Market Quality around Macroeconomic News Announcements: Evidence from the Australian Stock Markets

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This Version: November 2017

Abstract

In November 2011, an alternative trading venue, Chi-X, entered the Australian stock market and has since succeeded in capturing trading volume and market share from the ASX. In this study, I investigate market quality in the ASX and Chi-X during macroeconomic news announcements. I measure market quality in terms of liquidity, volatility, and price efficiency. Using the fifty largest Australian stocks, I document that on days with macroeconomic news announcements, market quality is generally higher in the ASX than in Chi-X. Trading activity is higher while trading cost is lower. Information shocks have larger immediate impact but lower persistence in the ASX compared to Chi-X. The pattern of intraday serial dependence in returns also reveals that that order imbalances in the ASX have smaller impact than in Chi-X, implying that the former offers greater price efficiency.

JEL Classification: C32, G15.

Keywords: Market Microstructure; Market Quality; Macroeconomic News Announcements

1. Introduction

Market quality refers to various aspects of financial markets such as liquidity, volatility and price efficiency. With the arrival of alternative trading venues, market quality becomes especially relevant because it validates the competitiveness of a market over others. Once a security starts trading on multiple venues, exchanges compete to provide better service and attract more investment and business opportunities. One particular example of this competition is the case of the Australian financial market. The Australian Stock Exchange (ASX) had a monopoly on listing and trading all Australian equities and other financial securities until up October 2011, when an alternative trading venue, Chi-X, entered the market. Chi-X has since posed strong competition and succeeded in capturing trading volume and market share from the ASX.[1]

To assess market quality, we can examine how factors such as liquidity, volatility and price efficiency react to the arrival of new information. Macroeconomic news announcements offer an ideal setting because these news releases provide information that investors use to fine-tune their investment and risk management strategies. Indeed, studies have shown that macroeconomic news announcements result in revisions of security prices (e.g., Bernanke and Kuttner, 2005; Boyd et al., 2005), volatility (Andersen et al., 2007; Nowak et al., 2011), and market liquidity (Balduzzi et al., 2001; Love and Payne, 2008). How macroeconomic news releases affects the quality of a newly-fragmented market, however, remains largely unexplored. This gap in the literature leaves several questions open to debate, especially

[1] There are currently two primary exchange venues in Australia: The ASX and Chi-X. Up until 2011, the ASX was the only exchange for the listing, trading and settlement of Australian equities and other financial securities. On 31 October 2011, Chi-X entered the market by trading originally several highly liquid stocks and exchange-traded funds (ETFs). The remaining ASX200 (top 200 listed stocks on ASX) constituents and ASX listed ETFs began trading on Chi-X on November 9th 2011. By May 3rd 2013, Chi-X's trading spectrum encompassed the full universe of ASX-listed securities. In the early period after its inception, Chi-X accounted for roughly 5% of the dollar volume traded in ASX listed equities (He et al., 2015). By 2016 the trading on Chi-X had grown to around 11% (Gismatullin et al., 2016).

following the entrance of Chi-X and the competition it poses to the ASX as the incumbent exchange. For instance, does Chi-X offer better liquidity during news announcements? Is volatility lower in Chi-X? Does Chi-X offer more efficient price compared to the ASX? Comparing the reactions of the ASX and Chi-X to macroeconomic news announcements sheds some light to the above questions. Thus, in view of the increasing competition in the Australian financial markets, the extent to which both exchanges respond to macroeconomic news is of considerable importance and relevance to market participants and regulators alike.

This paper focuses on the changes in market quality at the time of macroeconomic news releases. I assess market quality from three viewpoints. First, I look at market liquidity in terms of trading activity and costs (e.g., Tse and Erenburg, 2003; Jiang et al., 2011). The degree to which volumes, trades and bid-ask spreads react to the arrival of new information reflects the liquidity of a market. Second, I examine market quality based on the sensitivity and persistence of volatility (Kavajecz and Odders-White, 2001; Tse and Zabotina, 2004). Better market quality will alleviate temporary price fluctuations, allowing traders to reach consensus more rapidly and reducing the persistence of volatility. Finally, I consider the efficiency of prices by analyzing the speed of convergence to market efficiency (e.g., Chordia et al., 2005, 2008; Boehmer et al., 2015). For both the ASX and Chi-X, I examine how the above market quality measures differ between days with and without macroeconomic news announcements.

Using a sample of fifty largest companies in the ASX200 index from November 2011 to August 2016, I document several important findings. First, despite the competition from Chi-X, the ASX still offer better liquidity overall, as shown by increased trading activity and narrower spread relative to Chi-X during days with news announcements. Second, information shocks tend to have a large immediate impact and the persistence level in variance is lower in the ASX relative to Chi-X. Third, the pattern of intraday return dependence reveals that order imbalances in Chi-X has greater impact than order imbalances in the ASX, indicating that efficiency is lower in the former compared to the latter.

To assess the robustness of the results, I conduct two types of analysis. First, I assess the impact of news surprises on market quality. The idea is to confirm the findings even when macroeconomic news announcements convey substantial unexpected information to investors and the market. Second, I evaluate cross-sectional differences in the sample based on their exposure to the stock market. This is to assess whether reactions to news announcements differ across companies, particularly if their business operations have more exposure to the domestic economy. The results are robust to different degrees of news surprises and stock market exposure.

This study is related to the literature on the quality of the Australian financial market. There have been several studies on market quality following the entrance of Chi-X and the competition it brings to the incumbent exchange. Comerton-Forde (2012) examines the impact of market fragmentation on the attractiveness of the markets for high-frequency traders. She finds that the launch of Chi-X provided trading opportunities for those traders albeit to a more limited extent than the fragmentation in the U.S. markets. He et al. (2015) assess the growth in market share for Chi-X in various international markets, including Australia. They find that this growth is related to Chi-X's ability to attract market participants and the ability to offer the best prices. Aitken et al. (2017) assess the impact of fragmentation on market quality and find significant reductions in spreads and increases in depth. The current paper complements the above studies by comparing market quality of the two exchanges during macroeconomic news announcements, hence providing a more complete analysis of the quality of the Australian financial markets.

This study also relates to the literature on the importance of macroeconomic news releases for the Australian financial market. Studies such as Kim and Sheen (2000), Kim and Nguyen (2008) and Smales (2012) suggest that Australian macroeconomic news including the Reserve Bank of Australia (RBA) interest rate, trade balance, GDP and unemployment rate news have impacts on stock markets. This paper therefore extend their studies by examining whether these macroeconomic news affect liquidity, volatility and price efficiency of the ASX and Chi-X.

The remainder of this paper proceeds as follows. Section 2 discusses the different measures of market quality. Section 3 presents the data sources. Section 4 discusses the empirical findings. Section 5 reports the robustness tests. Section 6 concludes.

2. Market quality measures

I assess market quality in terms of liquidity, volatility sensitivity and persistence, and return dependence. This section discusses the measures and the steps taken to estimate each of the models.

2.1. Competition for liquidity

One of the most important functions of a market is providing liquidity, which reflects the degree to which assets can be traded in the market, and thus the competitiveness of a market. With the release of macroeconomic news, investors may choose to trade on the information in one or another market, leading to a temporal shift in trading activity between markets. To capture this change, I first assess trading activity in the market. In particular, I measure the proportion of trading that occurs in the ASX relative to Chi-X as follow:

$$Relative\_volume = \frac{Volume^{ASX}}{Volume^{ASX} + Volume^{CHI}} \quad (1)$$

$$Relative\_trade = \frac{Trade^{ASX}}{Trade^{ASX} + Trade^{Chi}}. \quad (2)$$

I measure $Relative\_volume$ and $Relative\_trade$ for each stock and day separately, and compare the mean of these measures across all stocks during days with macroeconomic news announcements and days with no announcements. Changes in these measures indicate competition for order flow between the two exchanges.

