ASIC
Australian Securities & Investments Commission

REPORT 452

Review of high-frequency trading and dark liquidity

October 2015

About this report

This report presents findings from our 2015 reviews of high-frequency trading and dark liquidity.

This report:

- builds on our analysis of equity markets published in Report 331 *Dark liquidity and high-frequency trading* (REP 331);
- analyses specific trading attributes associated with high-frequency trading in both equities and futures admitted to trading on Australian exchange markets, and dark liquidity in equities; and
- informs investors and consumers, market participants and listed entities about the markets in which they invest and raise capital.

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Regulatory guides: give guidance to regulated entities by:

- explaining when and how ASIC will exercise specific powers under legislation (primarily the Corporations Act)
- explaining how ASIC interprets the law
- describing the principles underlying ASIC's approach
- giving practical guidance (e.g. describing the steps of a process such as applying for a licence or giving practical examples of how regulated entities may decide to meet their obligations).

Information sheets: provide concise guidance on a specific process or compliance issue or an overview of detailed guidance.

Reports: describe ASIC compliance or relief activity or the results of a research project.

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This report does not constitute legal advice. We encourage you to seek your own professional advice to find out how the Corporations Act and other applicable laws apply to you, as it is your responsibility to determine your obligations.

Examples in this report are purely for illustration; they are not exhaustive and are not intended to impose or imply particular rules or requirements.

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Executive summary

1 Our financial markets play a critical role in the Australian economy. They provide the infrastructure for businesses to raise capital and manage risk, and for investors to invest and manage risk. It is vital that our markets are fair, orderly, transparent and efficient and that investors can have trust and confidence in their operation.

2 There have been enormous advances in technology within our markets in recent years. Trading in exchange market products is highly automated—with the vast majority of orders generated and executed by computer algorithms. This is largely the case for the full spectrum of market users, from firms that trade their own capital (e.g. high-frequency traders) through to market participants that trade on behalf of clients.

3 At the same time, there have been significant developments with the venues on which trading occurs. Exchange markets have expanded their dark trading facilities and service offerings, while market participant-operated dark pools (crossing systems) have continued to evolve.

4 High-frequency trading and dark liquidity have been two of the most topical market structure issues globally over recent years. In 2012, ASIC taskforces assessed the effect of high-frequency trading and dark liquidity on the quality and integrity of our equity markets. Those reviews culminated in:

(a) Report 331 *Dark liquidity and high-frequency trading* (REP 331) and Consultation Paper 202 *Dark liquidity and high-frequency trading: Proposals* (CP 202);

(b) action where breaches of the law were detected; and

(c) new and amended ASIC market integrity rules to address some of the concerning behaviour we observed, particularly with crossing systems.

5 During 2015, we have undertaken two new reviews of high-frequency trading and dark liquidity. The aim of these reviews has been to update and build on our earlier analysis of equity markets and to assess the effect of high-frequency trading on the futures market.

6 The reviews indicate that the existing regulatory settings for high-frequency trading and dark liquidity, including reforms we introduced in response to the findings of our 2012 reviews, are largely adequate and effective.

7 The current levels of high-frequency trading and dark liquidity in our markets do not appear to be adversely affecting the function of our markets or their ability to fulfil their role for businesses and investors in the real economy. Further, concerns about these and other market structure developments in overseas markets are not at concerning levels in our markets.

8 As a result, no further regulation specifically addressing high-frequency trading or dark liquidity is proposed at this stage but we will continue to monitor developments involving these and other markets issues.

9 The 2015 reviews involved:

(a) stakeholder engagement, including over 40 meetings with fund managers, market participants, high-frequency traders and market operators. Over 20 separate meetings on principal trading and facilitation with market participants, fund managers and overseas regulators;

(b) in-depth analysis of equity and futures order and trade data; and

(c) literature review, including research by academics and other regulators.

High-frequency trading review—key findings

10 Negative sentiment about high-frequency trading appears to have tapered off. Market users have become better informed and equipped to operate in an electronic and high-speed environment: see paragraphs 34–35.

Equity markets

11 The level of high-frequency trading in our equity markets is reasonably steady at 27% of total turnover (this is comparable to Canada, the European Union and Japan). However, the concentration of high-frequency trading in our markets is higher, with 30% fewer high-frequency trading accounts. Trading is also more active in mid-tier securities than in 2012: see paragraphs 44–63.

12 High-frequency traders are trading somewhat more aggressively than in 2012, while still contributing significantly to the orders at the best displayed prices: see paragraphs 88 to 92.

13 High-frequency traders appear to have become more sophisticated. Compared to 2012, they are better at avoiding interacting with one another and they are extracting larger gross trading revenues. We estimate that they earned $110–180 million in aggregate over the 12 months to 31 March 2015. This translates to a cost of 0.7 to 1.1 basis points to other market users. This is material, but substantially less than other figures suggested by some, and less than some other trading costs (e.g. average bid–offer spreads are 13 basis points). We are in a unique position to make this estimate because we have a complete view of all orders and trades, including participant and client identifiers: see paragraphs 49–52 and 93–98.

14 High-frequency trading does not appear to be a key driver of transaction costs. It appears that higher levels of high-frequency trading assist in lowering transaction costs for low turnover securities: see paragraphs 99–106.

15 Some concerns about predatory trading remain (i.e. where trading is undertaken to exploit others or unfairly induce them to trade). While not excessive in our markets, predatory trading can adversely affect the trading outcomes for fundamental investors (those who buy or sell on an assessment of intrinsic value). Fundamental investors remain our regulatory priority and unchecked predatory trading can undermine our objectives for those investors to have confidence and trust in our markets and for our markets to be fair, orderly, transparent and efficient: see paragraphs 107–123.

Futures market

16 High-frequency trading has grown rapidly in the futures market (130% since December 2013), although from previously low levels. High-frequency trading in the S&P/ASX 200 Index Futures Contract (SPI) accounts for 21% of traded volume and in the Three Year and Ten Year Commonwealth Treasury Bond Futures Contracts (bond futures) it accounts for 14% of traded volume. While these levels do not currently concern us, we are closely monitoring growth: see paragraphs 137–140.

17 As a result of our review, we are conducting inquiries into a number of traders for excessive order entry and cancellation in the ASX 24 market during the quarterly expiries (i.e. the 'roll'). This practice affects other market users because it prevents the prioritisation of their orders and forces them to cross the spread (i.e. pay more). We have asked ASX to consider what steps may be taken to discourage this practice: see paragraphs 158–168.

Key statistics

18 Some of the key statistics from our analysis for the March quarter 2015 are summarised in Table 1. It shows that while high-frequency traders comprised a small fraction of all market users, they were responsible for a substantial portion of trading activity in equities, the SPI and bond futures.

Table 1: Key statistics on high-frequency trading

Measure	Equities	SPI	Bond futures
Trading accounts	<0.5%	2%	4%
Turnover	27%	21%	14%
Number of trades	31%	25%	24%
Number of orders	47%	30%	40%

Dark liquidity review—key findings

19 There has been a partial shift back to using dark liquidity for its original purpose, namely large block trades to reduce market impact. This is a positive development and, in part, a response to the lowering of block trade thresholds in May 2013: see paragraphs 180–187.

20 Many of the concerning trends with crossings systems that we identified in 2012 have abated. The reasons for this are likely due to buy-side clients demanding improved standards and ASIC market integrity rules introduced to enhance fairness and improve transparency around the operation of crossing systems: see paragraphs 199–205.

21 There has been a decline in the use of crossing systems and growth in the use of the exchange dark venues (i.e. ASX Centre Point and Chi-X hidden orders). This is likely a response to the trade with price improvement rule introduced in May 2013, and a lack of price improvement opportunities in crossing systems: see paragraphs 206–210.

