

Report by Charles Lane Advisory: Review of recent rule changes affecting dark liquidity

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Charles Lane Advisory Pty Ltd (CLA)

About this report

ASIC commissioned Charles Lane Advisory Pty Ltd to conduct an independent study to assist in determining the impact of recent changes to dark trading rules on the use of dark liquidity and market quality.

This document is Charles Lane Advisory Pty Ltd's analysis of the impact on market quality of the meaningful price improvement rule and amendments to block size thresholds which came into effect on 26 May 2013. This report was prepared by Dr Carole Comerton-Forde.

Disclaimer

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Executive summary

- 1 On 26 May 2013,¹ ASIC implemented a package of rule changes relating to dark trading. The rule changes reduced the size requirement for block trades for most stocks in the market and imposed a meaningful price improvement requirement for below block size dark trades. ASIC has retained Charles Lane Advisory Pty Ltd (CLA) to assist it to determine the impact of these rule changes on the use of dark liquidity and market quality. This report examines the impact of those rule changes.
- 2 In the 100 days before and after the rule changes, block trading increased from \$39.5 billion to \$52.8 billion, accounting for 8.1% and 11.4% of the total dollar volume traded over these periods. The increase included \$5.8 billion in blocks below the previous \$1 million block threshold. The increases in the fraction of dollar volume traded as blocks were greatest for the stocks where the threshold was reduced to \$200,000. For S&P/ASX 200 stocks with a threshold of \$200,000 the fraction of dollar volume traded as blocks increased from 6.6% to 12.5%, and for stocks outside the S&P/ASX 200 index, block trading increased from 9.9% to 19.2%. The fraction of dollar volume below the previous \$1 million threshold in these stocks accounted for 23% and 30% of blocks respectively, for each of these stock groups.
- 3 As expected, the meaningful price improvement requirement substantially reduced the volume of below block size dark trades. In the 100 days before and after the rule changes, below block size dark trading decreased from \$73.8 billion to \$44.6 billion, accounting for 15.3% and 9.6% of total dollar volume traded over these periods. This decline came from trades executed as priority crossings or NBBO crossings. Dollar trading volumes in ASX Centre Point increased from \$17.3 billion to \$19.8 billion, and Chi-X hidden orders increased from \$1.7 billion to \$3.8 billion after the rule change. The decline in the fraction of dollar volume in below block size dark trades was largest (smallest) in the least (most) active stocks.
- 4 This report examines changes in market quality in the 100 days before and after the dark trading rule changes. Bid-ask spreads and order book depth move in line with volatility. Increases in spreads and decreases in order book depth coincide with increases in volatility. Regression analysis shows that changes in bid-ask spreads are either statistically and/or economically insignificant, after controlling for other factors known to influence spreads, such as trading activity and volatility.
- 5 Taken together, these results indicate that the package of rule changes implemented on 26 May 2013 facilitated the use of block trading, enhanced the fairness of dark trading relative to lit trading. by not allowing dark orders to step ahead of lit orders at the same price, without having any adverse impact on bid-ask spreads.

¹ The first day of trading after these amendments came into effect was 27 May 2013. Therefore, the impact of meaningful price improvement and amended block tier thresholds is measured from this day.

A Background

- 6 ASIC commissioned CLA to assist it to determine the impact of specific rule changes on the use of dark liquidity and market quality.
- 7 This report examines the impact of the package of rule changes relating to dark trading that occurred on 26 May 2013. This package of rules included:
 - (a) changes to the block trade thresholds; and
 - (b) the introduction of a requirement for trades below block size executed without pre-trade transparency to provide meaningful price improvement.
- 8 Further details of these rule changes are provided in Report 311 *Response to submissions on CP 179 and CP 184 Australian market structure: Draft market integrity rules and guidance* (REP 311) and ASIC Market Integrity Rules (Competition in Exchange Markets) Amendment 2012 (No.1).
- 9 The primary analysis presented in the report considers all ordinary equities listed on the Australian Securities Exchange (ASX). However, given that the block trade thresholds differ for different groups of stocks, analysis is also undertaken for each block tier category separately. In addition, the analysis separately considers stocks included in the S&P/ASX 200 Index. Annexure 1 provides further details of the different groups of stocks analysed.
- 10 The report examines the period 31 December 2012 to 14 October 2013, representing 100 trading days before and after the rule changes. This period provides a sufficiently long time series to obtain insights into the impact of the rule changes, without being excessively influenced by other changes in the market.
- 11 The report begins by defining the different types of dark trading examined. Section C describes the data used in the report. Section D reports descriptive statistics on the changes in the different types of dark trading. Section E provides descriptive statistics of changes in market quality variables around the rule changes. Section F presents a more formal analysis of the impact of the rule change on liquidity after controlling for other factors. Section G presents the conclusion to the report.

B Dark trading definitions and categories

- 12 The analysis presented in this report focuses on two different types of dark trades:
 - (a) Block Special Crossings, which prior to the rule change were required to be greater than \$1 million, and after the rule change were required to be greater than \$200,000, \$500,000 or \$1 million depending on stock liquidity. In this report, these trades are labelled "Blocks".
 - (b) Trades below block size executed without pre-trade transparency, which prior to the rule change could be executed at or within the spread, and after the rule change could only be executed if they offered meaningful price improvement. These trades can be executed using a number of different trading mechanisms, including priority crossings, NBBO crossings, ASX Centre Point and Chi-X hidden orders. In this report, these trades are collectively labelled "Below block size dark" trades. In some of the analysis, ASX Centre Point and Chi-X hidden orders are separately identified, with the residual below block size dark trades being labelled "at or within the spread" trades.
- 13 Other off-market trades, which were unaffected by the rule changes, are not specifically examined in the report. This category includes Portfolio Special Crossings and other types of trades executed off-market without pre-trade transparency. These trades are labelled "other off market".
- 14 Trades that do not meet one of these pre-trade transparency exceptions must be executed on either the ASX or Chi-X electronic limit order book with pre-trade transparency. These trades are referred to as "lit on exchange".
- 15 Further details of the different dark trading categories and the requirements associated with them are available in the ASIC Market Integrity Rules (Competition in Exchange Markets) 2011.

C Data

- 16 The data used in this report was provided by ASIC. Order and trade data are processed in SMARTS to extract trading volume and market quality statistics on a stock-day basis.² This process is similar to that developed in compiling ASIC's equity market data publication found on the ASIC website.³ Definitions for the market quality variables are provided in Annexure 2.
- 17 ASIC also provided details of the stocks assigned to each block tier category, index group and security type to facilitate the analysis by stock groups.

² There are a number of known errors in the SMARTS data. The overall magnitudes of these errors are small and are thought to have an insignificant impact on the results. These errors include: (a) some tailor made combinations are flagged as block trades; (b) where a priority crossing is entered at a price which is not the prevailing best bid or ask price, associated lit trades are incorrectly labelled as priority crossings; and (c) where priority crossing trades are cancelled, the cancellation is not always recognised as a priority trade.

³ The equity market data publication can be found at www.asic.gov.au/asic/asic.nsf/byheadline/Equity+market+data?openDocument.