I also examine the proportion of trades that occur during this period by grouping trades into three trade size (T) bins:

1. $T \leq 1{,}000$ (small trades)
2. $1{,}000 < T \leq 10{,}000$ (medium trades)
3. $T > 10{,}000$ (large trades).

For both the ASX and Chi-X, I calculate the number of trades that falls into each trade group. I then calculate the proportion of these transactions in the ASX relative to Chi-X, e.g. $(Tsmall^{ASX})/(Tsmall^{ASX} + Tsmall^{CHI})$. The idea of this classification is to explore which trade group contributes to changes in trading activity during macroeconomic news announcements periods.

I further assess market liquidity in terms of quoted bid-ask spreads. Studies such as Mayhew (2002) and Tse and Erenburg (2003) show that securities listed on multiple exchanges have narrower spreads than securities listed on a single exchange, suggesting that competition drives down spreads and trading costs. Following this argument, I measure percentage quoted spreads which is the difference between ask and bid prices, divided by the midquote. The percentage spread for each stock each day is computed and compared between announcement and non-announcement days.

2.2. Volatility sensitivity and persistence

The second assessment of market quality focuses on volatility in returns during announcement days. Macroeconomic news announcements often result in price changes. Better market quality will alleviate temporary price fluctuations leading to more efficient prices, allowing traders to reach consensus more rapidly and reducing the persistence of volatility.

Introduced by Engle (1982) and Bollerslev (1986), the autoregressive conditional heteroscedasticity (ARCH) and generalized ARCH (GARCH) models are often used to describe time-variation in volatility of financial returns. The extent to which current variance is impacted by lagged innovations to the return series and lagged variance in a GARCH model is described as the asset's sensitivity and persistence levels, respectively. Following Kavajecz and Odders-White (2001), I compare sensitivity and persistence levels in variance to draw conclusions regarding the flow of information and how quickly it is incorporated into prices.

I adopt the commonly used GARCH(1,1) model, which has the desirable features of interpretability and good fit for high-frequency data. The following equations are jointly estimated the using maximum likelihood:

$$r_t = a + br_{t-1} + \varepsilon_t, \tag{3}$$

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2, \tag{4}$$

where r_t represents the return series, σ_t^2 is the conditional variance, and ε_t is a normally distributed disturbance with a variance conditional to information set I at time $t-1$, such that $\varepsilon_t \mid I_{t-1} \sim N(0, \sigma_t^2)$. I model the return series as a first-order autoregressive process to account for the autocorrelation in returns. Rearranging Equation (4), Campbell et.al. (1997) obtain:

$$\sigma_t^2 = \omega + (\alpha + \beta)\sigma_{t-1}^2 + \alpha(\varepsilon_{t-1}^2 - \sigma_{t-1}^2). \tag{5}$$

In Equation (5), α measures the sensitivity of the variance to the most recent shock, indicating the overall flow of information shocks into the market. In this case, a high (low) sensitivity of the variance suggests that information shocks tend to have a large (small) immediate impact. $(\alpha + \beta)$ measures the persistence of information shocks in the variance, indicating how quickly information is incorporated into prices. A high persistence of the variance suggests that information is incorporated into prices gradually over time while a low persistence level in the variance suggests that information is quickly impounded into prices.

2.3. Return dependence and order imbalance

As final assessment of market quality, I examine how long it takes the market to remove return dependence during days with macroeconomic news announcements. This assessment is based on the observation that many investors still follow technical trading strategies that appear to generate little revenue and considerable cost. For instance, Chordia et al. (2002) find persistence in order imbalances on the NYSE and that market-order imbalances (the net value of purchases and sales) in the S&P 500 index are highly predictable from day to day. A day with high imbalance on the buy side is more likely to be followed by several additional days of aggregate buy-side imbalances, while the same applies for the sell side. This implies that investors continue buying or selling for quite a long time, either because they are herding or because they are splitting large orders across days, or both. Chordia et al. (2005) assess this serial dependence at the intraday level. Specifically, they examine how long within the day pressure from order imbalances continues to move prices. The intuition is that returns are not independent from trade to trade for some finite time period because it must take some time for investors to figure out whether there is new information regarding stocks' fundamental values. Their finding suggests that it takes more than five minutes but less than sixty minutes for sophisticated investors to react with countervailing trades and remove serial dependence in returns.

I define a market with higher quality as the one that takes less time to remove return dependence. I follow the approach of Chordia et al. (2005) and estimate regression models to explain stock returns. Specifically, I compute short-horizon returns from prices closest to the end of various time intervals within the trading day. For example, five-minute returns are computed for each stock by comparing the transaction closest to 10:05 am and 10:10 am. I consider intervals between one and sixty minutes to measure the timing of efficiency creation as precisely as possible. Order imbalances are computed over all trades within each time interval. The serial and univariate regression models are as follows:

$$r_j = X_{j-1} + \epsilon_j, \tag{6}$$

where r_j is midquote return at time interval j, ϵ_j is the error-term, and X_{j-1} is either the lagged midquote return or lagged-order imbalances. I consider two types of order imbalances: $OIBT$ (buyer-initiated less seller-initiated trades) and $OIBDV$ (buyer-initiated dollar volume less seller-initiated dollar volume) during the same interval. As the regressions involve lagged values, the first interval of each trading day is discarded.

The assessment of return dependence is categorized as follows. For the first test, I assess market efficiency based on the lagged return coefficients. In particular, if the coefficients are statistically significant, it suggests that the market is not weak-form efficient because the past history of returns is able to predict future returns. For the second and third test, I consider the coefficients for lagged trade order imbalance and dollar volume order imbalance, respectively. If these coefficients are significant predictors of future returns for short intervals, it implies the market is not strong-form efficient over very short periods. The test is for strong-form market efficiency because only market makers and agents on the exchange have immediate access to order imbalances (Chordia et al., 2005).

3. Data and summary statistics

3.1. Intraday stock price data

The sample comprises the fifty largest Australian companies in the ASX200 index for the period November 9, 2011 to August 31, 2016. As of November 2011, these companies represent about 80.3% of the market capitalization of the ASX200. The start of the sample marks Chi-X's entry to the market. Normal trading hours in the ASX are from 10:00am to 4:00pm while in Chi-X, it is from 10:00am to 4:12pm. I focus on the overlapping session from

10:05am to 4:00pm.[2] Data are collected from the Thomson Reuters Tick History (TRTH) database maintained by Securities Industry Research Centre of Asia-Pacific. I obtain transaction-level data from TRTH. The data is time-stamped to the nearest millisecond and contains all recorded transaction prices, quotes and trading volumes which are used to construct the various market quality measures.

Observation from the intraday data shows a number of anomalous records that appeared to be recording errors. I follow Chordia et al. (2001) and remove outliers using the following filters: (1) Quoted Spread > \$5, (2) Effective Spread/Quoted Spread > 4.0, (3) Quoted Spread/Transaction Price > 0.4.[3] I observe that some trades are executed at different prices but using the same time stamp. In such cases, I treat them as one trade. I assign the appropriate price of the trade using the value-weighted average and aggregate the volume from multiple trades, attributing it to the first trade, and then remove the other trades from the sample.

