibit any statistically significant changes in spreads. These stocks display a statistically significant increase in the change in the relative bid ask spread of 0.01 percent during the last half-hour of trading. While this change is statistically significant, economically it represents a very small increase in trading costs.[19]

The results for groups two and three indicate that there is no difference in the change in spreads from the pre to the post period. This suggests that the consolidation of liquidity at the closing call auction in these stocks has not had any adverse effect on the cost of trading during the continuous trading period. This difference in the results between group one and groups two and three is likely to be due to the differences in the magnitude of the shift in volume to the closing call auction.

[19] Pagano and Schwartz (2003) present descriptive statistics showing a decrease in percentage spreads during the last hour of trading for illiquid stocks and no change for liquid stocks following the introduction of a closing call auction. The authors suggest that spreads decline as investors become more willing to trade patiently, placing limit orders rather than market orders, when the call auction exists as a "back-up." However, the measure of spreads used by the authors is not standardised to control for changes in spreads not attributable to the introduction of the closing call auction. This problem is overcome by using a standardised spread measure which examines the change in spreads from one interval to the next.

7 CONCLUSIONS

The introduction of a closing call auction on the ASX provides an opportunity to assess the impact of closing call auctions on market behaviour. The issue is important due to the growing number of exchanges that have implemented call auctions to open and close trading.

The paper documents that on average approximately two and a half to three percent of daily trading volume on the ASX is executed at the closing call auction. However, this is not new liquidity; it is merely a redistribution of activity away from the end of the normal trading day. This is illustrated by a statistically significant decrease in the percentage of daily volume traded in the last hour following the introduction of the closing call auction.

The closing call auction is particularly important on quarter end days. The average level of activity rises to between five percent and eight percent. This increase in activity is likely to be the result of increased activity by arbitrage traders and passive index fund managers trying to achieve the closing price. The level of activity at the closing call auction is higher on Fridays and on low volume days.

The results also indicate that the introduction of the closing call auction had no economically significant impact on bid ask spreads at the end of the trading day. This suggests that the closing call auction provides a mechanism for consolidating liquidity and allowing investors to achieve the closing price without any adverse influence on the cost of trading during the continuous trading period. This change is particularly valuable for passive institutional investors wanting to achieve the closing price. The call auction also provides small investors with an opportunity to trade with multiple investors rather than just one, therefore reducing adverse selection risk.

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Table 1. Descriptive Statistics

Table 1 presents descriptive statistics for the sample stocks in the pre and the post period. Panel A provides the results for the pre-period which extends from 9 August 1996 to 9 February 1997. Panel B presents the results for the post period which includes 10 February 1997 to 10 August 1997. Market capitalisation is measured using the average market capitalisation on the first and last day of the sample period for each sample stock. Daily volume (value) is the average volume (value) of shares traded on a daily basis through the sample period. Daily frequency is the average number of trades on a daily basis through the sample period. In the post period the number of days with trades at the call is also presented. Group one comprises the 50 most actively traded stocks, Group two is made up of the 50 next most actively traded stocks and Group 3 represents the least active 100 stocks in the sample.

	Number of Stocks	Market Capitalisation (000s)	Daily Volume	Daily Value	Daily Frequency	Days with Trades at the Call
Panel A: Pre Period						
Group 1	50	3,977,114	1,270,199	6,313,369	162	-
Group 2	50	940,904	314,110	1,108,042	39	-
Group 3	100	354,851	94,766	250,980	15	-
Panel B: Post Period						
Group 1	50	4,583,462	1,432,042	7,786,140	199	80%
Group 2	50	1,048,971	330,131	1,365,564	48	44%
Group 3	100	618,260	105,330	299,800	18	25%

Table 2. Intra-day patterns in trading volume excluding derivative expiration days

Table 2 documents the intra-day patterns in trading volume before and after the introduction of the closing call auction for the top 200 stocks by turnover. The pre period extends from 9 August 1996 to 9 February 1997 and the post period includes 10 February 1997 to 10 August 1997. Option and futures expiration days are excluded. The trading day is divided into 14 intervals: the opening auction, the closing auction and 12 half-hour intervals between 10:00 and 16:00. Trading volume is measured as the volume traded in each interval on a give day *t*, divided by the total volume traded on day *t*. All intervals between 11:00 and 14:00 are statistically insignificant and therefore are not reported. Panel A presents the results for the 50 most actively traded stocks, Panel B for the next 50 most actively traded stocks and Panel C the least active 100 stocks in the sample. A t-statistic is calculated for the difference in means between the pre and post periods for each group of stocks in each half hour interval.