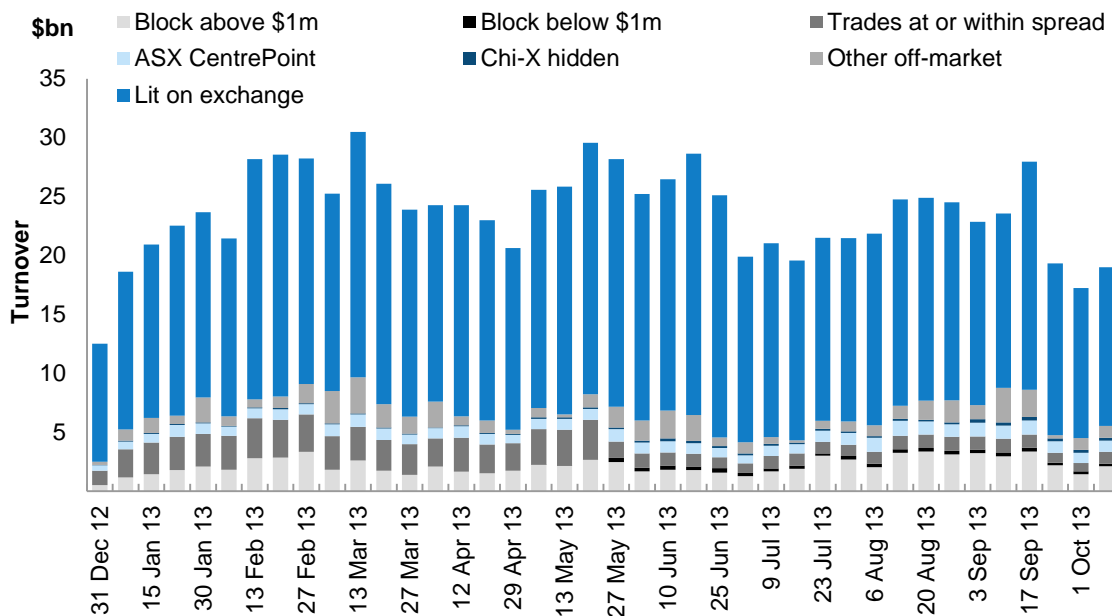
D Dollar volumes and dark trading statistics

- 18 All figures included in the report present weekly rather than daily statistics to reduce the noise in the data. A week is defined as five trading days, rather than a calendar week.

Analysis for all ordinary equities

- 19 Figure 1 presents the total dollar volume traded in all ASX-listed ordinary equities. The figure provides a breakdown of the different trade types considered in this report, including blocks above \$1 million, blocks below \$1 million, trades at or within the spread, ASX Centre Point, Chi-X hidden, other off-market trades and lit trades on exchange.

Figure 1: Total dollar volume traded in all ASX-listed ordinary equities by trade type



- 20 Figure 1 shows that the dollar volume traded exhibited no long-term trend over the period, ranging from \$12.52 billion (in the week commencing 31 December 2012) to \$30.49 billion (in the week commencing 13 March 2013). Overall, the dollar volume in the 100 days prior to the rule changes was \$483.6 billion, compared to \$463.1 billion in the 100 days after the rule change.

- 21 Figure 1 shows that there was an increase in the dollar volume of blocks, from a total of \$39.5 billion over the 100 days prior to the rule change to \$52.8 billion in the 100 days following.⁴ This represents 8.1% and 11.4% of total dollar volume traded, respectively. Block volumes have been extremely volatile historically, so it is difficult to directly attribute this increase in blocks to the rule change. However, in the 100 days after the

⁴ The SMARTS data feed incorrectly labels some tailor made combinations as block trades. As a result there are some trades included in the block trade category incorrectly.

rule change, there was \$5.8 billion traded in sizes of less than \$1 million, which would not have been possible in the absence of the rule change.

- 22 There is a clear decline in the dollar volume traded in below block size dark trades, from \$73.8 billion in the 100 days prior to the rule change to \$44.6 billion after. This represents a decline from 15.2% to 9.6% of total dollar volume, respectively. This decline was driven by the category labelled trades at or within the spread, representing priority crossings and NBBO crossings, from \$54.9 billion to \$21 billion. Priority crossings ceased to exist after the rule change. This category captures trades executed in broker-operated crossing systems and/or broker internalisation.
- 23 Over the same period, the dollar volume traded in ASX Centre Point rose marginally from \$17.3 billion to \$19.8 billion. The volume of Chi-X hidden orders almost doubled, from a low base of \$1.7 billion to \$3.8 billion. These trade types were not materially impacted by the rule change as they already typically offered meaningful price improvement. Although it is worth noting that the reference price for determining price improvement changed from the individual markets to the National Best Bid and Offer (NBBO) after 26 May 2013.

Analysis by stock group

- 24 Table 1 reports the total dollar volume traded and the fraction of each dark trade type broken down into the five stock groups, in the 100 days before and after the rule changes. This illustrates the impact of the different block trade threshold changes.

Table 1: Total dollar volume traded and fraction of dark trade type by stock group

| Stock Group | Total Turnover | Block size dark | | Below block size dark | | | |
|---|----------------------------------|-------------------|-------------------|-----------------------------|--------------------------------|------------------|--------------|
| | Total dollar volume traded (\$b) | Blocks above \$1m | Blocks below \$1m | Total below block size dark | Trades at or within the spread | ASX Centre Point | Chi-X hidden |
| Panel A: Pre period (31 December 2012–26 May 2013) | | | | | | | |
| Group 1 | 248.3 | 8.08% | 0.0% | 10.3% | 7.2% | 2.8% | 0.3% |
| Group 2 | 77.7 | 10.73% | 0.0% | 22.2% | 17.0% | 4.8% | 0.4% |
| Group 3 | 136.9 | 6.57% | 0.0% | 20.0% | 14.9% | 4.6% | 0.5% |
| Group 4 | 20.6 | 9.91% | 0.0% | 17.0% | 15.8% | 1.1% | 0.1% |
| Group 5 | 6.1 | 12.44% | 0.0% | 3.2% | 3.1% | 0.1% | 0.0% |

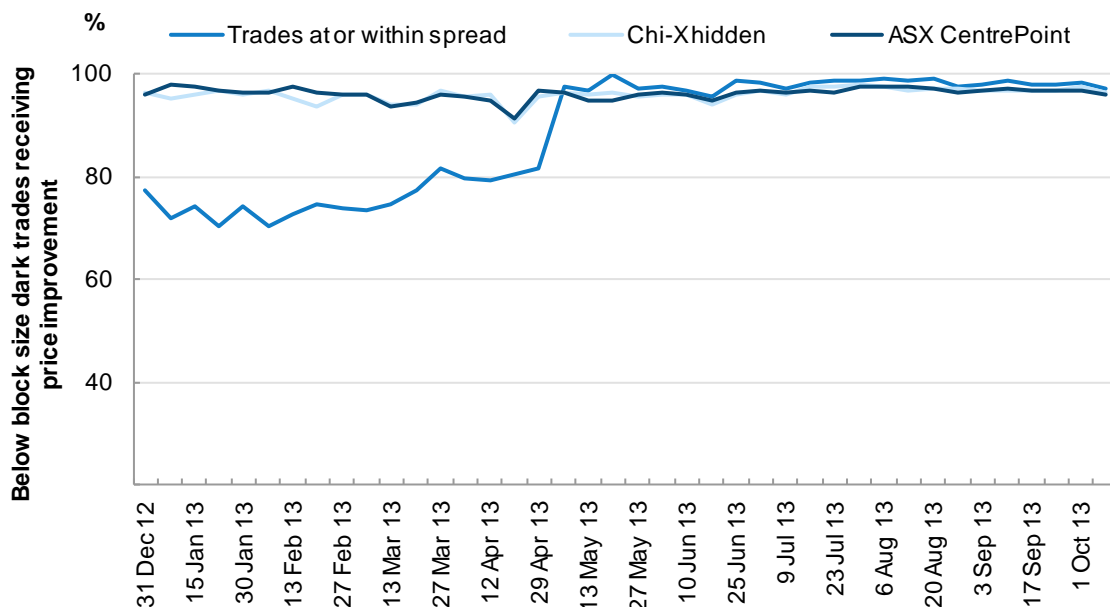
| Stock Group | Total Turnover | Block size dark | | Below block size dark | | | |
|---|----------------------------------|-------------------|-------------------|-----------------------------|--------------------------------|------------------|--------------|
| | Total dollar volume traded (\$b) | Blocks above \$1m | Blocks below \$1m | Total below block size dark | Trades at or within the spread | ASX Centre Point | Chi-X hidden |
| Panel B: Post period (27 May 2013–14 October 2013) | | | | | | | |
| Group 1 | 261.5 | 9.71% | 0.0% | 8.6% | 3.9% | 3.9% | 0.9% |
| Group 2 | 74.5 | 11.67% | 1.9% | 12.5% | 6.3% | 5.4% | 0.9% |
| Group 3 | 108.4 | 9.63% | 2.9% | 10.9% | 5.1% | 5.0% | 0.8% |
| Group 4 | 18.7 | 13.41% | 5.8% | 5.2% | 3.1% | 1.9% | 0.2% |
| Group 5 | 7.1 | 14.97% | 0.5% | 0.8% | 0.7% | 0.0% | 0.0% |