Table 1 contains summary statistics for the fifty companies in the sample. I report the market capitalization, average trade price, average daily number of trade, average daily trading volume, average percentage quoted spread and the average daily realized volatility for each stock in the ASX and Chi-X.[4] The sample covers a broad set of companies with market capitalization ranging from \$3 billion for Treasury Wine Estates Ltd. (TWE) to \$139 billion for the Commonwealth Bank of Australia (CBA). Share prices range between \$1.7 for the

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[2] The first five minutes of the trading day is omitted since sometimes trading in one of the markets starts later than 10:00AM. This helps avoid contamination of prices by overnight news arrival.

[3] Quoted spread is defined as the difference between the ask and bid prices, while effective spread is defined as two times the absolute difference between the transaction price and the quote midpoint.

[4] Realized volatility is measured as the square root of sum squared returns on day d, using data at one-minute intervals: $RV_d = \sqrt{\sum_{j=1}^{J} r_j^2}$.

Mirvac Group Stapled (MGR) and $71.6 for CBA. Daily number of trades is higher in the ASX, with an average of 3,214 trades, than in Chi-X, with an average of 1,039 trades. Similarly, trading volume is higher in the ASX than in Chi-X, with 3,836,000 and 833,000 stocks traded daily in the two exchanges, respectively. The average daily quoted spread in the ASX is 14.30 bps and in Chi-X is 14.91 bps, suggesting that cost of trading, on average, is lower in the ASX than in Chi-X. Daily realized volatility is comparable across the two exchanges.

INSERT TABLE 1 HERE

3.2. Macroeconomic announcements

I collect the dates and times for the Australian Macroeconomic news announcements from Bloomberg. In total, there are nine macroeconomic news announcements considered, in line with studies in the Australian market (see e.g., Kim and Sheen, 2000; Kim and Nguyen, 2008). Table 2 provides a list of the announcement releases, including the number of observations, the time and frequency of the release. GDP, Current Account Balance, CPI and House Price Index are announced quarterly, while Trade Balance, Unemployment Rate, Retail Sales and Private Sector Credit are announced monthly. In addition, there are eleven RBA Cash Rate target releases per year. In total, there are 1,217 trading days in the sample; 294 days with and 923 days without macroeconomic news announcements.

INSERT TABLE 2 HERE

4. Empirical results

In this section, I discuss the empirical results. The models are estimated daily on announcement and non-announcement days, and the difference between the two is then reported. This assessment is based on the central idea that investors learn more about the state of the economy on announcement days than on other days (Savor and Wilson, 2013). Reported results are the average across all the stocks in the sample.

Table 3 reports the changes in trading activity in the ASX relative to total activity in both the ASX and Chi-X. Panel A reports the changes in relative volume during news announcement days. On average, relative volume increases by 0.58%, suggesting that the proportion of trading volume in the ASX increases on days with macroeconomic news announcements. Six out of nine announcements report positive and significant coefficients, implying that the changes are not exclusive to one particular announcement. Similarly, Panel B shows that the proportion of trades in the ASX increases by 0.29%, with five out of nine announcements report positive and significant coefficients. These results suggest that the ASX attracts more order flow during days with macroeconomic news.

INSERT TABLE 3 HERE

In Panel C, trades are classified into three different size groups. The majority of increase trade increase in the ASX comes from the small-size group of less than 1,000 shares. The medium-size group (between 1,000 and 10,000 shares) shows positive coefficient, albeit insignificant. Large trades, on the other hand, do not appear to significantly change. These findings indicate that the ASX attracts smaller traders during announcement days while the medium and large traders remain relatively unchanged.

Table 4 reports the changes in percentage quoted spread. Panels A and B show spread change in the ASX and Chi-X, respectively, and Panel C reports the difference-in-difference between the two exchanges. I observe that there are indeed some differences in market quality between the ASX and Chi-X on non-announcement days. For instance, the quoted spread in Chi-X is about 0.64 bps larger than in the ASX on non-announcement days. This is consistent with the statistics reported in Table 1. On announcement days, spreads in the ASX increases by 0.050 bps, whereas in Chi-X, spreads increase more significantly by 0.170 bps. The difference between the two markets is -0.120 bps and statistically significant at the 1% level. Except for one announcement (CPI), the increase in spread in Chi-X outweigh the increase in spread in the ASX. These results suggest that the ASX offers better liquidity in terms of lower trading costs on the day with announcements.[5]

INSERT TABLE 4 HERE

Table 5 reports the results on the change in volatility sensitivity. Panels A and B report the result for the ASX and Chi-X, respectively, and Panel C reports the difference-in-difference between the two exchanges. I observe that volatility sensitivity in the ASX and Chi-X are virtually identical on non-announcement days (small differences are not visible due to rounding). Volatility sensitivity increases in both exchanges on announcement days. On average, it increases by 4.33% in the ASX and by 2.02% in Chi-X, leading to a significant difference of 2.30%. In the ASX, the changes are positive and significant for seven out of nine announcements, whereas in Chi-X, four out of nine announcements report positive and significant coefficients. As suggested by Ross (1989), volatility is directly related to

[5] I also assess the change in effective spread, measured as two times the absolute value of the difference between the trade price and the midpoint, i.e. $Espread_t = 2 * |p_t - m_t|/m_t$. The results are similar where spread increases higher in Chi-X than in the ASX.

information flow. Thus, I interpret the increase in volatility sensitivity as a sign that information shocks have larger immediate impact in the ASX than in Chi-X, i.e. trades are more informative.

INSERT TABLE 5 HERE

The results on the change in volatility persistence is reported in Table 6. While volatility persistence is comparable between both exchanges on non-announcement days, it increases on days with news releases. On announcement days, volatility persistence increases by 0.25% in the ASX and 0.85% in Chi-X, with the difference between the two being 0.60% and significant at the 1% level. Volatility persistence increases in four out of nine announcements in the ASX, but in seven out of nine announcements in Chi-X. These results indicate that information is incorporated into prices more gradually in Chi-X compared to the ASX. Overall, Tables 5 and 6 suggest that the ASX offers better quality in terms of incorporating information shocks into prices while at the same time reducing the time it takes for volatility to dissipate.

INSERT TABLE 6 HERE

Finally, Table 7 reports the coefficients of serial regressions for returns and univariate regressions of returns on lagged-order imbalances. Turning first to returns, there is negative and significant serial dependence in returns over short intervals (one to five minutes) both in the ASX and Chi-X. Midquote deviations from fundamental values may result due to prices being less that fully informationally efficient. Once prices reflect all public and private information, returns no longer display autocorrelation, or if private information were revealed instantaneously rather than gradually, returns would also have zero autocorrelation. Higher coefficients for Chi-X, in this case, suggests that informational inefficiency is greater, i.e. lagged returns have more predictive power. It takes the ASX more than five minutes to attain price efficiency, but more than 10 minutes in Chi-X.

INSERT TABLE 7 HERE

The subsequent columns in each panel show that lagged-order imbalances are also significant predictors of future returns over short intervals. However, the order imbalances' predictive ability declines as the return interval lengthens. The coefficients for trade order imbalances are positive and highly significant in both markets at the 3-min interval or less. For the volume order imbalance, the coefficients are positive and highly significant only at one-minute interval. These findings suggest that both markets are not strong-form efficient over very short periods because order imbalances can predict returns.[6] I also observe that the magnitude of the regression coefficients for order imbalances (both for trade and volume order imbalances) are higher in Chi-X than in the ASX, across all time intervals. The difference in point estimates between the two exchanges indicates the difference in market quality. Particularly, the ASX offers better quality because order imbalances have less predictive power than they are in Chi-X.