Time of Day	Pre Period	Post Period	Difference	t-statistic
Panel A: Group 1 (Most Liquid)				
Open	1.72%	1.60%	-0.11%	-1.67
10:00-10:30	11.39%	11.23%	-0.16%	-0.91
10:30-11:00	9.23%	9.03%	-0.19%	-1.22
…				
14:00-14:30	7.30%	7.54%	0.23%	1.76
14:30-15:00	9.79%	10.07%	0.28%	1.67
15:00-15:30	11.81%	11.30%	-0.51%	-2.76**
15:30-16:00	18.91%	17.26%	-1.65%	-7.09**
Close	0.00%	2.49%	2.49%	
Panel B: Group 2				
Open	2.72%	2.57%	-0.16%	-1.26
10:00-10:30	10.54%	10.32%	-0.23%	-0.85
10:30-11:00	9.05%	8.88%	-0.18%	-0.71
…				
14:00-14:30	6.84%	7.11%	0.27%	1.31
14:30-15:00	9.04%	9.50%	0.47%	1.81
15:00-15:30	11.53%	10.80%	-0.73%	-2.59**
15:30-16:00	17.97%	16.65%	-1.32%	-3.78**
Close	0.00%	2.71%	2.71%	
Panel C: Group 3 (Least Liquid)				
Open	3.64%	3.57%	-0.07%	-0.53
10:00-10:30	11.17%	10.72%	-0.45%	-1.78
10:30-11:00	9.37%	9.19%	-0.17%	-0.74
…				
14:00-14:30	6.64%	6.79%	0.14%	0.74
14:30-15:00	8.68%	9.06%	0.38%	1.66
15:00-15:30	10.27%	10.05%	-0.22%	-0.87
15:30-16:00	16.20%	15.35%	-0.85%	-2.77**
Close	0.00%	2.82%	2.82%	

* Significant at the 0.05 level
** Significant at the 0.01 level

Table 3. Regression Analysis

Table 3 reports the results for the following regression:

$$Closingcall_{i,t} = \alpha + \beta_1 Qtrend_t + \beta_2 Optexp_t + \beta_3 Monday_t + \beta_4 Tuesday_t + \beta_5 Thursday_t + \beta_6 Friday_t + \beta_7 Hour6_{i,t} + \beta_8 Hour5_{i,t} + \beta_9 Hour4_{i,t} + \beta_{10} Dailyvol_{i,t} + \beta_{11} Volatility_{i,t}$$

where *Closingcall* is the volume traded at the closing call auction in stock *i* on a given day *t* as a percentage of the total volume traded in stock *i* on day *t*, *Qtrend* is a dummy variable which takes a value of 1 on quarter end days and 0 on other days, *Optexp* is a dummy variable which takes a value of 1 on option expiry days and 0 on other days, *Monday* is a dummy variable which is 1 on Mondays and 0 on other days, *Tuesday* is a dummy variable which is 1 on Tuesdays and 0 on other days, *Thursday* is a dummy variable which is 1 on Thursdays and 0 on other days, *Friday* is a dummy variable which is 1 on Fridays and 0 on other days, *Hour6, Hour5 and Hour4* are the volume traded between 15:00 and 16:00; 14:00 and 15:00; and 13:00 and 14:00 in stock *i* on day *t* as a percentage of the total volume traded in stock *i* on day *t*, *Dailyvol* is the volume of shares traded in stock *i* on day *t*, *Volatility* is the log of the highest best ask price and the lowest best bid price in stock *i* over trading day *t*. Group one comprises the 50 most actively traded stocks, Group two is made up of the 50 next most actively traded stocks and Group 3 represents the least active 100 stocks in the sample.