- 25 Groups 1 and 5 exhibited an increase in overall trading activity, while the other groups exhibited decreases. In terms of block trading, Group 1 increased from 8.1% (\$20 billion) to 9.7% (\$25.5 billion), despite the fact that this stock group experienced no change in the block trade threshold. The increase in the fraction of dollar volume executed as blocks was larger in the stock groups where the block trade threshold was reduced. Group 2, where the threshold reduced to \$500,000, the level of block trading increased from 10.7% (\$8.3 billion) to 13.6% (\$10.1 billion). The increases were largest in Groups 3 and 4 where the block threshold fell to \$200,000. Group 3 increased from 6.6% (\$9 billion) to 12.5% (\$13.6 billion) and Group 4 almost doubled from 9.9% (\$2 billion) to 19.2% (\$3.6 billion). In Groups 2 to 5, some, but not all of the increase was attributed to trades in sizes that were previously not eligible for block trading. The fraction of dollar volume in block trades below \$1 million was largest in Groups 3 and 4, accounting for 23% and 30% of all block volumes, respectively, after the rule change. Group 3 accounted for \$3.2 billion of the \$5.8 billion blocks traded is sizes below \$1 million. These results suggest that the lower block trade thresholds facilitated additional block liquidity.
- 26 Table 1 also shows that there is substantial variation in the impact of the rule changes on the other dark trade types. The below block size dark trades are broken into three sub-categories: trades at or within the spread, ASX Centre Point and Chi-X hidden.
- 27 The meaningful price improvement rules substantially reduced the level of trading at or within the spread for all stock groups. The decrease was largest in Group 4 declining from 15.8% (\$3.3 billion) to 3.1% (\$0.6 billion) and smallest in Group 1 declining from 7.2% (\$17.9 billion) to 3.9% (\$10.1 billion).
- 28 Although not materially impacted by the rule, Table 1 also shows that changes in the fraction of activity on ASX Centre Point and Chi-X hidden are also observed. ASX Centre Point exhibited increased activity in all groups, with the largest growth being in Groups 1 and 4. Chi-X hidden increased across all groups, from a relatively low base.

Level of price improvement

- 29 The requirement for below block size dark trades to offer price improvement was aimed at eliminating the possibility that dark orders step-ahead of orders displayed on the limit order book (sometime referred to as queue-jumping). This was intended to encourage the display of limit orders in lit order books and to protect the quality of the price discovery process.
- 30 Figure 2 provides details of the fraction of dollar volume executed with price improvement for 100 days before and after the rule change for all ordinary equities. The fraction is reported separately for trades at or within the spread, ASX Centre Point and Chi-X hidden. The fraction of dollar volume at or within the spread receiving price improvement increased from around 70% to close to 100%. This increase began approximately 50 days prior to the rule change suggesting that some market participants began offering more price improvement before it was mandated. The level of price improvement for these trades after the rule change, and for ASX Centre Point and Chi-X hidden before and after the rule change remains slightly below 100%. The reason that the fraction remains slightly below 100%, rather than equalling 100% is likely due to latency issues between exchanges or where orders are entered at the same time stamp as trades are reported allowing trades to appear to offer no price improvement.

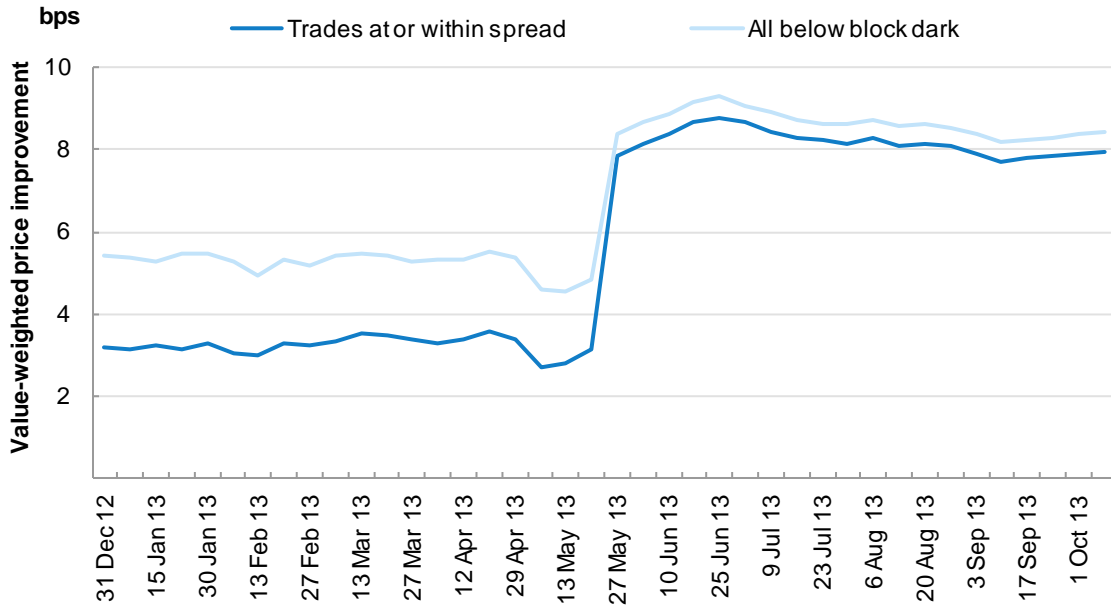
Figure 2: Fraction of dollar volume executed with price improvement for 100 days before and after meaningful price improvement



- 31 Figure 3 attempts to quantify the economic magnitude of the price improvement, by estimating the value-weighted average price improvement. This is calculated as the difference between the trade price and the best bid or ask price at the time of the trade, expressed in basis points. A value-weighted measure is calculated across the day by weighting the price improvement by the dollar volume of each trade. This is then averaged across stocks, again value-weighting based on the stock's total dollar volume traded. This is reported separately for trades at or within the spread and all below block

size dark trades. The level of price improvement for trades at or within the spread increased from approximately 3 bps prior to the rule change, to 8 bps after the rule change. The increase in the value price improvement for all below block size dark trades was slightly lower, from 5.5 bps to 8.5 bps, reflecting the fact that ASX Centre Point and Chi-X hidden were typically already offering price improvement prior to the rule change.