5. Robustness Tests

As robustness tests, I conduct two types of analyses. First, I assess the impact of news surprises on market quality. Second, I evaluate cross-sectional differences in the sample based on their exposure to the local stock market.

[6] Note that only market makers and agents on the exchange have immediate access to order imbalances.

5.1. Impact of news surprises on market quality

I perform analyses based on the degree of news surprises. The purpose is to confirm that the full sample results hold even when macroeconomic news announcements convey substantial unexpected information to investors and the market. Specifically, for each macroeconomic news announcement, I group announcement days based on their absolute news surprises defined as follows:

$$\left|S_{i,t}\right| = \left|\frac{A_{i,t}-E_{i,t}}{\sigma_i}\right|, \tag{7}$$

where $A_{i,t}$ and $E_{i,t}$ are the actual and expected value of news announcement *i*, respectively, and σ_i is the standard deviation of $A_{i,t} - E_{i,t}$ over the sample period. These actuals and expected figures are collected from Bloomberg for the sample period November 2011 to August 2016. Days with absolute surprises higher than the median are grouped as 'high-news surprise days', while days with absolute surprises lower than the median are considered 'low-news surprise days'.

The results for market liquidity in presented in Table 8. Panels A, B and C report the changes in relative trading activity. Consistent with the previous findings, both volumes and trades in the ASX increases on news days regardless the degree of news surprises. The proportion of small trades also increase in the ASX relative to Chi-X. Changes in trading activity is larger on days with larger news surprises, suggesting that increased trading activity in the ASX is greater on days with unexpected news content. Panel D shows that spread increases more in Chi-X than in the ASX. Changes in spread is larger during days with high news surprises, indicating that market reaction is stronger when news content is unexpected.

INSERT TABLE 8 HERE

Table 9 reports the results for volatility sensitivity and persistence. Panel A shows that volatility sensitivity increases in either market during days with announcements, but the increase is larger during days with high news surprises. Similarly, the increase in volatility persistence is also greater for days with high surprises, suggesting that on such days, information takes longer time to get fully incorporated into prices. This evidence suggests that reactions during high-news surprise days are stronger than during low-news surprise day, particularly when it comes to market liquidity and volatility.

INSERT TABLE 9 HERE

The results for the return dependence are reported in Table 10. The findings are consistent with those documented in Table 7. For instance, lagged returns are informative at short intervals between one and five minutes. Trade (volume) order imbalances are informative at the 2-min (1-min) intervals or less. However, there is no notable difference between days with low or high surprises.

INSERT TABLE 10 HERE

5.2. Variation across companies

I further examine whether reactions to news announcements differ across companies, particularly if their business operations have more exposure to the economy. To assess this, I measure stock exposures to the local stock market using CAPM betas. Specifically, I regress excess stock returns on the Australian market (ASX200) risk premium over the sample period

November 2011 to August 2016. The risk-free rate used is the Reserve Bank of Australia 3-month bank bill and estimation is done using monthly stock return data obtained from Datastream. Based on the beta estimates, I form two equal-sized groups: low- and high-beta stocks and re-do the analyses for these two groups. The average beta for the low- and high-beta stocks are 0.64 and 1.20, respectively.

In Table 11, I report the results for the changes in liquidity. Trading activity increases in the ASX relative to Chi-X, as shown by the increase in trading volume and number of trades. I do not find that high-beta stocks to be more responsive to macroeconomic news. For the quoted spread (Panel D), I observe that the while trading costs increase less in the ASX, this increase is stronger for the low-beta stocks.

INSERT TABLE 11 HERE

Table 12 presents the differences in volatility sensitivity and persistence for the low and high-beta stocks. Panel A shows that, on average, volatility sensitivity increases more in the ASX than in Chi-X, leading to a significant difference of 5.33% between the two exchanges. This finding suggests that prices for high beta stocks respond more strongly to news. In terms of volatility persistence (Panel B), it increases more in Chi-X than in the ASX, particularly for the low-beta stocks, indicating that this group of stocks incorporate information more gradually compared to stocks with greater market exposure (high beta).

INSERT TABLE 12 HERE

Table 13 reports the results for the return dependence. As previously documented, the magnitude of the regression coefficients for order imbalances are higher in Chi-X than in the ASX, both for the low- and high-beta stocks. However, if we compare the point estimates between the two markets, the difference is greater for the high-beta stocks, suggesting that the difference in market quality is more apparent for stocks with greater market exposure. The pattern of market efficiency is consistent with the findings thus far. Particularly, it takes the market more than three minutes to incorporate information coming from trades, and two minutes or more for information coming from volume.

INSERT TABLE 13 HERE

6. Conclusion

In this study, I compare the quality of the ASX and Chi-X around macroeconomic news announcements. Using a sample of the fifty largest stocks in Australia over the period November 2011 to August 2016, I assess market quality in terms of liquidity, the sensitivity and persistence of volatility, and the speed of convergence to market efficiency.

The analyses yield several key findings in terms of comparing the quality of the two exchanges. First, I observe that Trading activity is higher while trading cost is lower in the ASX than in Chi-X, suggesting that the ASX offers better liquidity at the time of announcements. Second, analyses based on the sensitivity and persistence of volatility indicate that information shocks have larger immediate impact but lower persistence in the ASX compared to Chi-X. Third, the pattern of intraday serial dependence in returns also reveals that that order imbalances in the ASX have smaller impact than order imbalances in Chi-X, implying that the former offers greater price efficiency. All these evidence point toward higher quality overall in the ASX than in Chi-X.

These findings contribute to the literature on market quality in Australia. Existing studies document that spreads have reduced and depths have increased following the arrival of Chi-X (see e.g. Comerton-Forde, 2012, Aitken et al., 2017). This study adds another dimension to the literature by documenting market quality during public news arrival, hence providing a more complete analysis on the quality of the Australian financial markets.

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Table 1. Summary Statistics

This table provides a summary statistics of the 50 stocks in the sample for the period November 9, 2011 through August 31, 2016. It reports the company name, symbol, market capitalization (as of November 9, 2011) and average share price. It also reports the average daily number of trades, the average daily trading volume, the average daily quoted spread and the average daily realized volatility (square root of sum squared returns) in the ASX and Chi-X.