	Group 1 (most liquid)		**Group 2**		**Group 3 (least liquid)**	
Variable	**Estimate**	**t-statistic**	**Estimate**	**t-statistic**	**Estimate**	**t-statistic**
Intercept	0.0340	17.72**	0.0290	14.04**	0.0188	14.42**
Quarter End Dummy	0.0298	5.54**	0.0471	6.19**	0.0369	6.85**
Option Expiry Dummy	-0.0009	-0.33	0.0046	1.27	0.0010	0.38
Monday Dummy	0.0009	0.59	0.0026	1.23	-0.0006	-0.38
Tuesday Dummy	0.0021	1.46	0.0039	1.96	0.0012	0.84
Thursday Dummy	0.0023	1.47	0.0040	1.85	0.0024	1.56
Friday Dummy	0.0032	2.15*	0.0047	2.29*	0.0006	0.4
15:00 - 16:00	-0.0210	-5.99**	-0.0231	-7.27**	-0.0128	-6.99**
14:00 - 15:00	-0.0267	-5.81**	-0.0235	-5.9**	-0.0135	-5.98**
13:00 - 14:00	-0.0132	-1.23	-0.0021	-0.25	0.0055	1.38
Daily Volume	-8.9E-10	-2.42*	-4.7E-9	-2.6**	1.3E-9	0.47
Daily Volatility	0.0003	0.17	-0.0048	-0.42	-0.0319	-1.21
Adjusted R2/F-statistic	0.0140	8.84	0.0184	11.26	0.0108	12.47

* Significant at the 0.05 level

** Significant at the 0.01 level

Table 4. Intra-day changes in relative bid ask spreads

Table 4 documents the intra-day patterns in changes in relative bid ask spreads before and after the introduction of the closing call auction for the top 200 stocks by turnover. The pre period extends from 9 August 1996 to 9 February 1997 and the post period includes 10 February 1997 to 10 August 1997. Quarter end days are excluded. The trading day is divided into 12 half-hour intervals between 10:00 and 16:00. The change in the relative bid ask spread is calculated from one half-hour to the next. All intervals between 12:00 and 14:00 are statistically insignificant and therefore are not reported. Panel A presents the results for the 50 most actively traded stocks, Panel B for the next 50 most actively traded stocks and Panel C the least active 100 stocks in the sample. A t-statistic is calculated for the difference in means between the pre and post periods for each group of stocks in each half hour interval.

Time of Day	Pre Period	Post Period	Difference	t-statistic
Panel A: Group 1 (Most Liquid)				
10:30-11:00	-0.077	-0.086	-0.009	-1.57
11:00-11:30	-0.015	-0.015	0.000	-0.02
11:30-12:00	0.026	0.027	0.001	0.16
…				
14:00-14:30	0.062	0.061	0.000	-0.06
14:30-15:00	0.034	0.037	0.003	0.51
15:00-15:30	0.036	0.037	0.000	0.08
15:30-16:00	0.046	0.057	0.012	1.99*
Panel B: Group 2				
10:30-11:00	-0.019	-0.028	-0.009	-1.52
11:00-11:30	0.023	0.009	-0.014	-1.59
11:30-12:00	0.046	0.043	-0.003	-0.38
…				
14:00-14:30	0.083	0.074	-0.009	-0.88
14:30-15:00	0.062	0.068	0.006	0.65
15:00-15:30	0.075	0.085	0.011	0.76
15:30-16:00	0.125	0.113	-0.012	-1.07
Panel C: Group 3 (Least Liquid)				
10:30-11:00	0.014	0.001	-0.013	-1.59
11:00-11:30	0.041	0.048	0.008	0.71
11:30-12:00	0.052	0.051	-0.002	-0.22
…				
14:00-14:30	0.050	0.064	0.014	1.74
14:30-15:00	0.077	0.072	-0.005	-0.43
15:00-15:30	0.082	0.094	0.012	1.44
15:30-16:00	0.121	0.117	-0.004	-0.51

* Significant at the 0.05 level
** Significant at the 0.01 level