Figure 3: Value-weighted average price improvement for dark trades over time

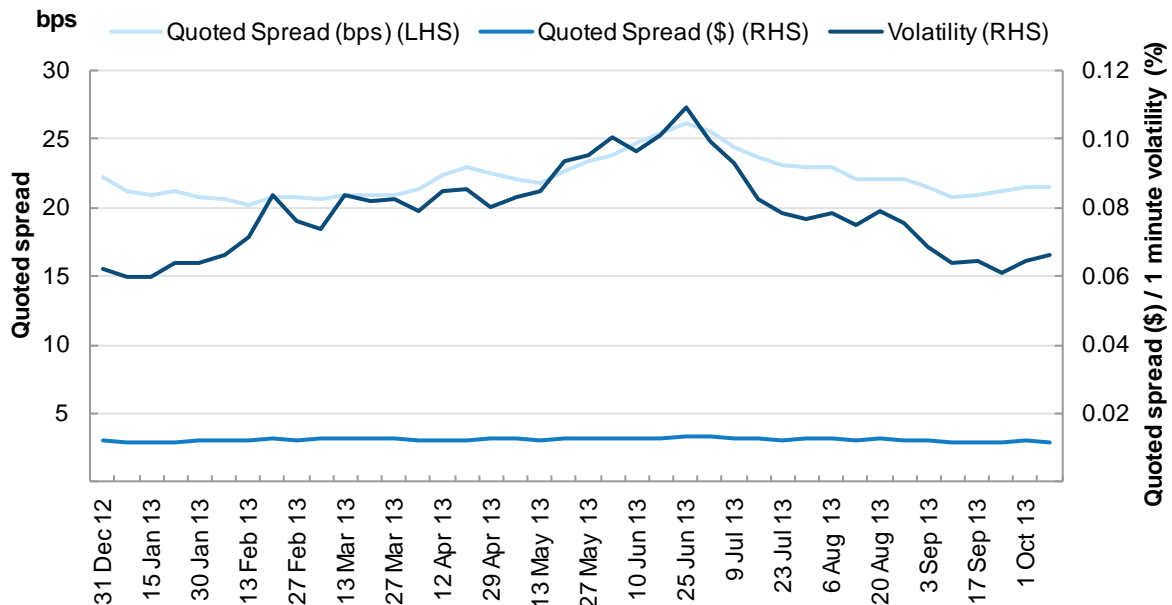


E Market quality descriptive statistics

32 A range of market quality statistics are examined for the 100 days before and after the rule changes. The main statistics presented are value-weighted averages for all ASX-listed ordinary equities.⁵ This approach means that larger, more active, stocks more heavily influence the statistics than smaller, less active, stocks. Consistent with the dark trading statistics, weekly statistics are reported in order to reduce noise.

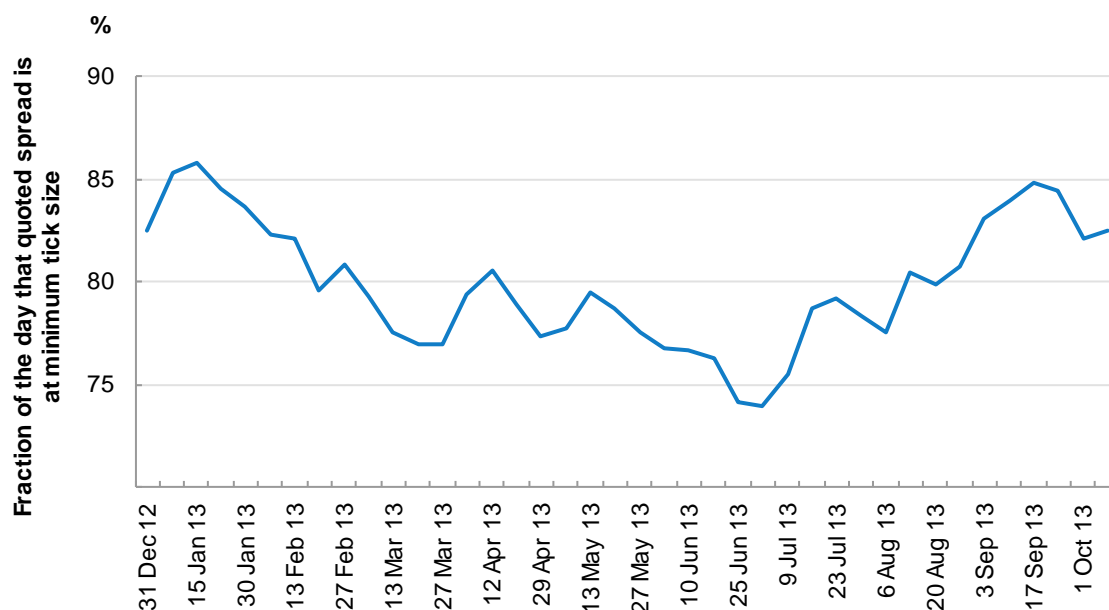
33 Figure 4 reports quoted bid-ask spreads, measured in basis points and dollars, and intraday volatility. The basis points spreads began trending upward in mid-February 2013, peaking in late June 2013. Over the same period, dollar spreads remained essentially unchanged at an average of 1.2 cents, indicating that the change in basis point spreads was driven by declining prices.

Figure 4: Quoted bid-ask spreads and volatility for all ASX-listed ordinary equities



34 The relatively constant dollar spreads are, at least in part, driven by the large number of highly active stocks that are constrained by their minimum tick size. This is investigated further by examining the fraction of time during the day stocks trade at their minimum tick size. Figure 5 shows that on average stocks are constrained between 74% and 86% of the time. The high level of constraint makes it unlikely that spreads can decline further. Figure 5 shows that average spreads became less constrained over the period from February to June 2013, when spreads were rising.

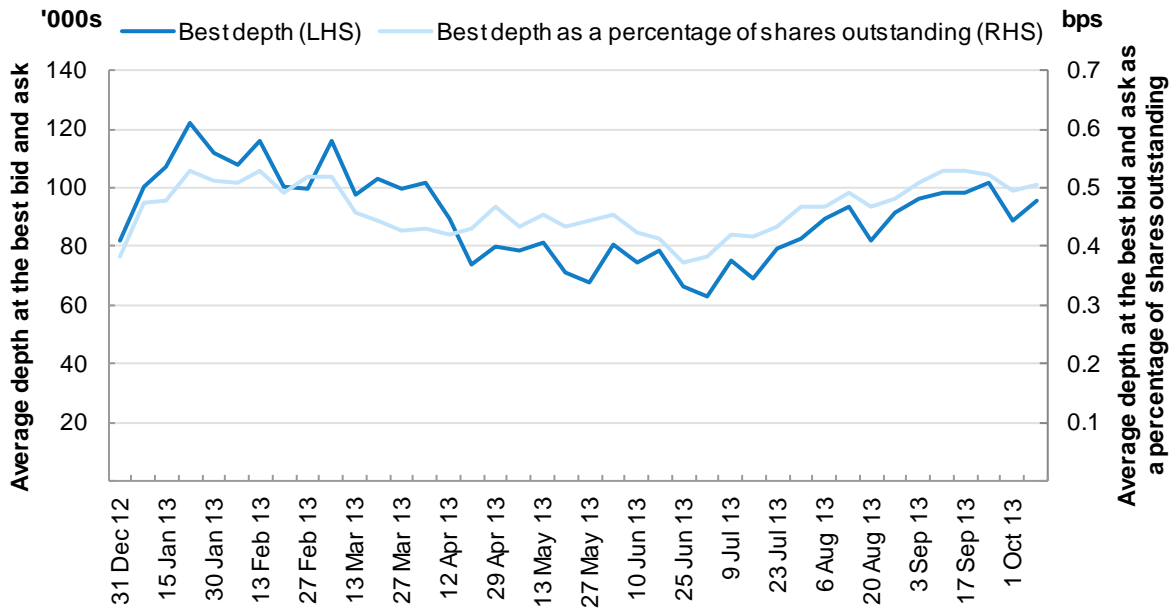
⁵ In the analysis presented the weights are based on total dollar volume traded, however, sensitivity analysis is also undertaken by weighting based only on-market dollar volumes. The results remain qualitatively similar and are therefore not reported.