No	Company Name	Symbol	Market Cap	Price	Trade		Volume ('000)		Spread(bps)		Realized Volatility	
			(AUD mil)	(AUD)	ASX	CHI	ASX	CHI	ASX	CHI	ASX	CHI
1	AGL Energy Limited	AGL	9,183	16.7	2,651	977	1,240	277	8.54	10.09	1.04%	1.11%
2	Amcor Limited	AMC	16,411	11.0	2,824	1,027	2,683	546	11.49	11.44	1.16%	1.15%
3	AMP Limited	AMP	16,475	5.2	2,176	856	6,224	1,388	21.37	21.69	1.29%	1.29%
4	Australia and New Zealand Banking Group Limited	ANZ	88,681	28.2	6,294	2,070	4,613	756	4.66	4.87	0.93%	0.96%
5	APA Group Stapled	APA	7,602	6.9	1,634	675	1,730	411	17.37	18.31	1.25%	1.20%
6	ASX Limited	ASX	7,155	36.8	2,913	622	423	46	5.00	6.07	0.95%	0.95%
7	Aurizon Holdings Limited	AZJ	9,941	4.4	1,778	879	5,366	1,819	24.60	23.47	1.32%	1.35%
8	BHP Billiton Limited	BHP	94,681	31.0	7,311	2,242	6,115	869	4.55	4.72	0.95%	1.11%
9	Brambles Limited	BXB	16,836	9.4	2,584	924	3,057	578	12.82	13.48	1.21%	1.19%
10	Commonwealth Bank of Australia	CBA	139,352	71.6	7,815	1,950	2,295	233	2.59	3.09	0.81%	0.85%
11	Coca-Cola Amatil Limited	CCL	7,017	11.0	2,362	750	1,697	355	11.30	12.01	1.05%	1.08%
12	Computershare Limited	CPU	6,608	10.4	2,073	654	1,373	229	12.30	13.50	1.28%	1.28%
13	CSL Limited	CSL	41,640	71.5	6,126	1,266	884	89	3.28	4.68	0.99%	1.08%
14	Caltex Australia Limited	CTX	9,531	24.4	3,165	837	705	105	7.68	9.55	1.41%	1.38%
15	Crown Resorts Limited	CWN	9,163	12.5	2,360	729	1,333	236	10.66	12.71	1.24%	1.25%
16	Dexus Property Group Stapled	DXS	6,466	7.8	1,941	992	770	601	14.67	14.40	1.23%	1.30%
17	Fortescue Metals Group Limited	FMG	8,781	3.8	2,870	1,195	16,588	3,297	29.56	29.96	2.36%	2.48%
18	Goodman Group Stapled	GMG	10,141	5.4	1,771	792	4,920	823	21.43	22.20	1.39%	1.36%
19	GPT Group Stapled	GPT	7,483	4.0	1,723	742	4,058	1,001	26.87	27.42	1.21%	1.22%
20	Insurance Australia Group Limited	IAG	14,893	5.2	2,096	880	5,423	1,278	21.66	22.09	1.31%	1.30%
21	Incitec Pivot Limited	IPL	5,463	3.2	1,735	744	5,569	1,338	34.28	34.62	1.75%	1.78%
22	James Hardie Industries PLC	JHX	5,890	12.8	2,186	661	1,159	187	12.13	13.43	1.51%	1.47%
23	Lendlease Group Stapled	LLC	9,581	11.7	2,182	731	1,542	252	11.85	12.74	1.31%	1.28%
24	Mirvac Group Stapled	MGR	6,766	1.7	1,575	672	9,246	2,264	34.44	35.18	1.45%	1.46%
25	Macquarie Group Limited	MQG	18,948	53.4	5,288	1,025	1,024	90	4.16	6.04	1.11%	1.15%
26	National Australia Bank Limited	NAB	81,315	30.0	6,023	1,867	4,362	639	4.53	4.84	0.94%	0.98%
27	Newcrest Mining Limited	NCM	8,777	17.2	4,464	1,216	3,280	432	9.09	10.66	1.60%	1.73%
28	Origin Energy Limited	ORG	13,055	11.4	2,872	954	3,313	593	12.43	12.98	1.48%	1.48%
29	Orica Limited	ORI	7,168	20.7	3,186	772	1,278	152	7.71	9.09	1.35%	1.36%
30	Oil Search Limited 10T	OSH	12,182	7.6	2,443	868	3,912	883	15.69	16.48	1.49%	1.47%

Table 1. Summary Statistics (continued)

No	Company Name	Symbol	Market Cap (AUD mil)	Price (AUD)	Trade ASX	Trade CHI	Volume ('000) ASX	Volume ('000) CHI	Spread(bps) ASX	Spread(bps) CHI	Realized Volatility ASX	Realized Volatility CHI
31	Qantas Airways Limited	QAN	5,491	2.1	1,616	741	8,860	2,196	36.72	37.02	1.86%	1.92%
32	QBE Insurance Group Limited	QBE	15,356	12.7	3,639	1,274	4,038	742	10.00	10.14	1.33%	1.37%
33	REA Group Limited	REA	5,985	45.6	2,299	733	196	38	12.03	9.32	1.74%	1.61%
34	RIO Tinto Limited	RIO	25,483	57.3	7,067	1,377	1,968	160	3.36	4.67	1.00%	1.13%
35	Resmed Inc.	RMD	9,922	5.7	1,299	503	3,199	771	21.79	23.29	0.98%	0.95%
36	Scentre Group Stapled	SCG	19,008	4.0	2,135	1,114	4,177	3,158	26.96	27.06	1.37%	1.46%
37	Seek Limited	SEK	6,006	12.4	2,209	641	1,099	138	11.94	14.41	1.47%	1.41%
38	Stockland Stapled	SGP	9,794	3.9	1,899	776	6,496	1,470	27.35	28.19	1.31%	1.34%
39	Sonic Healthcare Limited	SHL	7,506	16.5	2,719	865	988	161	8.84	9.30	1.19%	1.17%
40	Santos Limited	STO	8,114	10.5	3,134	1,051	4,480	961	13.78	15.17	1.59%	1.62%
41	Suncorp Group Limited	SUN	18,154	11.9	2,924	972	2,985	524	10.16	10.85	1.09%	1.09%
42	Sydney Airport Forus	SYD	10,704	4.5	1,652	752	4,075	1,112	25.81	26.20	1.19%	1.16%
43	Transurban Group Stapled	TCL	16,662	8.0	1,993	907	3,314	747	14.88	14.80	1.01%	1.02%
44	Telstra Corporation Limited	TLS	73,109	5.0	3,726	1,483	24,443	4,543	21.21	21.41	0.93%	0.94%
45	Treasury Wine Estates Limited	TWE	3,080	5.6	1,763	699	2,700	613	22.27	22.47	1.52%	1.53%
46	Westpac Banking Corporation	WBC	103,465	29.9	6,239	2,255	4,817	743	4.60	4.63	0.95%	0.99%
47	Wesfarmers Limited	WES	47,052	39.3	5,291	1,307	1,721	185	4.17	4.92	0.93%	0.95%
48	Westfield Corporation Stapled	WFD	19,326	9.4	2,694	1,298	1,777	1,037	12.79	13.18	1.19%	1.26%
49	Woolworths Limited	WOW	38,197	29.6	4,717	1,332	2,371	341	5.07	5.70	0.94%	0.96%
50	Woodside Petroleum Limited	WPL	31,581	34.7	5,250	1,309	1,908	222	4.62	5.92	1.10%	1.16%
	Mean				3,214	1,039	3,836	833	14.30	14.91	1.26%	1.28%

Table 2. Australian Macroeconomic News Releases

This table provides a summary of the macroeconomic news announcements considered in the study for the period November 9, 2011 to August 31, 2016. The table shows the total number of releases (Obs.), the agency source, the time of release in Australian Eastern Standard Time (AEST), and the frequency of releases. ABS stands for the Australian Bureau of Statistics, and RBA stands for the Reserve Bank of Australia. Total announcement days is adjusted for overlapping days.