22 There is a trend here and overseas toward exchange and crossing system operators seeking to preference some market users over others (e.g. better or worse order execution priority) for dark trading. These developments have the potential to undermine fair and non-discriminatory trading and may be inconsistent with operators' obligations. We are unlikely to support any form of preferencing where it unduly favours some market users over others, unfairly limits access to market facilities, or otherwise results in the unfair treatment of orders or market users: see paragraphs 237–252.

23 We have concerns about how some market participants are managing their conflicts of interest for principal trading and client facilitation. Market participants should review their arrangements to protect clients' trading intentions, manage conflicts of interest, avoid the risks of insider trading, conduct compliance and supervision and have appropriate incentive structures. They should avoid situations where staff are responsible for the participant's own trading while having access to unexecuted client orders. Additional controls, including physical separation, should be put in place to manage the conflicts and conduct risk arising from active facilitation: see paragraphs 253–269.

Next steps

24 We will continue to monitor these developments, including the growth of high-frequency trading in the futures market and the costs imposed on others by high-frequency trading (compared to the benefits). Our surveillance focus on predatory trading will continue and we will actively enforce market misconduct laws. We will inform the market of our progress on the futures roll issue. We will also continue our forward-looking review of the purpose of markets and their fundamental role in an environment of rapid change. We will continue to publish market statistics on our website.

A High-frequency trading

Key points

We analysed trading on Australian equity markets from 1 January 2012 to 31 March 2015 to assess what has changed since our 2012 review and to build on that earlier work. We also analysed trading in the SPI and bond futures for the period 1 December 2013 to 31 March 2015.

The level of high-frequency trading in equity markets remains reasonably steady at 27% of total turnover. However, there is more concentration, with the 10 largest high-frequency traders accounting for 78% of all high-frequency trading turnover compared to 64% in 2012. Activity has increased markedly in lower-tiered securities.

High-frequency traders in equity markets have become more sophisticated. They are trading more aggressively and are better at avoiding one another. They are extracting larger gross trading revenues and imposing more costs on other market users, although these costs are relatively small compared to other trading costs.

Some institutional investors have also become more sophisticated, increasingly managing their own order flow and execution decisions so they can limit 'information leakage' and interaction with 'predatory' traders.

There are market users who remain concerned about predatory trading. Where the interests of fundamental investors and predatory traders are misaligned our priority is ensuring fundamental investors have trust and confidence in our markets.

High-frequency trading is rapidly growing in the futures market. A few high-frequency traders are 'crowding out' other market users from the futures roll and we are taking steps to address the issue.

Purpose

25 The scope of our analysis on high-frequency trading is equities and futures admitted to trading on Australian exchange markets. We have separately examined the role of high-frequency traders in price movements around recent Reserve Bank of Australia interest rate announcements and will comment on those findings in due course.

26 This section outlines the findings of the high-frequency trading review:

(a) *A1 Analysis of high-frequency trading in Australian equity markets*—summarises the characteristics of high-frequency trading in Australian equity markets in the 300 most heavily traded equity securities (see paragraphs 39–77);

(b) *A2 Perceptions of high-frequency trading in equity markets*—outlines stakeholder concerns on high-frequency trading in equity markets and presents our findings on those areas of concern (see paragraphs 78–127);

(c) *A3 Analysis of high-frequency trading in the Australian futures market*—summarises the characteristics of high-frequency trading in the SPI and bond futures (see paragraphs 128–153); and

(d) *A4 Perceptions of high-frequency trading in the futures market*—outlines stakeholder concerns on high-frequency trading in the SPI and bond futures and presents our findings on those areas of concern (see paragraphs 154–168).

Background

27 High-frequency trading has been defined in various ways. Consistent with the approach taken in 2012, we use the definition of the International Organization of Securities Commissions (IOSCO), which lists a number of common characteristics with which to identify high-frequency trading:

- the use of sophisticated technological tools for pursuing a number of different strategies, ranging from market making to arbitrage;
- a highly quantitative tool that employs algorithms along the whole investment chain: analysis of market data, deployment of appropriate trading strategies, minimisation of trading costs and execution of trades;
- characterised by a high daily portfolio turnover and order-to-trade ratio (i.e. a large number of orders are cancelled in comparison to trades executed);
- usually involves flat or near flat positions at the end of the trading day, meaning that little or no risk is carried overnight, with obvious savings on the cost of capital associated with margined positions. Positions are often held for as little as seconds or even fractions of a second;
- mostly employed by proprietary trading firms or desks; and
- latency sensitive. The implementation and execution of successful HFT [high-frequency trading] strategies depend crucially on the ability to be faster than competitors and to take advantage of services such as direct electronic access and co-location.[1]

28 Many of the attributes described above are not confined to entities that identify themselves, or are identified by others, as 'high-frequency traders'. Many investors and market participants exhibit a number of these attributes—using sophisticated technology for trading, and algorithms to control orders and make execution decisions according to predetermined parameters.

29 Our analysis shows that a small group of entities dominate high-frequency trading. They are specialised trading desks within major investment banks,

[1] Technical Committee of IOSCO, *Regulatory issues raised by the impact of technological changes on market integrity and efficiency* (PDF 587 KB), IOSCOPD354, final report, July 2011.

proprietary trading firms and some hedge funds. In this report we refer to those entities as 'high-frequency traders'.

From our 2012 review to now

30 In the years before our 2012 review, high-frequency trading received considerable attention from financial commentators and mainstream media.

31 Our 2012 review found that it was not just high-frequency traders creating noise (i.e. excessive orders and cancellations) in our markets. We concluded that the regulatory framework to address automated trading in Australia was broadly adequate and recommended some additional controls. Some of the controls we have put in place include:

(a) extreme price movement rules for ASX and Chi-X (November 2012);

(b) suspicious activity reporting rules (January 2013);

(c) enhanced data reporting rules (October 2013); and

(d) additional rules to require direct and immediate control over orders and certification of automated order processing (AOP) systems (May 2014).

32 However, together with market operators and market users, we still need to continue to monitor developments in our markets.

33 Since our 2012 review, high-frequency trading has continued to attract the attention of market users and regulators. There have been numerous developments overseas, including:

(a) new trading venues—such as Aequitas NEO Exchange (Aequitas) in Canada and IEX Group in the United States—emerging to 'level the playing field'. Features such as 'speed bumps' and preferencing non-high-frequency traders have been introduced to minimise interaction with, and the effects of, high-frequency traders;

(b) some overseas jurisdictions extending their regulatory reach over high-frequency traders, requiring core organisational or operational obligations to apply to high-frequency trading firms.[2] Examples include:

(i) Germany's *High Frequency Trading Act* which makes high-frequency trading a licensed activity (and applies a penalty fee for excessive order entry);[3]

(ii) the European Union's extension of the Markets in Financial Instruments Directive (MiFID) to high-frequency traders;[4] and

[2] In Australia, these types of obligations already apply to high-frequency traders that are direct participants of an Australian exchange market.
[3] Federal Financial Supervisory Authority (BaFin), *Translation of the main provisions of the High Frequency Trading Act (Hochfrequenzhandelsgesetz)*, 8 January 2014.
[4] Markets in Financial Instruments Directive 2014/65/EU (MiFID II) (EU).