Figure 5: Percentage of the day that ASX-listed ordinary equities are tick constrained

- 35 Figure 4 shows that the trend in volatility matches the trend in basis points spread, consistent with a large body of academic research which indicates that spreads are elevated during periods of increased volatility.⁶ This suggests that spreads increased due to elevated volatility rather than the rule changes.
- 36 Figure 6 reports two measures of depth – the average volume of shares at the best bid and ask price and the average volume of shares at the best bid and ask price scaled by the number of shares outstanding. Both depth measures appear to be negatively correlated with the trend in volatility – depth declines as volatility rises.

⁶ See, for example, Chan, Christie and Schultz (1995), McInish and Wood (1992) and Li and Wu (2006).

Figure 6: Volume of shares at the best bid and ask price and the volume of shares at the best bid and ask price scaled by the number of shares outstanding over time



37 Annexure 3 provides weekly statistics broken down into the five stock groups. The general trends are broadly consistent across each of the groups. The variation in basis point spreads and volatility are larger in Groups 3 and 4 than in Groups 1 and 2. The dollar spreads are relatively flat across Groups 1 to 4, although Group 4 has slightly more variation than the other groups. Group 5 also exhibits no obvious trend but displays extreme volatility in dollar spreads. The lack of variation in dollar spreads is, at least in part, explained by the high level of tick size constraint exhibited by stocks in Groups 1 to 3. The value-weighted average stock in Group 2 and 3 trades at its minimum tick size more than 80% of the time. Group 1 is slightly less constrained, but is constrained on average more than 70% of the time. As a result, the potential for the dark trading rule changes to lead to reductions in bid-ask spread is reduced. Variations in depth are relatively consistent across the stock groups.

F Regression analysis

Empirical Approach

38 Sections D and E provide details of the changes in dark trading and the changes in market quality around the rule changes. This section more formally assesses the impact of the rule changes on one dimension of market quality, namely bid-ask spreads. This analysis focuses on bid-ask spreads as it is a well-accepted measure of market quality, and because there is a large body of both theoretical and empirical academic literature⁷ identifying other factors that are known to influence spreads such as trading activity and volatility. To effectively assess the impact of the rule change on spreads, it is necessary to control for these other factors.

39 Regression analysis is undertaken to control for these other factors. The following regression model is estimated in equation (1):

$$Spread_{i,t} = \alpha + \beta_1 PrePostDummy_t + \beta_2 X_{i,t} + \beta_3 TimeTrend_t + \varepsilon_{i,t} (1)$$

40 Where:

- $Spread_{i,t}$ is the quoted bid-ask spread measured in basis points. The spread is measured every minute, and averaged across the trading day for each stock;
- $PrePostDummy_{i,t}$ is a dummy variable which takes a value of 0 before the dark trading rule changes, and 1 after the dark trading rule changes. The dummy variable captures the impact of the rule change, after controlling for the other factors including the time trend;
- $X_{i,t}$ is a vector of control variables including trading activity and volatility; and
- $TimeTrend_t$ is a time trend variable which takes a value of 0 on the first day of the sample and increases by 1 each trading day.

41 The control variables included in the main regression are based on numerous academic studies which have investigated the factors affecting bid-ask spreads. These variables include:

- *TradingActivity* – measured as either the natural log of the total number of trades or the natural log of total dollar value traded; and
- *Volatility* – measured as the standard deviation of log midpoint price changes calculated at either 1 or 5 minute intervals over the trading day.

42 The previous literature shows that spreads are negatively associated with trading activity and positively associated with volatility.

⁷ See, for example, McNish and Wood (1992), Harris (1994) and Foucault, Moinas and Thiessen (2007).

- 43 All variables are calculated for each stock, each day (indices i and t identify the stock and trading day, respectively). Equation (1) is estimated for a period 100 trading days before and after the dark trading rule changes. Standard errors are clustered by stock and by day. This analysis is repeated for each of the five groups of stocks described above.

Regression results

- 44 Table 2 reports the regression results for each of the five stock groups.

Table 2: Regression results by stock group

| | Group 1 | | Group 2 | | Group 3 | | Group 4 | | Group 5 | |
|------------------|----------|-------|----------|-------|----------|-------|----------|--------|----------|-------|
| | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat |
| Intercept | 86.79 | 6.60 | 101.89 | 4.12 | 184.11 | 9.11 | 1113.31 | 30.44 | 143.53 | 4.85 |
| PrePostDummy | 0.71 | 1.61 | -0.73 | -1.23 | -0.78 | -0.50 | 123.22 | 4.34 | -3.24 | -0.20 |
| Trading Activity | -9.13 | -6.76 | -11.39 | -4.19 | -23.19 | -8.85 | -260.16 | -34.11 | -49.73 | -4.65 |
| Volatility | 119.26 | 3.84 | 177.37 | 5.00 | 285.77 | 12.59 | 884.79 | 38.42 | 1003.33 | 11.72 |
| Trend | -0.003 | -0.44 | 0.002 | 0.15 | 0.008 | 0.64 | -0.037 | -0.16 | 0.203 | 1.26 |
| Obs | 4,361 | | 4,647 | | 30,538 | | 206,274 | | 16,138 | |
| Adj R2 | 0.58 | | 0.36 | | 0.55 | | 0.27 | | 0.17 | |

Table 2 reports regression estimates for equation (1) using a stock-day panel, in which the dependent variable is the time-weighted average proportional quoted bid-ask spread measured in basis points. The independent variables are:

- *PrePostDummy* which takes a value of 0 prior to 26 May 2013, and 1 afterwards.
- *TradingActivity* is the natural log of the total number of trades.
- *Volatility* is the standard deviation of log midpoint price changes calculated at 1 minute intervals over the trading day.
- *TimeTrend* is a time trend variable which takes a value of 0 on the first day of the sample and increases by 1 each trading day.
- Standard errors are clustered by stock and by date.

- 45 In all regression specifications, the main control variables behave as expected. Bid-ask spreads increase with stock volatility and decrease with trading activity. Spreads exhibit no linear time trend.
- 46 The *PrepostDummy* variable captures the impact of the rule change after controlling for these other factors. Groups 1, 2, 3 and 5 show no statistically significant changes in spreads. Group 4 shows a statistically significant increase in spreads, however, the economic magnitude of this change is very small at 1.23 bps (123.22 / 100). This change should be viewed in the context of the pre-period average spreads for these groups of 173 bps. These results indicate that after controlling for other factors, the

changes in the dark trading rules on 26 May 2013 had little or no impact on bid-ask spreads.

- 47 These results also remain qualitatively consistent for a range of alternative regression specifications, including the use of different *TradingActivity* and *Volatility* measures (as specified above), and the inclusion of two additional control variables:
- *TickConstraint* measured as the percentage of minutes during the trading day where the bid-ask spread is equal to the minimum tick size, and
 - *MessageRatio* measured as the ratio of messages (order submissions, amendments and cancellations) to trades.
- 48 In unreported results, the coefficients on *TickConstraint* are positive and significant in all groups except Group 5, indicating that within each group, stocks with spreads that are more frequently constrained by tick size, have larger percentage spreads. The coefficients on *MessageRatio* are negative and significant in all groups, except Group 4, showing that within each group, stocks with higher message-to-trade ratios have lower spreads.
- 49 For robustness, equation (1) is also estimated with stock fixed effects. The results for the *PrePostDummy* are qualitatively consistent and therefore are not reported.

Additional testing

- 50 One of the difficulties associated with empirically examining the impact of dark trading on liquidity is the endogeneity of dark trading with respect to liquidity. For example, traders may alter their use of dark trading in response to changes in the level of liquidity, rather than liquidity changing in response to changes in the level of dark trading. It is possible to address this potential endogeneity using an instrumental variable that captures a change in the level of dark trading but is exogenous with respect to liquidity. The change in the dark trading rules on 26 May 2013 provides such an instrument.⁸ Therefore, an alternative empirical approach for assessing the impact of the rule change is to adopt a two-stage least squares regression, using the rule change as an instrumental variable. For robustness purposes this analysis is also undertaken and the results are reported in Annexure 4. These results are qualitatively consistent with those found in the main analysis presented in Section F.