No	*Announcement*	*Obs*	*Agency*	*Time*	*Frequency*
1	GDP	19	ABS	11:30	Quarterly
2	Current Account Balance	19	ABS	11:30	Quarterly
3	CPI	19	ABS	11:30	Quarterly
4	House Price Index	18	ABS	11:30	Quarterly
5	Trade Balance	57	ABS	11:30	Monthly
6	Unemployment Rate	58	ABS	11:30	Monthly
7	Retail Sales	57	ABS	11:30	Monthly
8	Private Sector Credit	58	RBA	11:30	Monthly
9	RBA Cash Rate Target	52	RBA	14:30	11 per year
	Total Announcement Days	294			
	Total Non-Announcement Days	923			
	Total Sample Days	1217			

Table 3. Trading activity during announcement days

This table reports the changes in trading activity in the ASX relative to Chi-X during announcement days, e.g. $Relative\_volume_{A}^{ASX} - Relative\_volume_{NA}^{ASX}$. Panel A shows the changes in proportion of volume, Panel B shows the changes in proportion of trades and Panel C shows the changes in transactions by size (shares). Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: Relative Volume		Panel B: Relative Trade		Panel C: Transaction by Size (shares)					
					≤ 1,000 (%)		1,000 - 10,000 (%)		≥ 10,000 (%)	
	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat
All Announcements	0.58%***	(5.52)	0.29%***	(3.58)	0.25%**	(2.10)	0.10%	(1.41)	-0.22%	(-1.52)
GDP	1.11%***	(3.67)	0.37%**	(2.40)	0.29%	(1.52)	0.48%**	(2.28)	0.12%	(0.21)
Current Account Balance	0.51%	(1.59)	-0.09%	(-0.56)	-0.30%*	(-1.72)	0.38%**	(2.46)	-0.68%	(-0.88)
CPI	0.44%	(1.27)	0.45%**	(2.06)	0.42%*	(1.69)	0.00%	(-0.01)	0.11%	(0.24)
House Price Index	0.63%**	(2.29)	0.36%	(1.64)	0.55%**	(2.19)	-0.15%	(-0.70)	-0.49%	(-0.81)
Trade Balance	0.17%	(1.01)	0.04%	(0.39)	-0.05%	(-0.46)	-0.06%	(-0.73)	-0.67%*	(-1.82)
Unemployment Rate	0.79%***	(4.41)	0.51%***	(4.93)	0.43%***	(3.35)	0.02%	(0.22)	-0.59%	(-1.62)
Retail Sales	0.34%*	(1.94)	0.11%	(0.99)	0.02%	(0.16)	-0.04%	(-0.41)	-0.35%	(-1.32)
Private Sector Credit	0.93%***	(6.29)	0.17%*	(1.87)	0.02%	(0.22)	0.09%	(0.92)	0.59%*	(1.80)
RBA Cash Rate Target	0.29%*	(1.85)	0.64%***	(6.62)	0.85%***	(7.78)	0.18%*	(1.78)	-0.05%	(-0.21)

Table 4. Quoted spread during announcement days

This table provides the change in relative spread (in bps) for 50 stocks in the sample during announcement days. The figures reported are the difference (in basis points) between quoted spread during announcement and non-announcement days ($Spread_A - Spread_{NA}$). Panel A reports the ASX response and Panel B for Chi-X response. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX				Panel B: Chi-X				Panel C: ASX less Chi-X	
Quoted spread	NA	A	Diff	t-stat	NA	A	Diff	t-stat	Diff-in-diff	t-stat
All Announcements	14.24	14.33	0.050**	(2.12)	14.88	15.06	0.170***	(3.74)	-0.120***	(-2.78)
GDP	14.24	14.25	-0.017	(-0.33)	14.88	15.13	0.202	(1.57)	-0.219*	(-1.90)
Current Account Balance	14.24	14.38	0.124***	(2.82)	14.88	15.16	0.298***	(3.02)	-0.174*	(-1.95)
CPI	14.24	14.27	-0.034	(-0.79)	14.88	14.77	-0.079	(-1.12)	0.045	(0.65)
House Price Index	14.24	14.27	-0.054	(-0.80)	14.88	15.04	0.088	(0.87)	-0.141	(-1.14)
Trade Balance	14.24	14.32	0.006	(0.21)	14.88	15.02	0.162***	(2.65)	-0.156***	(-2.61)
Unemployment Rate	14.24	14.49	0.220***	(6.32)	14.88	15.19	0.314***	(4.29)	-0.093	(-1.53)
Retail Sales	14.24	14.33	0.057*	(1.88)	14.88	15.13	0.255***	(3.15)	-0.198**	(-2.46)
Private Sector Credit	14.24	14.36	0.096***	(3.57)	14.88	15.05	0.176***	(4.14)	-0.080*	(-1.77)
RBA Cash Rate Target	14.24	14.30	0.046	(1.62)	14.88	15.03	0.113**	(2.09)	-0.067	(-1.24)

Table 5. Volatility sensitivity during announcement days

This table provides the change in volatility sensitivity for 50 stocks in the sample during announcement days. The figures reported are the percentage difference between sensitivity during announcement and non-announcement days $(\alpha_A - \alpha_{NA})/\alpha_{NA}$. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX				Panel B: Chi-X				Panel C: ASX less Chi-X	
Volatility sensitivity	NA	A	Diff	t-stat	NA	A	Diff	t-stat	Diff-in-diff	t-stat
All Announcements	0.085	0.089	4.33%***	(4.23)	0.085	0.087	2.02%**	(2.50)	2.30%*	(1.80)
GDP	0.085	0.087	2.02%	(1.38)	0.085	0.089	4.27%*	(1.81)	-2.25%	(-0.83)
Current Account Balance	0.085	0.091	5.43%**	(2.22)	0.085	0.090	5.47%**	(2.22)	-0.05%	(-0.01)
CPI	0.085	0.085	-0.25%	(-0.21)	0.085	0.086	-0.05%	(-0.02)	-0.20%	(-0.06)
House Price Index	0.085	0.090	5.43%***	(3.95)	0.085	0.089	3.61%	(1.36)	1.82%	(0.68)
Trade Balance	0.085	0.089	3.35%**	(2.19)	0.085	0.084	-1.96%	(-1.28)	5.31%**	(2.12)
Unemployment Rate	0.085	0.091	6.62%***	(3.24)	0.085	0.085	0.01%	(0.00)	6.61%***	(2.67)
Retail Sales	0.085	0.089	4.02%***	(2.95)	0.085	0.085	-0.82%	(-0.53)	4.84%**	(2.22)
Private Sector Credit	0.085	0.093	8.39%***	(3.02)	0.085	0.090	4.85%***	(3.30)	3.54%	(1.18)
RBA Cash Rate Target	0.085	0.089	3.92%***	(2.80)	0.085	0.088	2.83%*	(1.94)	1.09%	(0.53)

Table 6. Volatility persistence during announcement days

This table provides the change in volatility sensitivity for 50 stocks in the sample during announcement days. The figures reported are the percentage difference between sensitivity during announcement and non-announcement days $[(\alpha+\beta)_A-(\alpha+\beta)_{NA}]/(\alpha+\beta)_{NA}$. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX				Panel B: Chi-X				Panel C: ASX less Chi-X	
Volatility persistence	NA	A	Diff	t-stat	NA	A	Diff	t-stat	Diff-in-diff	t-stat
All Announcements	0.919	0.921	0.25%*	(1.89)	0.919	0.927	0.85%***	(5.66)	-0.60%***	(-3.77)
GDP	0.919	0.924	0.53%*	(1.88)	0.919	0.933	1.49%***	(4.40)	-0.14%***	(-2.91)
Current Account Balance	0.919	0.916	-0.32%	(-0.93)	0.919	0.922	0.34%	(0.72)	-0.96%	(-1.13)
CPI	0.919	0.919	0.02%	(0.08)	0.919	0.936	1.81%***	(5.00)	-0.66%***	(-3.60)
House Price Index	0.919	0.921	0.20%	(0.60)	0.919	0.928	1.01%***	(3.01)	-1.79%**	(-2.12)
Trade Balance	0.919	0.923	0.42%**	(2.02)	0.919	0.925	0.68%***	(2.67)	-0.81%	(-0.89)
Unemployment Rate	0.919	0.923	0.49%**	(2.40)	0.919	0.926	0.71%***	(3.31)	-0.27%	(-0.71)
Retail Sales	0.919	0.922	0.30%*	(1.79)	0.919	0.925	0.62%**	(2.44)	-0.22%	(-1.05)
Private Sector Credit	0.919	0.922	0.30%	(1.52)	0.919	0.922	0.34%	(1.40)	-0.32%	(-0.13)
RBA Cash Rate Target	0.919	0.921	0.28%	(1.21)	0.919	0.925	0.62%**	(2.13)	-0.04%	(-0.98)