(iii) the US proposal for high-frequency traders to be registered with the Financial Industry Regulatory Authority (FINRA);[5]

(c) some governments seeking to target high-frequency trading through taxation. France and Italy currently impose a tax at a domestic level, while 11 member states of the European Union are in discussions on a proposed pan-EU financial transaction tax;

(d) regulators being urged to re-examine maker–taker pricing models over growing concerns of its contribution to incentivising high-frequency trading and potentially distorting trading behaviour. Maker–taker pricing models generally involve the exchange market operator providing a payment for price makers, while price takers pay a fee. In the United States, legislation has been proposed to prohibit maker–taker pricing.[6] In addition, Nasdaq OMX Group, Inc. conducted a pilot program to test the effect of the level of rebates, and found that when it reduced its rebates, its market share decreased;[7] and Intercontinental Exchange/New York Stock Exchange (ICE/NYSE) proposed the 'grand bargain', which included lowering market access fees;[8]

(e) some high-frequency trading firms entering public capital markets with their own share offerings. For example, the reverse merger by Getco Holding Co, LLC of Knight Capital Group, Inc. to form KCG Holdings, Inc., and the initial public offerings in 2015 of US-based Virtu Financial, Inc. (valued at US$2.6 billion) and the Netherlands-based Flow Traders N.V. (valued at €1.5 billion). These events provide insights into the value that the market places on their profitability; and

(f) regulators, governments and academics continuing to assess the effect of high-frequency trading on markets globally, including in-depth reviews undertaken in the European Union and Canada.[9]

Stakeholder engagement—observations

34 The negative sentiment toward high-frequency trading in domestic equity markets appears to have tapered off since 2012. The regulatory settings, at least for equities, are generally considered to be appropriate.

35 The industry appears to be better informed and equipped to operate in an electronic and high-speed environment. Market users have greater access to

[5] FINRA, *Registration of associated persons who develop algorithmic trading strategies* (PDF 102 KB), 15-06, regulatory notice, March 2015.
[6] The *Maker–Taker Conflict of Interest Reform Act (US)* of 2015 was proposed by Congressman Stephen Lynch.
[7] Frank Hatheway, *NASDAQ access fee experiment* (PDF 69 KB), report II, NASDAQ, May 2015.
[8] Sam Mamudi, *NYSE proposes market overhaul in bargain with dark pools*, article, Bloomberg,18 December 2014.
[9] See IIROC, *Identifying trading groups—methodology and results* (PDF 935 KB), administrative notice 14-0210, 9 September 2014; and ESMA, *High-frequency trading activity in EU equity markets* (PDF 1.87 MB), number 1, economic report, 17 December 2014.

information and tools to avoid high-frequency traders. Some buy-side firms now make their own execution choices and operate algorithms themselves.

36 However, concerns were expressed about predatory trading, market noise (excessive order entry and cancellation), contribution to price volatility and the cost that high-frequency trading imposes on other market users. High-frequency traders have been described as 'toll takers', effectively imposing a 'tax' on execution. Some suggest that market operators are exacerbating the problem with faster (and more expensive) technology and data offerings.

37 With regard to futures, many market participants and buy-side firms raised concerns about being 'crowded out', particularly during the futures roll. To address these concerns, it was suggested that ASIC and ASX should consider removing short-term rental of market gateways from ASX. It was also raised whether:

(a) orders should not be automatically purged at the end of each trading session;

(b) block trading should be permitted during the futures roll; and

(c) there should be further reduction of tick sizes (price increments).

38 There were some remarks about poor-quality filters and controls of some market participants in the futures market. We will consider extending aspects of the regulatory framework for AOP in equity markets to futures as part of our market integrity rule harmonisation in 2016.

A1 High-frequency trading in Australian equity markets

Our approach

39 We analysed trading data across exchange markets and dark trading venues in equity market products over the period 1 January 2012 to 31 March 2015.

40 Unless specifically noted, our analysis is based on the 300 most heavily traded securities for each trading day. We ranked all securities in the equity markets each day by the value traded (the most heavily traded security is ranked '1') and separated them into five bands:

(a) *Band 1*—securities ranking 1 to 50;

(b) *Band 2*—securities ranking 51 to 100;

(c) *Band 3*—securities ranking 101 to 150;

(d) *Band 4*—securities ranking 151 to 200; and

(e) *Band 5*—securities ranking 201 to 300.

41 As with our approach in REP 331, we identified a number of attributes that could be consistently measured and that relate to the characteristics of high-frequency trading outlined in paragraph 27. These were:

(a) total turnover per day;

(b) inventory traded within a day;

(c) order-to-trade ratios;

(d) the number of fast messages;

(e) holding times; and

(f) revenue captured per dollar traded (as a proxy for sophistication).

42 These measures are discussed in paragraphs 54–77 and our approach is set out in more detail in the appendix at paragraphs 270–274.

43 Measures of high-frequency trading differ by jurisdiction and by researcher, based on the availability of data and their view of relevant attributes.[10] Studies by the Investment Industry Regulatory Organization of Canada (IIROC) initially focused on firms that had a high order-to-trade ratio but more recently have drawn on machine learning techniques (27% of dollar value traded and 38% of trades executed).[11] The European Securities and Markets Authority (ESMA) had a dual approach, focusing on the primary business of each firm and the types of algorithms they use (24% of value traded), and statistics such as order-to-trade ratio or the length of time orders rest before they are amended or cancelled (43% of value traded).[12] Studies in Japan have focused on a range of high-frequency trading attributes (20-45% of value traded).[13]

High-frequency traders in Australian equity markets

44 High-frequency traders are a small fraction of total market users (less than 0.5%). This remains consistent with our 2012 findings.

45 In 2012, there was a broadly equal breakdown in high-frequency trading turnover between proprietary trading desks within investment banks, proprietary trading firms and hedge funds. Now, proprietary desks within investment banks are conducting relatively less high-frequency trading.

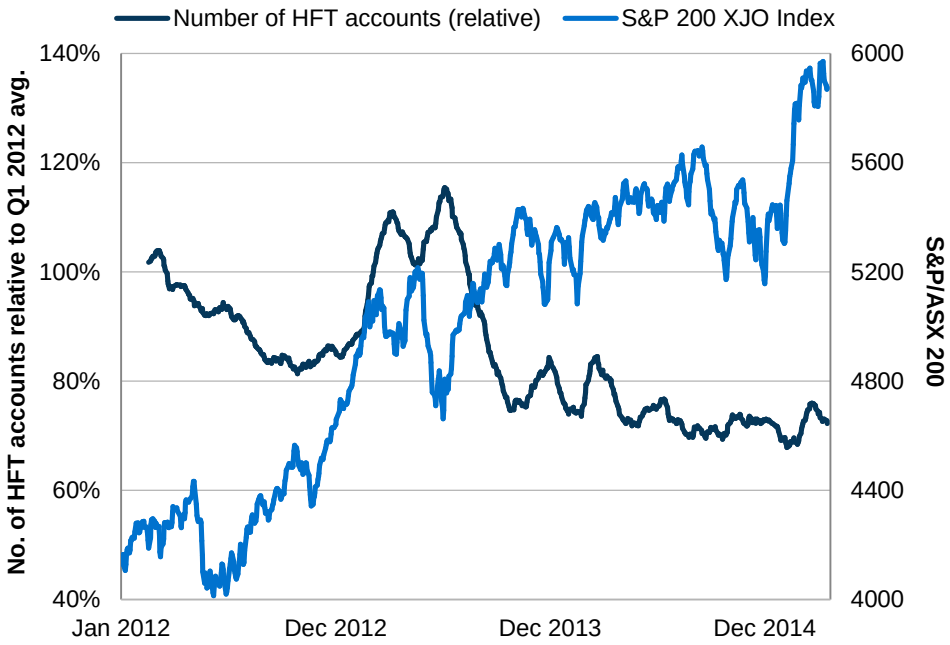
46 There is greater concentration of high-frequency traders in Australian equity markets as the number of traders has declined by 30% over the past three years. In the March quarter 2012, the largest 10 and 20 traders accounted for

[10] We have a unique data set, which provides a complete view of all orders and trades, including participant and client identifiers, which enabled us to analyse high-frequency trading in a relatively granular way.
[11] IIROC, *Identifying trading groups—methodology and results* (PDF 935 KB), administrative notice 14-0210, 9 September 2014.
[12] ESMA, *High-frequency trading activity in EU equity markets* (PDF 1.87 MB), number 1, economic report, 17 December 2014.
[13] Studies in Japan vary, with the proportion of high-frequency trading reported from 20% up to 45%: see, for example, Japan Exchange Group, *JPX working paper: Analysis of high-frequency trading at Tokyo Stock Exchange* (PDF 587 KB), vol. 04, working paper, 20 May 2014 and Robert J. Kauffman, Yuzhou Hu and Dan Ma., 'Will high-frequency trading practices transform the financial markets in the Asia-Pacific Region (PDF 718 KB)', Financial Innovation, (2015) 1:4, 2015.