⁸ This approach is commonly used in microstructure literature. Examples of this approach include Hendershott, Jones and Menkveld (2011) and Boehmer, Fong and Wu (2012). The instrument used in this report is arguably weaker than those used in Hendershott et al. and Boehmer et al. because the rule changes applied to all stocks on the same date.

G Conclusion

- 51 The analysis presented in this report shows that the package of rule changes implemented on 26 May 2013 impacted the use of dark trading in Australia. Reductions in the block trade thresholds facilitated an increase in the level of block trading. The meaningful price improvement requirements reduced the level of below block size dark trading substantially. The average level of price improvement associated with these trades increased. Dark orders below block size can no longer step ahead of limit orders displayed on the exchange limit order books.
- 52 Although there were changes in market quality variables in the period around the rule change, regression analysis shows that changes in bid-ask spreads are either statistically and/or economically insignificant, after controlling for other factors.

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Annexure A: Stock groups

- 53 The analysis considers all equity market products and divides securities into five groups based on the block tier category⁹ to which the product belongs and the indices in which it is included. This grouping facilitates an analysis of whether the rule changes had different impacts on different types of stocks. Stocks included in Group 1 are the largest and most active stocks in the market, and did not experience any change in the block trading rules. In all other stocks the size requirements for block trades were substantially reduced.

Table A.1: Details of stock groups

| Stock Group | Block tier category | Index inclusion |
|-------------|----------------------|---|
| 1 | Tier 1 - \$1,000,000 | S&P/ASX 200 |
| 2 | Tier 2 - \$500,000 | S&P/ASX 200 |
| 3 | Tier 3 - \$200,000 | S&P/ASX 200 |
| 4 | Tier 3 - \$200,000 | Ordinary equities not included in the S&P/ASX 200 |
| 5 | Tier 3 - \$200,000 | Non-standard equity market products including ETFs, ETNs, hybrids and other class B listed securities (or non-primary listed securities) e.g. partly protected or non-voting securities |

⁹ Market Integrity Rule 4.2.1 allows a transaction to be executed without pre-trade transparency where the consideration for the transaction exceeds a specified threshold. Three different thresholds are where defined based on stock liquidity. ASIC publishes a list of products that fall within each tier its website: www.asic.gov.au/asic/ASIC.NSF/byHeadline/Block%20trade%20tiers.

Annexure B: Market quality variable definitions

| Variable | Definition |
|------------------------------|---|
| Quoted bid ask spreads (bps) | (Best ask price – best bid price) / midpoint price calculated every 1 minute during the trading day and averaged over the day. |
| Quoted bid ask spreads (\$) | Best ask price – best bid price calculated every 1 minute during the trading day and averaged over the day. |
| Tick constraint | Percentage of minutes during the trading day when the (best ask price – best bid price) is equal to the minimum tick size. |
| Volatility | The standard deviation of the individual minute to minute log midpoint price changes during the trading day. This measure is also calculated using 5 minute price changes. |
| Depth (shares) | The average of Best Bid Depth and Best Ask Depth where, Best Bid (Ask) Depth is the average bid (ask) volume of shares at the best bid (ask) not including hidden orders, calculated every 1 minute during the trading day, and then averaged over the day. |
| Depth (% issued shares) | As per Depth (shares), but divided by the number of shares outstanding. |