Table 7. Return dependence during announcement days

This table reports the coefficients from univariate regressions predicting returns. The dependent variable is the midquote return, which is computed from the midpoint of the bid-ask quotes associated with the transaction nearest the end of an intraday time interval of fixed length (from 1 to 30min). $OIBT_{t-1}$ is the number of buyer-initiated less the number of seller-initiated trades at the previous time interval while $OIBDV_{t-1}$ is the net dollar amount associated to those trades. The first number in each cell is the cross-sectional mean of the estimated regression coefficients while the second number (in parentheses) is the average t-statistics from the individual regressions. To adjust the units for presentation, the coefficients for $OIBT$ and $OIBDV$ are multiplied by 10^5 and 10^9, respectively. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX						Panel B: Chi-X					
Frequency	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat
1-min	-0.059***	(-6.13)	0.684***	(4.69)	0.183**	(2.28)	-0.078***	(-7.17)	2.439***	(7.63)	1.268***	(3.45)
2-min	-0.062***	(-4.85)	0.425***	(2.56)	0.126	(1.26)	-0.081***	(-5.75)	1.271***	(3.56)	0.652	(1.48)
3-min	-0.067***	(-4.28)	0.318*	(1.77)	0.098	(0.86)	-0.083***	(-4.92)	0.783**	(2.08)	0.376	(0.77)
4-min	-0.056***	(-3.03)	0.274	(1.50)	0.101	(0.79)	-0.074***	(-3.80)	0.547	(1.42)	0.259	(0.49)
5-min	-0.051**	(-2.48)	0.228	(1.18)	0.091	(0.63)	-0.064***	(-3.01)	0.427	(1.10)	0.229	(0.38)
10-min	-0.041	(-1.45)	0.142	(0.68)	0.078	(0.43)	-0.054*	(-1.88)	0.154	(0.35)	-0.012	(0.02)
15-min	-0.033	(-0.98)	0.089	(0.41)	0.067	(0.31)	-0.049	(-1.39)	0.056	(0.13)	-0.014	(0.01)
30-min	-0.034	(-0.62)	0.022	(0.10)	0.052	(0.13)	-0.045	(-0.83)	-0.015	(-0.07)	-0.028	(-0.11)

Table 8. Liquidity during days with low and high news surprises

This table reports the changes in trading activity in the ASX relative to Chi-X during days with different degree of news surprises. Panel A shows the changes in proportion of volume, Panel B shows the changes in proportion of trades, Panel C shows the changes in transactions by size (shares) and Panel D reports the changes (in basis points) in quoted spread. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: Relative Volume		Panel B: Relative Trade		Panel C: Transaction by Size (shares)						Panel D: Quoted Spread	
					≤ 1,000 (%)		1,000 - 10,000 (%)		≥ 10,000 (%)			
	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat
Low surprises	0.56%*	(1.69)	0.79%*	(1.76)	0.86%*	(1.66)	0.40%	(1.36)	-0.07%	(-0.23)	-0.110	(-1.57)
High surprises	0.77%***	(3.04)	0.97%***	(2.56)	1.01%**	(2.41)	0.27%	(0.84)	-0.30%	(-1.16)	-0.123*	(-1.77)

Table 9. Volatility sensitivity and persistence during days with low and high news surprises

This table provides the change in volatility sensitivity and persistence for 50 stocks in the sample during days with different degree of news surprises. Panel A reports the percentage difference between volatility sensitivity during announcement and non-announcement days $(\alpha_A - \alpha_{NA})/\alpha_{NA}$. Panel B reports the percentage difference between volatility persistence during announcement and non-announcement days$[(\alpha + \beta)_A - (\alpha + \beta)_{NA}]/\ (\alpha + \beta)_{NA}$. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	ASX				Chi-X				ASX less Chi-X	
	NA	A	Diff	t-stat	NA	A	Diff	t-stat	Diff-in-diff	t-stat
Panel A: Volatility Sensitivity										
Low surprises	0.085	0.089	4.20%***	(4.21)	0.085	0.087	1.63%	(1.45)	2.56%*	(1.73)
High surprises	0.085	0.089	4.43%***	(3.37)	0.085	0.088	2.47%**	(2.17)	1.96%*	(1.84)
Panel B: Volatility Persistence										
Low surprises	0.919	0.921	0.24%	(1.50)	0.919	0.926	0.80%***	(4.68)	-0.56%***	(-2.95)
High surprises	0.919	0.922	0.36%***	(2.79)	0.919	0.931	1.22%***	(4.10)	-0.86%***	(-2.77)

Table 10. Return dependence during days with low and high news surprises

This table reports the coefficients from univariate regressions predicting returns. The dependent variable is the midquote return, which is computed from the midpoint of the bid-ask quotes associated with the transaction nearest the end of an intraday time interval of fixed length (from 1 to 30min). $OIBT_{t-1}$ is the number of buyer-initiated less the number of seller-initiated trades at the previous time interval while $OIBDV_{t-1}$ is the net dollar amount associated to those trades. The first number in each cell is the cross-sectional mean of the estimated regression coefficients while the second number (in parentheses) is the average t-statistics from the individual regressions. To adjust the units for presentation, the coefficients for $OIBT$ and $OIBDV$ are multiplied by 10^5 and 10^9, respectively. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX						Panel B: Chi-X					
	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat
Low surprises (1-min)	-0.057***	(-4.35)	0.711***	(3.43)	0.208*	(1.73)	-0.075***	(-4.92)	2.470***	(5.35)	1.865***	(2.75)
High surprises (1-min)	-0.060***	(-4.32)	0.674***	(3.22)	0.180	(1.55)	-0.079***	(-5.18)	2.521***	(5.49)	1.676***	(2.71)
Low surprises (2-min)	-0.060***	(-3.37)	0.430*	(1.84)	0.131	(0.87)	-0.078***	(-3.91)	1.321***	(2.56)	0.995	(1.25)
High surprises (2-min)	-0.065***	(-3.50)	0.436*	(1.80)	0.143	(0.96)	-0.083***	(-4.24)	1.326**	(2.53)	0.892	(1.14)
Low surprises (3-min)	-0.064***	(-2.90)	0.330	(1.27)	0.102	(0.62)	-0.078***	(-3.27)	0.810	(1.51)	0.579	(0.67)
High surprises (3-min)	-0.072***	(-3.19)	0.313	(1.23)	0.093	(0.61)	-0.087***	(-3.68)	0.835	(1.48)	0.590	(0.65)
Low surprises (4-min)	-0.051**	(-2.06)	0.285	(1.08)	0.121	(0.61)	-0.070***	(-2.60)	0.568	(1.03)	0.391	(0.40)
High surprises (4-min)	-0.060**	(-2.24)	0.270	(1.05)	0.108	(0.55)	-0.076***	(-2.80)	0.590	(1.03)	0.403	(0.44)
Low surprises (5-min)	-0.047*	(-1.71)	0.242	(0.85)	0.107	(0.45)	-0.063**	(-2.11)	0.448	(0.81)	0.306	(0.30)
High surprises (5-min)	-0.055*	(-1.84)	0.215	(0.82)	0.096	(0.45)	-0.065**	(-2.17)	0.468	(0.78)	0.315	(0.32)
Low surprises (10-min)	-0.036	(-0.97)	0.175	(0.56)	0.093	(0.35)	-0.049	(-1.25)	0.223	(0.34)	0.020	(0.07)
High surprises (10-min)	-0.045	(-1.10)	0.110	(0.40)	0.074	(0.29)	-0.058	(-1.39)	0.146	(0.20)	0.016	(-0.03)
Low surprises (15-min)	-0.032	(-0.76)	0.089	(0.29)	0.077	(0.26)	-0.046	(-1.02)	0.115	(0.16)	-0.005	(0.05)
High surprises (15-min)	-0.032	(-0.64)	0.084	(0.29)	0.077	(0.19)	-0.048	(-0.94)	0.018	(0.04)	-0.071	(-0.06)
Low surprises (30-min)	-0.023	(-0.37)	0.042	(0.10)	0.051	(0.06)	-0.037	(-0.56)	0.059	(0.03)	-0.049	(-0.02)
High surprises (30-min)	-0.043	(-0.54)	-0.005	(0.04)	0.042	(0.12)	-0.051	(-0.64)	-0.064	(-0.12)	-0.089	(-0.13)