64% and 88% of all high-frequency trading turnover, respectively. These figures had risen to 78% and 95%, respectively, by the March quarter 2015.

47 As illustrated in Figure 1, growth in trader numbers was apparent in early-2013 as market levels retracted from 2012 lows. Numbers subsequently peaked in mid-2013 during a period of intense volatility. They have since reversed and, since mid-2014, plateaued. This degree of concentration may reflect the technology intensive nature of high-frequency trading and the maturing of that segment of the market.

Figure 1: Relative changes in high-frequency traders and the S&P/ASX 200 XJO Index



48 Potential factors contributing to the fall in the number of high-frequency traders in mid-2013 are:

(a) the cost of trading capital may have increased following a period of market volatility in May 2013. This period (often referred to as the 'taper tantrum') was sparked by suggestions of an end to the US Federal Reserve's quantitative easing policy;

(b) overseas implementation of the 'Volcker rule' may have limited the capacity of some banks to trade on their own behalf;[14] and

(c) market structural changes may have affected the strategies of some high-frequency traders, such as:

(i) the trade with price improvement ASIC market integrity rule;

(ii) the introduction of tiered block trading thresholds; and

[14] § 619 (12 U.S.C. § 1851) of the *Dodd–Frank Wall Street Reform and Consumer Protection Act (US).*

(iii) the cessation of priority crossings.

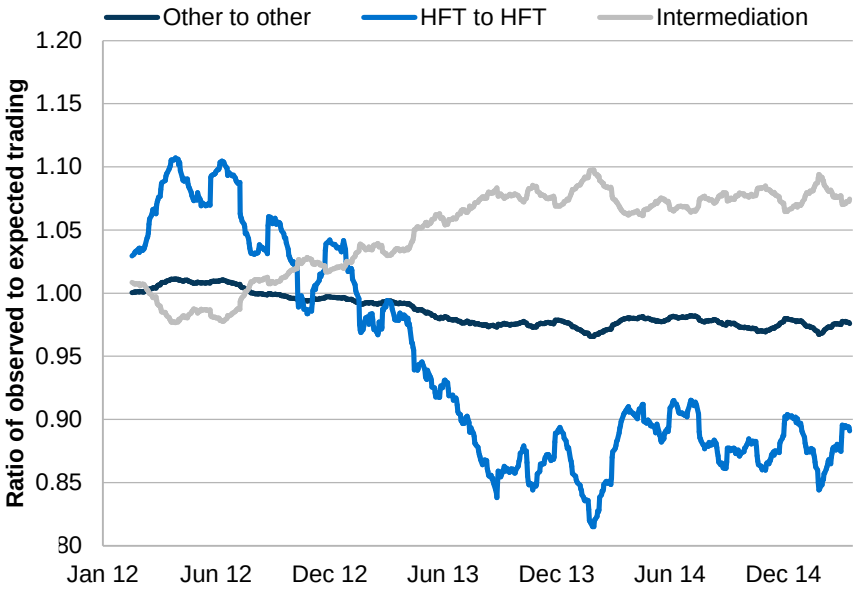
49 The behaviour and trading styles of high-frequency traders have changed over the past three years. For example:

(a) they trade less between themselves (see Figure 2); and

(b) tend to use more aggressive orders (see paragraphs 89–90).

50 Figure 2 charts an 'attraction-avoidance' index for all pairings of market users (i.e. high-frequency traders to high-frequency traders, high-frequency traders to other users and other users to other users). This is expressed as the ratio of actual transactions to expected transactions (as suggested by relative turnover). Levels above 1.00 indicate more trading than should be expected; levels below 1.00 suggest less trading than should be expected.

Figure 2: The ratio of observed trading (in value terms) to expected trading



51 Figure 2 shows the growing trend for high-frequency traders to intermediate (i.e. step in between other buyers and sellers in the market). Possible reasons for this trend are:

(a) high-frequency traders are identifying and avoiding themselves and other high-frequency traders;

(b) the strategies utilised by high-frequency traders have a greater tendency to find other market users as counterparties; and

(c) the traders that left the market in 2013 (see Figure 1) may have been responsible for the majority of high-frequency trader to high-frequency trader activity (Figure 2 indicates that this activity dropped off around the same time).

52 We have highlighted this trend, not because it is concerning to us at current levels, but because it is illustrative of the dynamics in equity markets.

53 High-frequency traders have also changed the venues where they participate. In REP 331, we noted the majority of their trading occurred within a single exchange market. Now, they are increasingly trading across both pre-trade transparent ('lit') exchange markets (i.e. ASX and Chi-X) and exchange dark venues (i.e. ASX Centre Point and Chi-X hidden orders). In contrast, high-frequency trading within market participant-operated crossing systems has trended down: see paragraphs 218–227.

Measures of high-frequency trading in equity markets

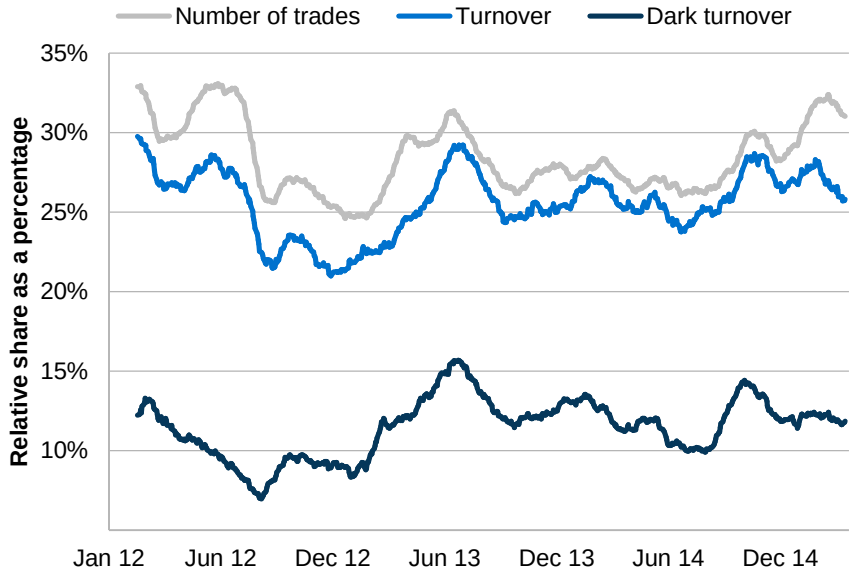
54 We analysed the trading behaviour of high-frequency traders against that of other market users, using the measures listed in paragraph 41.

Total turnover per day

55 Despite high-frequency traders representing a small proportion of overall market users, they collectively account for a relatively large component of total market turnover.

56 Over the March quarter 2012, high-frequency traders accounted for approximately 31% of all transactions and 28% of all turnover.[15] By the March quarter 2015, this remained almost unchanged at 31% of all transactions and 27% of all turnover (with daily fluctuation in between): see Figure 3. This is somewhat consistent with levels of high-frequency trading reported in other jurisdictions: see paragraph 43, for example.