Annexure C: Weekly market quality by stock group

Figure 7: Quoted spread by stock grouping measured in basis points

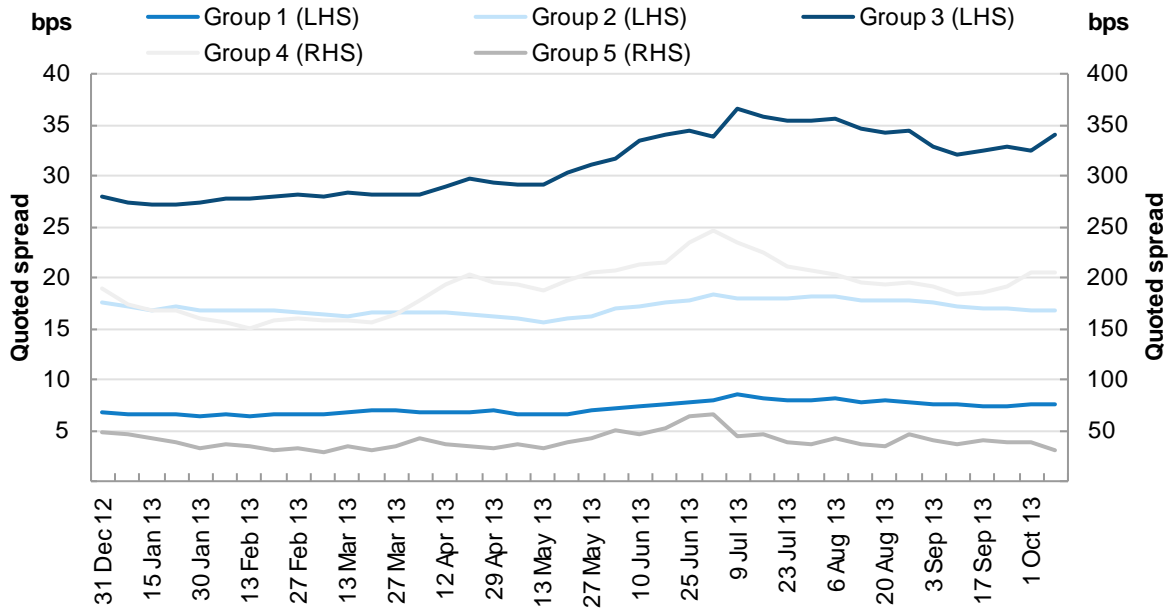


Figure 8: Quoted spread by stock grouping measured in nominal dollar terms

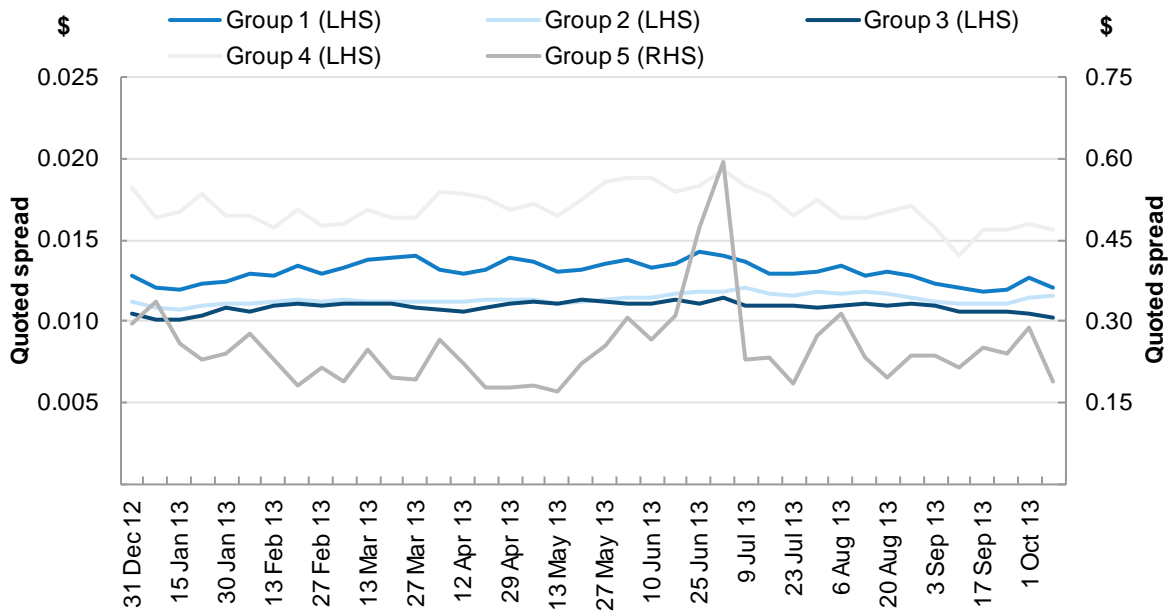


Figure 9: Percentage of the day each stock group is tick constrained on average

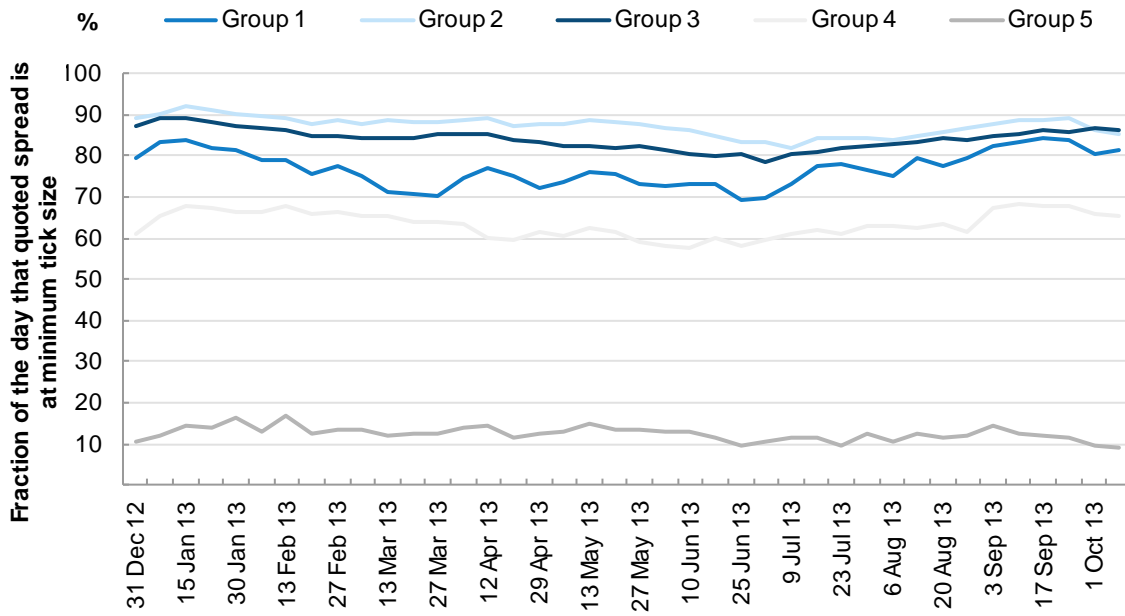


Figure 10: One minute volatility by stock group

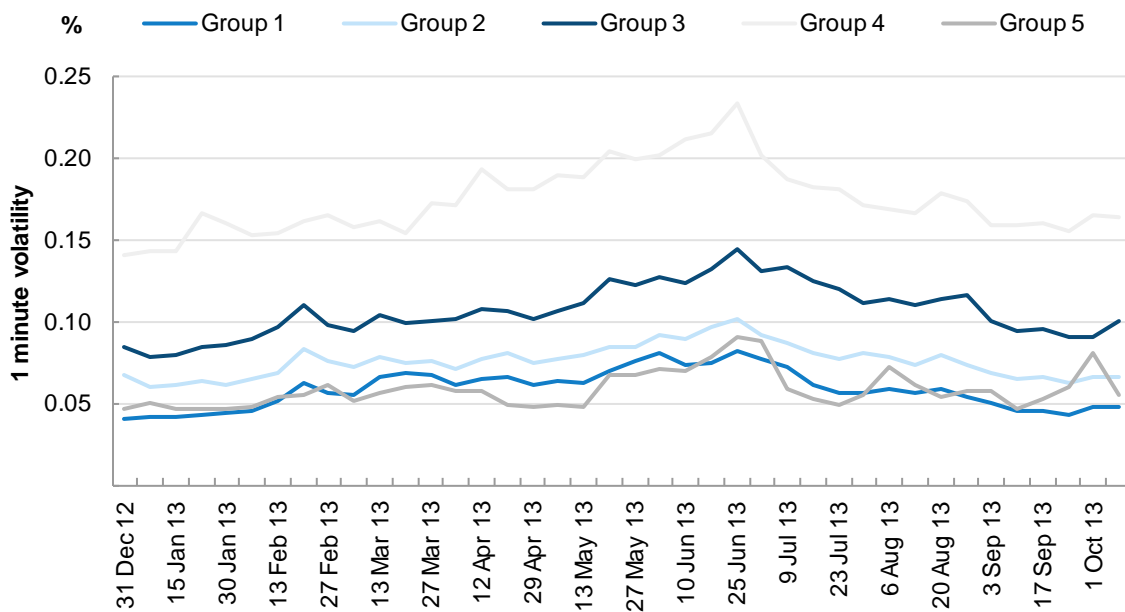
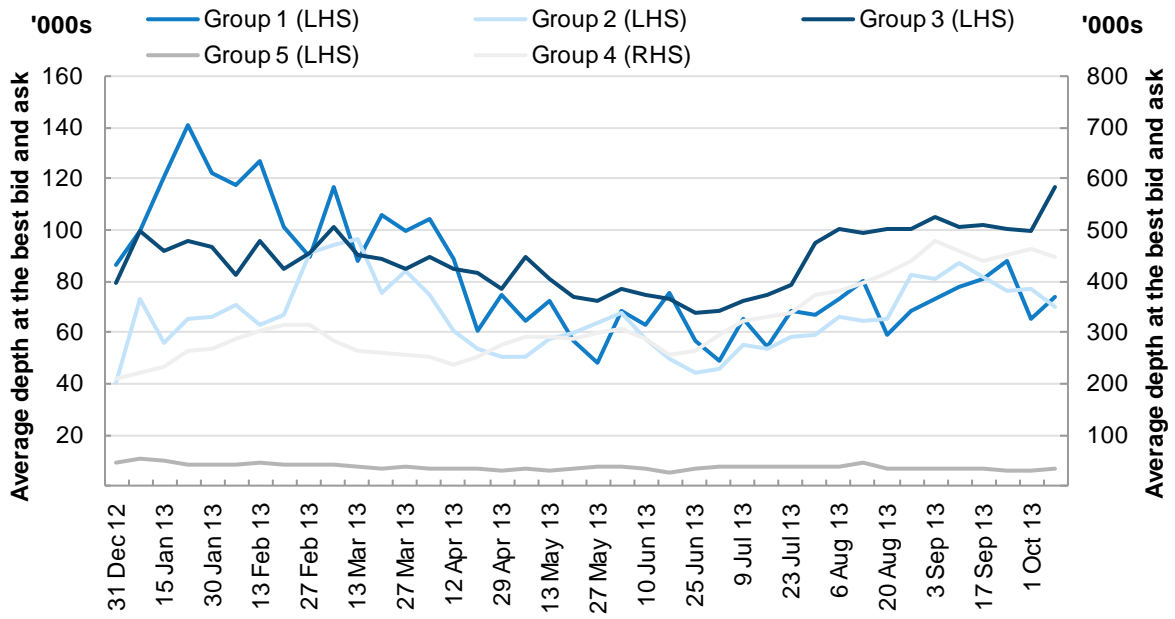


Figure 11: Average depth by stock group



Annexure D: Instrumental variable regression

Empirical approach

- 54 To control for potential endogeneity, the 26 May 2013 rule changes are used in a two-stage least squares regression. In the first stage, the level of below block size dark trading in stock i is regressed on a dummy variable that takes a value of 0 before, and 1 after, the rule change, and a time trend to remove any general trends in below block size dark trading unrelated to the rule change.

$$Dark_{i,t} = \alpha + \beta_1 PrePostDummy_t + \beta_2 TimeTrend_t + \varepsilon_{i,t} \quad (2)$$

- 55 Where:

- $Dark_{i,t}$ is the fraction of dollar volume in stock i on day t that is traded in the dark, below block size.
- $PrePostDummy_t$ is dummy variable relating to the rule change.
- $TimeTrend_t$ is a time trend variable that takes a value of 0 on the first day of the sample and increases by 0.1 each trading day.