Table 11. Changes in liquidity across different stocks

This table reports the changes in trading activity in the ASX relative to Chi-X for stocks with different market exposure. Panel A shows the changes in proportion of volume, Panel B shows the changes in proportion of trades, Panel C shows the changes in transactions by size (shares) and Panel D reports the changes (in basis points) in quoted spread. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: Relative Volume		Panel B: Relative Trade		Panel C: Transaction by Size						Panel D: Quoted Spread	
					(1)		(2)		(3)			
	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat
Low Beta	0.52%***	(4.20)	0.37%***	(3.72)	0.40%***	(2.79)	0.04%	(0.62)	-0.29%	(-1.50)	-0.179***	(-3.04)
High Beta	0.67%***	(4.82)	0.20%**	(2.07)	0.23%**	(2.05)	0.15%*	(1.84)	-0.14%	(-0.54)	-0.060	(-0.95)

Table 12. Changes in volatility sensitivity and persistence across different stocks

This table provides the change in volatility sensitivity and persistence for stocks with different market exposure. Panel A reports the percentage difference between volatility sensitivity during announcement and non-announcement days $(\alpha_A - \alpha_{NA})/\alpha_{NA}$. Panel B reports the percentage difference between volatility persistence during announcement and non-announcement days$[(\alpha+\beta)_A - (\alpha+\beta)_{NA}]/\ (\alpha+\beta)_{NA}$. Figures in parentheses are the t-statistics. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	ASX				Chi-X				ASX less Chi-X	
	NA	A	Diff	t-stat	NA	A	Diff	t-stat	Diff-in-diff	t-stat
Panel A: Volatility Sensitivity										
Low Beta	0.087	0.089	2.60%***	(2.78)	0.092	0.095	2.27%***	(2.79)	0.33%	(0.25)
High Beta	0.084	0.089	5.96%***	(3.28)	0.078	0.079	0.63%	(0.55)	5.33%***	(2.68)
Panel B: Volatility Persistence										
Low Beta	0.918	0.921	0.26%	(1.15)	0.915	0.924	1.03%***	(4.65)	-0.77%***	(-3.60)
High Beta	0.919	0.922	0.24%*	(1.72)	0.924	0.930	0.67%***	(3.35)	-0.43%*	(-1.83)

Table 13. Return dependence across different stocks

This table reports the coefficients from univariate regressions predicting returns. The dependent variable is the midquote return, which is computed from the midpoint of the bid-ask quotes associated with the transaction nearest the end of an intraday time interval of fixed length (from 1 to 30min). $OIBT_{t-1}$ is the number of buyer-initiated less the number of seller-initiated trades at the previous time interval while $OIBDV_{t-1}$ is the net dollar amount associated to those trades. The first number in each cell is the cross-sectional mean of the estimated regression coefficients while the second number (in parentheses) is the average t-statistics from the individual regressions. To adjust the units for presentation, the coefficients for $OIBT$ and $OIBDV$ are multiplied by 10^5 and 10^9, respectively. *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: ASX						Panel B: Chi-X					
	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat	r_{t-1}	t-stat	$OIBT_{t-1}$	t-stat	$OIBDV_{t-1}$	t-stat
Low Beta (1-min)	-0.067***	(-6.91)	0.711***	(4.97)	0.177**	(2.48)	-0.086***	(-7.74)	2.224***	(7.21)	1.072***	(3.32)
High Beta (1-min)	-0.050***	(-5.35)	0.658***	(4.42)	0.188**	(2.07)	-0.069***	(-6.61)	2.654***	(8.04)	1.464***	(3.57)
Low Beta (2-min)	-0.070***	(-5.37)	0.446***	(2.82)	0.122	(1.40)	-0.089***	(-6.20)	1.168***	(3.48)	0.567	(1.54)
High Beta (2-min)	-0.055***	(-4.33)	0.403**	(2.30)	0.130	(1.12)	-0.073***	(-5.30)	1.374***	(3.64)	0.736	(1.41)
Low Beta (3-min)	-0.072***	(-4.54)	0.346**	(2.08)	0.100	(1.05)	-0.090***	(-5.26)	0.738**	(2.15)	0.330	(0.87)
High Beta (3-min)	-0.062***	(-4.03)	0.290	(1.46)	0.097	(0.67)	-0.075***	(-4.58)	0.827**	(2.01)	0.421	(0.67)
Low Beta (4-min)	-0.062***	(-3.33)	0.289*	(1.69)	0.096	(0.86)	-0.083***	(-4.20)	0.536	(1.53)	0.199	(0.51)
High Beta (4-min)	-0.049***	(-2.74)	0.259	(1.31)	0.105	(0.71)	-0.064***	(-3.40)	0.558	(1.32)	0.319	(0.47)
Low Beta (5-min)	-0.059***	(-2.85)	0.236	(1.33)	0.087	(0.72)	-0.073***	(-3.36)	0.400	(1.13)	0.214	(0.47)
High Beta (5-min)	-0.042**	(-2.11)	0.219	(1.03)	0.095	(0.54)	-0.056***	(-2.67)	0.453	(1.06)	0.244	(0.29)
Low Beta (10-min)	-0.048*	(-1.69)	0.143	(0.74)	0.065	(0.49)	-0.060**	(-2.07)	0.161	(0.43)	-0.014	(0.16)
High Beta (10-min)	-0.033	(-1.21)	0.141	(0.63)	0.090	(0.37)	-0.048*	(-1.70)	0.147	(0.27)	-0.010	(-0.11)
Low Beta (15-min)	-0.042	(-1.21)	0.085	(0.44)	0.070	(0.38)	-0.054	(-1.56)	0.047	(0.16)	-0.024	(0.04)
High Beta (15-min)	-0.025	(-0.75)	0.093	(0.38)	0.064	(0.25)	-0.043	(-1.22)	0.066	(0.09)	-0.003	(-0.01)
Low Beta (20-min)	-0.038	(-0.71)	0.017	(0.11)	0.029	(0.08)	-0.050	(-0.90)	0.003	(-0.02)	-0.094	(-0.10)
High Beta (20-min)	-0.029	(-0.54)	0.027	(0.10)	0.075	(0.18)	-0.040	(-0.76)	-0.033	(-0.12)	0.037	(-0.11)