Figure 3: High-frequency traders' relative share of trade count, lit turnover and dark turnover



[15] In REP 331 we reported that high-frequency trading accounted for 27% of total turnover in S&P/ASX 200 securities over the nine-month period from January to September 2012. Our figure of 28% is based on the March quarter of 2012.

57 Fewer high-frequency traders are now responsible for the same level of turnover: see paragraph 46. The diversity of traders conducting high-frequency trading business has declined markedly over the past three years.

58 While the aggregate figures show the overall share of high-frequency trading remained reasonably steady over the March quarter 2012 to the March quarter 2015, it grew strongly outside of Band 1 (i.e. 1–50) securities. Turnover increased by 31% for securities in Band 5 (i.e. 201-300) securities (from 13% over the March quarter 2012 to 17% in the March quarter 2015) and 26% in Band 4 (151–200) securities (from 19% to 24%). See Table 9 of the appendix for additional details.

59 The low growth in relative turnover for Band 1 securities, together with significant expansion in lower turnover securities, suggests that:

(a) high-frequency traders have chosen to broaden the range of securities they trade to grow their business; or

(b) these securities have become relatively more attractive.

60 As discussed in paragraph 105, it appears that increased participation by high-frequency traders in small-tier securities may have contributed to lower transaction costs for other market users.

61 High-frequency turnover in below block size dark trading has increased: see Figure 3. Over 2012, approximately 10% of all dark turnover was traded by high-frequency traders. By March quarter 2015 it was 12% (an increase of 20%). This growth has occurred on exchange dark venues: see paragraph 221.

62 The proportion of lit orders (i.e. new orders, amendments and cancellations) submitted by high-frequency traders has remained steady (47% for both March quarters 2012 and 2015) although numbers have fluctuated within a range of 38–51% over the period: see Figure 21 in the appendix.

63 There has been considerable growth in the proportion of dark orders from high-frequency traders on exchange dark venues, from a low of 16% in early-2012 to between 41–52% of all messages from late-2012 until now: see Figure 21 in the appendix. This reflects a number of factors, including overall growth of these venues (by all market users) and high-frequency traders becoming more sophisticated in their use of the dark (e.g. some immediately explore dark venues for further trading opportunities after every trade).

Inventory traded within a day

64 Inventory traded within a day is the proportion of turnover that is bought and sold, or sold and then bought, within a day.

65 We estimated the extent of intraday trading for all traders on every trading day.[16] This is expressed as a percentage of total traded value. One hundred percent would imply that no positions were held overnight. High-frequency traders tend to conduct most of their trading on an intraday basis, so the value held overnight is small in comparison to their total turnover.

66 Over the March quarter 2015, approximately 82% of all high-frequency trader holdings were closed out within the day—that is, 18% was held overnight.[17] The corresponding rate of trading that was closed out over the March quarter 2012 was slightly lower at 79%.[18]

67 This reflects a tendency for larger high-frequency traders to close out more of their positions. In contrast, smaller high-frequency traders have a greater propensity to carry overnight positions.

Order-to-trade ratios

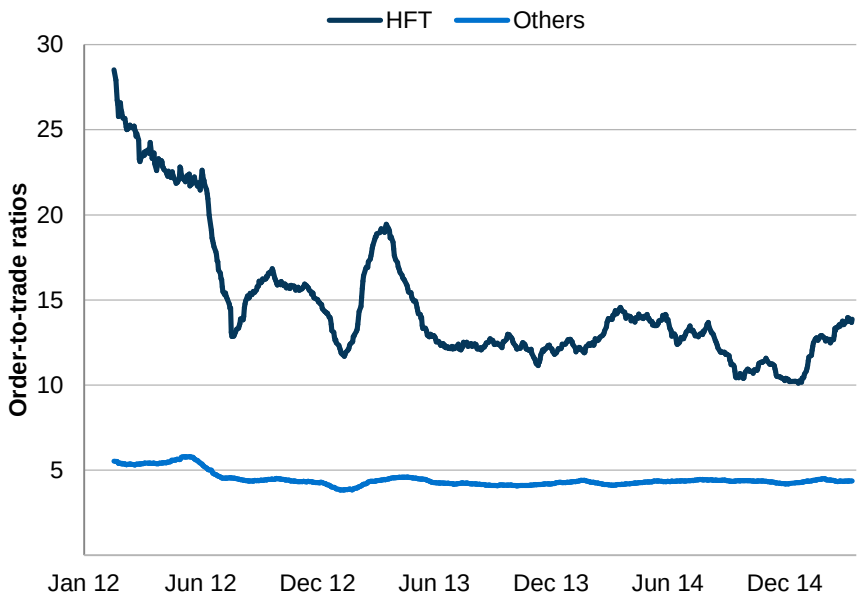
68 An order-to-trade ratio is the number of times orders are amended or cancelled relative to the number of trades. A ratio of 1:1 means every order submitted to a market results in a trade.

69 High-frequency traders tend to operate with the highest order-to-trade ratios in our markets: see Figure 4. Individual order-to-trade ratios vary widely between high-frequency traders. In early-2012, individual ratios in the vicinity of 1000:1 were not uncommon. Such high levels are now rare and, when seen, are indicative of a malfunctioning algorithm rather than a deliberate strategy. In the March quarter 2015, the average order-to-trade ratio for high-frequency traders was 13:1.[19] This suggests a marked reduction in excessive order entry, and it is not a level that is concerning to us.

70 Other market users also use algorithms to manage orders. As identified in REP 331, some other users also operate strategies with high order-to-trade ratios. However, collectively, other users have an average ratio of 4:1.

[16] We define inventory traded as the dollar-weighted average of each security's intraday traded value as a percentage of contributed turnover. This is calculated for each trader. The intraday percentage, for each security, may be simply calculated as one minus the net value traded divided by the gross value traded.
[17] Our analysis did not capture hedging or other derivatives trading, so it is possible that 18% overestimates the real exposure.
[18] In REP 331 we reported that 65% of all high-frequency trading was closed out within a day. In REP 331 our definition used a simple average of 'turnover traded' for each security. Calculating a dollar-weighted average raises the figure by discounting contributions of smaller traders and is more representative.
[19] This is comparable to ratios in Canada, which were 55:4: see IROC, *Identifying trading groups—methodology and results* (PDF 135 KB), administrative notice 14-0210, 9 September 2014.

Figure 4: Average order-to-trade ratios for high-frequency traders and other market users



71 Along with a downward trend in order-to-trade ratios, a skew has also developed across trading bands. In 2012, lower turnover was synonymous with higher ratios; however, that correlation has progressively reversed over the following three years. From the March quarter 2012 to March quarter 2015, the ratio for Band 1 securities fell 43% from 24:1 to 14:1. In Band 5 the ratio fell 70% from 39:1 to 11:1 (see Table 10 in the appendix).

Number of fast messages

72 The vast majority of market users (not just high-frequency traders) is using automated trading. The broad use of automation reduces latencies, lowers order size and increases the number of order messages for all market users. To measure the number of fast messages, we identified all orders that rested in a market for not more than 100 milliseconds (i.e. 1/10th of a second) before being amended or cancelled.

73 In general, both high-frequency traders and other market users are capable of managing orders over extremely short time intervals. Over the March quarter 2012, the average resting time for short-lived orders (i.e. at most 100 milliseconds)[20] was 24 milliseconds for high-frequency traders and 21 milliseconds for other market users.