- 56 This first stage is repeated replacing below block size dark trading with block trading.

- 57 The second stage regression estimates the impact of below block size dark and block trading on spreads, using the fitted values for below block size dark and block trading obtained from estimating equation (2) and controlling for other factors:

$$Spread_{i,t} = \alpha_i + \beta_1 \widehat{Dark}_{i,t} + \beta_2 \widehat{Block}_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (3)$$

- 58 Where:

- $Spread_{i,t}$ is the quoted bid-ask spread measured in basis points. The spread is measured every minute, and averaged across the trading day for each stock.
- $\widehat{Dark}_{i,t}$ and $\widehat{Block}_{i,t}$ are the fitted values obtained from equation (2) for the level of below block size dark and block trading in stock i on day t .
- $X_{i,t}$ is a vector of control variables, including the same variables outlined for equation (1).

- 59 To assess the strength of our instrumental variables, F-tests of the null hypothesis that the instruments do not enter the first stage regression are conducted. The results suggest that the tests do not suffer from a weak instruments problem.

Regression results

60 Table A.2 reports the first stage results. Panel A reports the results for below block size dark trades, and Panel B reports the results for block trades. Panel A shows that the 26 May 2013 rule changes lead to a statistically significant decline in average below block size dark trading in all stock groups. There is variation in the magnitude of the change across the stock groups, with Group 2 exhibiting the largest decrease of 10% for the average stock in this group. Only the Group 1 stocks exhibited a statistically significant time trend in below block size dark trading. Groups 2 to 4 had no statistically significant time trend in the fraction of dollar volume executed in below block size dark trades.

Table A.2: First stage instrumental variables regression results by stock group

| | Group 1 | | Group 2 | | Group 3 | | Group 4 | | Group 5 | |
|---|----------|-------|----------|-------|----------|--------|----------|--------|----------|-------|
| | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat |
| Panel A: Dark trades below block size (% dollar volume) | | | | | | | | | | |
| Intercept | 0.101 | 6.60 | 0.206 | 10.69 | 0.171 | 24.42 | 0.097 | 37.26 | 0.014 | 4.46 |
| PrePostDummy | -0.031 | -5.20 | -0.096 | -8.53 | -0.08 | -11.90 | -0.088 | -33.94 | -0.012 | -2.67 |
| TimeTrend | 0.002 | 2.23 | 0.001 | 0.92 | 0.001 | 0.42 | 0.000 | 1.57 | 0.000 | 0.32 |
| Obs | 4,368 | | 4,649 | | 30,561 | | 207,768 | | 16,958 | |
| Adj R ² | 0.01 | | 0.14 | | 0.10 | | 0.06 | | 0.01 | |
| Panel B: Block trades (% dollar volume) | | | | | | | | | | |
| Intercept | 0.049 | 6.30 | 0.044 | 6.34 | 0.014 | 3.91 | 0.001 | 1.06 | 0.004 | 1.59 |
| PrePostDummy | 0.006 | 0.58 | 0.012 | 1.20 | 0.022 | 4.55 | 0.008 | 6.15 | 0.002 | 0.58 |
| TimeTrend | 0.002 | 2.47 | 0.002 | 2.70 | 0.002 | 3.92 | 0.000 | 0.00 | 0.000 | 1.20 |
| Obs | 4,368 | | 4,649 | | 30,561 | | 207,768 | | 16,958 | |
| Adj R ² | -0.02 | | -0.02 | | -0.03 | | 0.00 | | 0.00 | |

Table A.2 reports coefficient estimates from the first stage of the instrumental variables regression in equation (2) where the 26 May 2013 dark trading rules are used as an instrument for the level of below block size dark trading and block trading. Where:

- *PrePostDummy* is a dummy variable that takes the value of 0 before, and 1 after, the rule change.
- *TimeTrend* is a time trend variable that takes a value of 0 on the first day of the sample, and increases by 0.1 each trading day.
- Standard errors are clustered by stock and by date.

61 Panel A reports results for below block size dark trading, and Panel B reports results for block trading.

- 62 Panel A shows that there were statistically significant decreases in the level of below block size dark trading for all stock groups following the rule change. Only Group 1 stocks exhibited a statistically significant upward trend in below block size dark trading over time.
- 63 The *PrePostDummy* variable in Panel B shows that there was no statistically significant change in the level of block trading in Group 1 stocks, which experienced no change in the block trade threshold. Similarly, Group 2 stocks also exhibited no significant change following the rule change. In contrast, in Groups 3 and 4, where the threshold for block trades was lowered to \$200,000, stocks exhibited statistically significant increases in the average level of block trading after 26 May 2013. The increase for the average stock was largest in Group 3 stocks. The *TimeTrend* variable shows that there was a statistically significant upward trend in blocks in Groups 1, 2 and 3.
- 64 Table A.3 reports the second stage results. These results show that after controlling for the rule change and time trend, the association between spreads and below block size dark/block trading is statistically insignificant in all stock groups. Therefore, it is possible to conclude that after controlling for the 26 May 2013 rule change there is no association between below block size dark/block trading and bid-ask spreads.

Table A.3: First stage instrumental variables regression results by stock group

| | Group 1 | | Group 2 | | Group 3 | | Group 4 | | Group 5 | |
|--------------------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|
| | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat | Estimate | tstat |
| Intercept | 88.9 | 6.2 | 100.0 | 3.8 | 180.0 | 9.1 | 1246.8 | 11.0 | 106.2 | 2.8 |
| Fitted Dark | -21.9 | -1.4 | 8.0 | 0.8 | 20.0 | 0.6 | -1370.1 | -1.6 | 10017.2 | 0.6 |
| Fitted Block | 4.1 | 0.2 | 4.0 | 0.1 | 37.2 | 0.6 | 376.9 | 0.1 | 4403.1 | 1.3 |
| Trading Activity | -9.1 | -6.8 | -11.4 | -4.2 | -23.2 | -8.8 | -260.2 | -34.1 | -49.7 | -4.6 |
| Volatility | 119.3 | 3.8 | 177.4 | 5.0 | 285.8 | 12.6 | 884.8 | 38.4 | 1003.3 | 11.7 |
| Obs | 4,361 | | 4,647 | | 30,538 | | 206,274 | | 16,138 | |
| Adj R ² | 0.58 | | 0.36 | | 0.55 | | 0.27 | | 0.17 | |

Table A.3 reports coefficient estimates from the second stage of the instrumental variables regression in equation (3). Where:

- The dependent variable is the time-weighted average proportional quoted bid-ask spread measured in basis points.
- The independent variables $\widehat{Dark}_{i,t}$ and $\widehat{Block}_{i,t}$ are the fitted values obtained from equation (2) for the level of below block size dark and block trading in stock i on day t .
- *TradingActivity* is the natural log of the total number of trades.
- *Volatility* is the standard deviation of log midpoint price changes calculated at 1 minute intervals over the trading day.
- Standard errors are clustered by stock and by date.