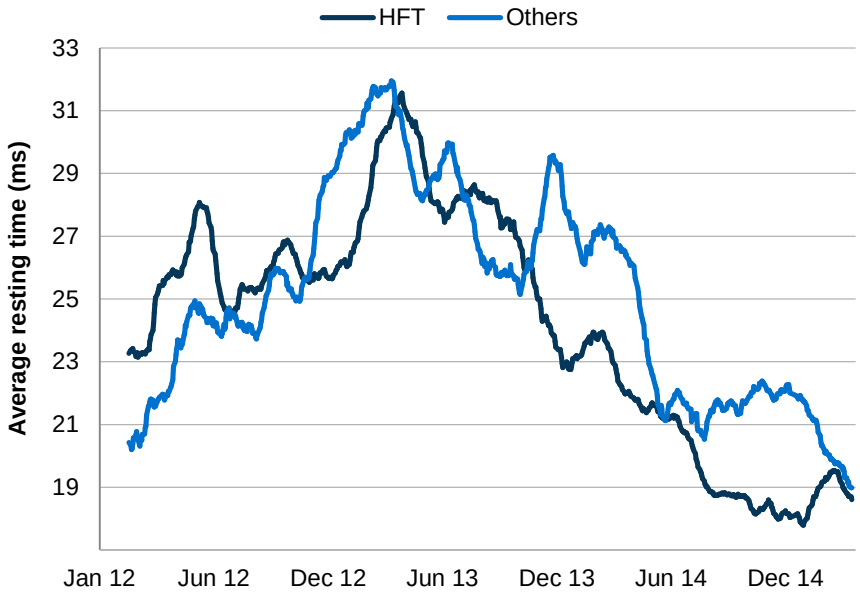
74 As shown in Figure 5, lifetimes of orders for all market users tended to increase over 2012. However, from April 2013 onwards, resting times progressively decreased to below 2012 levels for all market users. By 2015, the average resting period for short-lived orders decreased to 19 milliseconds

[20] This estimate is different to the 40 millisecond window used to define the 'fast message' index in the definition for high-frequency traders.

for high-frequency traders and 20 milliseconds for other market users. However, short-lived orders are not as small as in 2012: see paragraph 79–81.

75 While on average there is little difference between resting times for high-frequency traders and other market users, the fastest high-frequency traders are able to achieve extremely low latencies. We frequently see reactivity of less than a millisecond. This suggests that even among high-frequency traders, some are faster than others.

Figure 5: Average resting times (milliseconds) in market order books



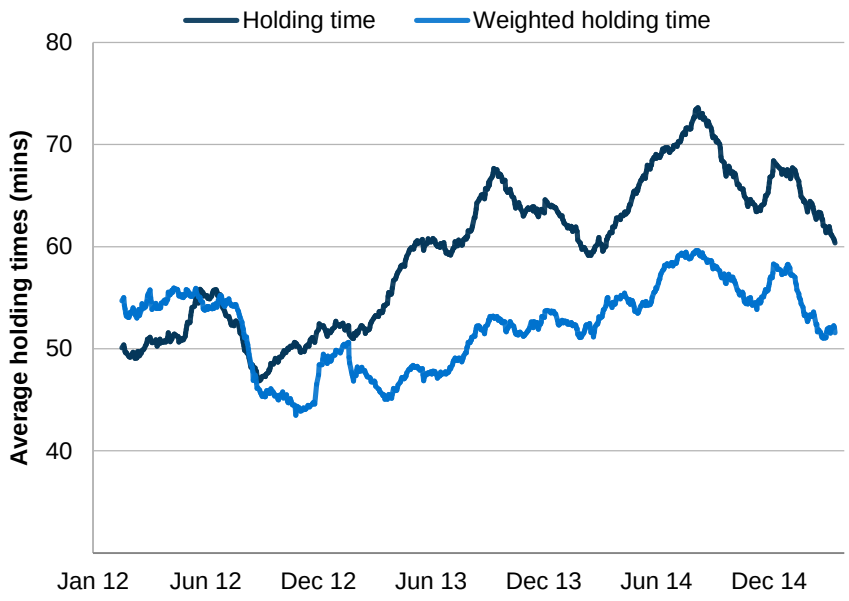
Holding time

76 'Holding time' is the passage of time between the sale and corresponding purchase (or vice versa) of a security. Commentary on high-frequency trading often focuses on the propensity of high-frequency traders to buy and sell within sub-second intervals. However, there is a trend for high-frequency traders to hold securities for longer.

77 Over the March quarter 2012, the turnover-weighted and simple average[21] holding times ran to 54 and 51 minutes respectively: see Figure 6. By 2015, there was a marginal increase to 52 minutes in the weighted average. A more meaningful rise to 62 minutes was evident in the simple average.

[21] Holding times are presented in aggregate terms across the entire market. The 'simple average' includes all high-frequency traders on an equal basis. The 'weighted average' uses dollar turnover by each high-frequency trader to weight each contribution into the daily figure. The weighted average may be used to more accurately specify holding periods on a 'per dollar turnover' basis.

Figure 6: Estimated average holding time (minutes) for equity securities by high-frequency traders



A2 Perceptions of high-frequency trading in equity markets

78 From our stakeholder discussions it is apparent that concerns about high-frequency trading have tapered off compared to 2012. However, concerns are still being expressed by stakeholders (some of which were also raised during our 2012 review). They include 'noise', the inability to access small and fleeting orders, the exacerbation of price volatility, and the costs imposed on other market users from high-frequency trader intermediation and predatory trading. Paragraphs 79–127 present our findings on these areas of concern.

Contribution of high-frequency trading to market noise

79 Some investors claim that high-frequency traders do not provide 'real' liquidity because their orders are small and fleeting (i.e.do not rest in a market for any meaningful period of time) and are largely inaccessible.

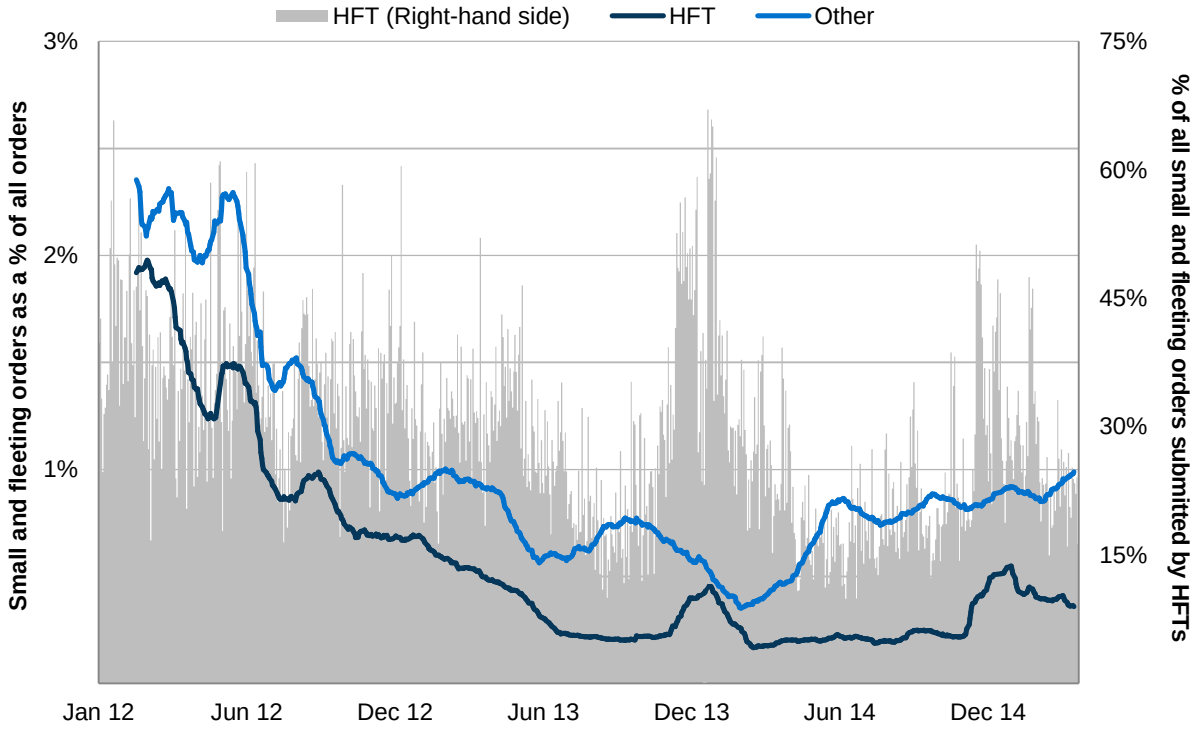
80 In the March quarter 2012, approximately 2.1% of all equity orders submitted to a market could be described as small and fleeting (i.e. less than $500 in value and removed from the market in less than half a second).[22] By the March quarter 2015, this had more than halved to 0.7%. As indicated in Figure 7, both high-frequency traders and other market users were responsible for these orders, with high-frequency traders accounting for 40% in the March quarter 2012, and 26% in the March quarter 2015. These

[22] In REP 331 these measurements were presented in terms of 'untraded orders' (i.e. 3.6% of all untraded orders were measured as fleeting).

figures indicate that all market users have taken considerable steps to reduce small and fleeting orders.

81 We previously proposed to introduce a market integrity rule to address small and fleeting orders by requiring a minimum resting time of 500 milliseconds for 'small' orders in our markets (defined as $500 or less for equities): see CP 202. We did not proceed with this proposal because the proportion of 'small and fleeting' orders fell considerably following our review. Given the reduction has been sustained, this proposal is still not considered necessary.

Figure 7: Small and fleeting orders submitted by high-frequency traders and other users



Intraday volatility

82 The relationship between high-frequency trading and volatility is still being considered by regulators and academics globally.[23] There are concerns that high-frequency trading, and other automated trading, exacerbates volatility and that these traders withdraw from markets during periods of high volatility,[24] affecting liquidity in the markets.

[23] Valeria Caivano, *The impact of high-frequency trading on volatility. Evidence from the Italian market*, no. 80, working paper, Commissione Nazionale per le Società e la Borsa, 2 March 2015.
[24] Volatility, as measured by the S&P/ASX 200 VIX Index, doubled over the month of August 2015. This reflected rapidly falling prices in both overseas and Australian markets. We note that high-frequency traders maintained a significant presence within our markets.

83 In REP 331, we noted that high-frequency trading appeared more prevalent in equity securities with wider daily trading ranges (i.e. more volatile prices). We attributed this to the nature of the underlying business model.

84 We re-assessed volatility from a market-wide perspective. We examined the association between high-frequency turnover and intraday volatility, and questioned whether these traders exacerbate or depress price movements in the equity markets.

85 Our analysis suggests that a complicated relationship exists between high-frequency trading and volatility. Detailed findings and regression analysis are outlined in paragraphs 276–283 in the appendix. In our approach we calculated the aggregate market share of high-frequency traders, long-term volatility and intraday volatility[25] for each security on every trading day. In summary, we observed that:

(a) as with our findings in REP 331, and consistent with research on the relationship of high-frequency trading to volatility,[26] high-frequency traders' share of turnover was largest in securities with the greatest trading ranges;

(b) intraday volatility is highly correlated with long-term volatility. After controlling for long-term volatility, high-frequency trader turnover is negatively correlated with intraday volatility. That is, high-frequency turnover and intraday volatility tend to move in opposite directions. This suggests that additional high-frequency trading acts to dampen price movements; and

(c) there is a negative correlation between the use of dark venues and intraday volatility (i.e. there is less trading in the dark when there is more volatility). This is probably because lit markets provide more execution certainty, which is important during volatile times.

86 It is important to distinguish these findings from the possible response of traders during sudden and extremely volatile periods. It is likely that many automated trading strategies used across the market are aligned (e.g. seek similar outcomes and trade in the same direction), which may exacerbate volatility in these situations. It is also possible that high-frequency and other automated traders will withdraw orders from the market during such times. To help address these concerns, we have introduced a range of controls: see paragraph 31.

87 During sudden and extremely volatile periods, it is the responsibility of all market users to not intentionally exacerbate price movements, and we remind market participants of the importance of their own filters and controls.

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[25] We measure 'intraday volatility' using 15 minute price returns and 'long-term volatility' using end-of-day price returns.
[26] For example, Frank Zhang, *High-frequency trading, stock volatility, and price discovery*, Yale School of Management, December 2010 and Jonathan Brogaard, Terrence Hendershott, Ryan Riordan, 'High-frequency trading and price discovery', *Review of Financial Studies*, volume 27, issue 8, 14 May 2014, pp. 2267–2306.

Passive and aggressive trading

88 There are two main ways in which high-frequency traders interact with other users of lit markets:

(a) *passively (provide liquidity)* by submitting orders that rest on a market. These orders add to liquidity. Other market users are able to choose whether or not they wish to participate in transactions at the provided prices; or

(b) *aggressively (take liquidity)* by submitting orders to trade at a price and size already available on a market. These orders do not rest on the order book, they remove resting liquidity.

89 Over the past three years there has been a general trend towards more aggressive high-frequency trading. As illustrated in Figure 8, over 2012 and 2013, there was a rapid move into aggressive trading by high-frequency traders. By July 2013, 60% of all high-frequency trading was undertaken on an aggressive basis. While this trend did reverse in late 2013, the general trend remains upwards.

Figure 8: Percentage of high-frequency trader 'lit' orders that are submitted to market on an aggressive basis

90 It may be that the tendency towards aggressive strategies explains the trend for high-frequency traders to avoid trading amongst themselves: see paragraphs 50–52 and Figure 2. Aggressive orders only interact with resting orders.

91 However, high-frequency traders still contribute significantly to volumes of resting orders around the best bid and offer (accounting for around 50%). There has been a steady increase in the contribution of high-frequency traders to depth within three prices of the best bid or offer since 2012 (excluding Band 1 which was broadly stable). The biggest increase occurred in the less liquid securities (Band 5): see Figure 23 in the appendix.

92 We have focused on these findings, not because they are concerning to us, but because it is illustrative of the dynamics in our equity markets.

Costs of high-frequency trading to investors

93 There is a body of academic research here and overseas that indicates that high-frequency market-making strategies (i.e. the provision of passive orders) act to tighten bid–offer spreads (meaning better prices) and contribute to price formation through the submission of pre-trade transparent prices.[27] The research generally attributes a positive effect to market quality.

94 Others highlight the 'toxicity' of high-frequency trading. In 2013, it was claimed that the cost to investors in our markets was $1.6–1.9 billion.[28] More recently there have been claims of $3 billion.[29] These claims are not supported by our analysis.

95 We estimate that the annual gross revenue of high-frequency traders in Australian equity markets was $110–180 million over the 12 months to 31 March 2015.[30] This is up 70–100% over the past three years.[31]

96 This translates to an effective cost to other market users of 0.70–1.14 basis points (i.e. 0.007–0.014% of traded value). To provide context, some other costs of trading are included in Table 2.[32]

Table 2: Estimated trading costs for market users*

Description	Cost (bp)†	Compared to HFT costs
High-frequency trading	0.7–1.14‡	N/A
Exchange trading, clearing and settlement fees	0.3–0.7	Half
Institutional brokerage (direct market access)	1–5	1–5 times
Market spreads	13	13 times

[27] For example. Jonathan Brogaard, Terrence Hendershott, Ryan Riordan, *High-frequency trading and price discovery* (PDF 96 KB), working paper series, no. 1602, European Central Bank, November 2013; and Joel Hasbrouck, Gideon Saar, 'Low latency trading', *Journal of Financial Markets*, volume 16, issue 4, November 2013, pp. 646-679.
[28] Industry Super Network, *Fair game or fatally flawed? Some costs of high frequency trading in low latency markets* (PDF 508 KB), June 2013.
[29] Senator Jacquie Lambie, media statement, Media statement 3.6.15 (PDF 1.55 MB), 3 June 2015.
[30] Our estimates are based on daily mark-to-market profits. Low estimates are derived from the effective entry and exit prices of intraday trades. High estimates include an estimated marginal improvement from any remaining position. The effect of hedging, by any non-equity products, is not accounted for. Revenue is aggregate for all high-frequency traders. Many high-frequency traders withdrew from the market in 2013 (see Figure 1) and the reduction in trader diversity has had some effect on average calculations.
[31] Brogaard, Hendershott and Riordan estimated that high-frequency traders earned $0.43 revenue on a $10,000 trade in Nasdaq securities in the United States in 2008. See Jonathan Brogaard, Terrence Hendershott, Ryan Riordan, 'High-frequency trading and price discovery', *Review of Financial Studies*, volume 27, issue 8, 14 May 2014, pp. 2267–2306
[32] One basis point is the equivalent of 0.01%, so a one basis point cost on a $1,000,000 transaction implies a cost of $100.

Description	Cost (bp)†	Compared to HFT costs
Retail (direct) brokerage	20–30	20–30 times

* These costs were estimated using a combination of stakeholder feedback and ASX and Chi-X fee schedules.

† Basis points.

‡ These estimates are gross figures only. They do not account for the running costs of high-frequency traders, for example, the costs of systems, staff and market access.

97 At 27% of market turnover, high-frequency trading accounts for a substantial part of Australian equity markets. High-frequency trading creates, and constantly replenishes, orders around the best bid and offer. The benefit to other market users from this constant supply of orders (or intermediation) by high-frequency traders could be that it improves investors' chances of meeting their trading benchmark. For example, investors with large orders that are executed in smaller parcels may benchmark their performance against the day's volume-weighted average price. The constant supply of orders by high-frequency traders throughout the day may facilitate this. However, we also recognise that some investors consider high-frequency traders as not providing 'real' liquidity: see paragraphs 107–123.

98 The costs that high-frequency traders impose on other market users are material, but substantially less than the billions estimated by some commentators. Further, discussion of cost to investors should take into account the effect of high-frequency trading on other transaction costs (see paragraphs 99–106) and the benefits of filling supply and demand shortages.

The effect of high-frequency trading on investor transaction costs

99 There have been claims that high-frequency traders increase transaction costs for other investors. Some commentators have referred to high-frequency trading as a form of legalised 'front-running',[33] claiming that traders are able to detect, and trade ahead of, large orders. This activity has the potential to raise the purchase or lower the selling price of investor transactions.

100 Academic research is mixed on the contribution of high-frequency traders to transaction costs.[34]

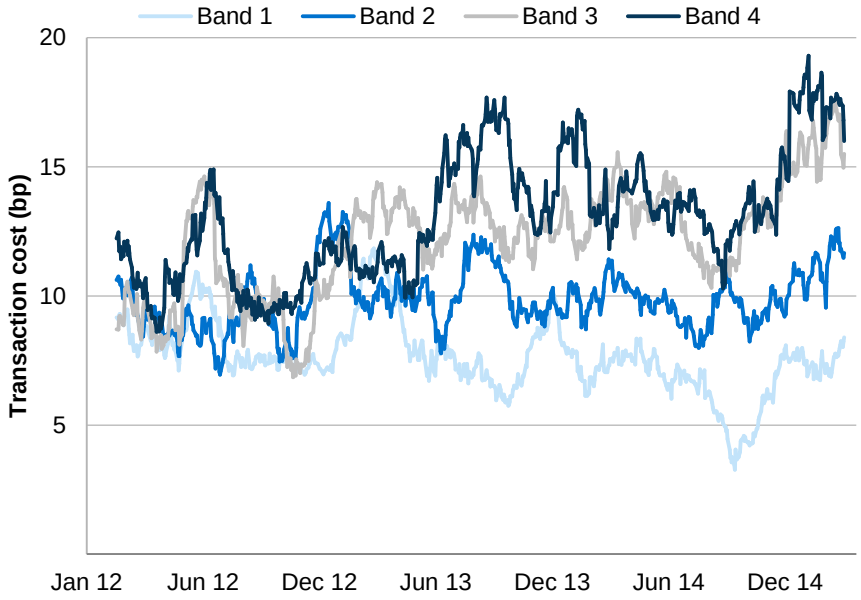
[33] Gregory Scopino, 'The (questionable) legality of high-speed 'pinging' and 'front running' in the futures markets', *Connecticut Law Review*, volume 47, number 3, February 2015, pp. 607–698.

[34] A study in the United Kingdom found there was no evidence that high-frequency trading impacts execution costs for institutional investors: see Jonathan Brogaard, Terrence Hendershott, Ryan Riordan, 'High-frequency trading and price discovery', *Review of Financial Studies*, volume 27, issue 8, 14 May 2014, pp. 2267–2306. A study in Sweden found that it depends on the direction the high-frequency trader is trading (i.e. transaction costs were 46% lower when trading in the opposite direction to the investor and 169% higher when trading in the same direction): see Vincent Van Kervel and Albert J. Menkveld, *High-Frequency trading around large institutional orders*, 7 October 2015. A study in Australia suggests high-frequency trading might adversely impact transaction costs: see Amy Kwan and Richard Philip, *High-frequency trading and execution costs* (PDF 189 KB), 12 June 2015.

101 Many institutional investors routinely monitor execution costs to evaluate the effectiveness of their trading tools and venue choices.[35] Costs are often expressed in units of basis points and broken out as a discrete component of any transaction.

102 We sought to measure the effect of high-frequency trading on overall transaction costs in Australian equity markets.[36] Our estimates are illustrated in Figure 9, which shows daily estimates of the dollar-weighted average cost across all securities within each band. Only the largest orders executed over a minimum period of four hours contribute to our analysis. Outcomes across individual securities, participants and users vary widely.

Figure 9: The estimated dollar-weighted average transaction cost of execution across bands



103 The cost of sourcing liquidity remained largely unchanged at 9 basis points over the March quarter 2012 to the March quarter 2015. However, the variation between the trading bands is wide and growing. Average trading costs trended down in Band 1 securities but rose materially across securities in Bands 2–4: see Table 3.

[35] Ian Domowitz and Henry Yegerman, *Measuring and interpreting the performance of broker algorithms* (PDF 233 KB), ITG Inc., August 2005.
[36] We estimated institutional trading costs and their association with high-frequency trading by: identifying all large unidirectional trading across the 200 most heavily traded securities; aggregating all individual transactions for an identified user within a trading day into single parent order; calculating the 'cost of execution' as the difference between the first traded price and the average executed price; and exploring the association between these execution costs and level of high-frequency trading.

Table 3: Estimated average trading costs across trading bands

Securities	Q1 2012 (bp)	Q1 2015 (bp)	Change
Band 1 (1-50)	8.8	7.6	↓ 13%
Band 2 (51-100)	9.8	10.9	↑ 11%
Band 3 (101-150)	9.1	15.8	↑ 74%
Band 4 (151-200)	11.3	16.3	↑ 44%

104 We assessed the association between the level of high-frequency trading and transaction costs after controlling for a range of other factors. Our detailed analysis and findings are outlined in paragraphs 285–293 of the appendix.

105 In summary, we conclude that high-frequency trading is not a dominant driver of transaction costs. Its effect on Band 1 securities is negligible. There is a suggestion of 'low toxicity' within the mid-tier securities but a statistically significant relationship exists between high-frequency trading and *lower* transaction costs in less liquid securities.

106 We found that the three single factors with the greatest effect on transaction costs were investor competition, the amount of liquidity sought and volatility. These are all associated with *higher* transaction costs.

Predatory trading and market manipulation

107 A significant proportion of trading in equity markets occurs for technical (e.g. price arbitrage) or speculative reasons, rather than for fundamental reasons. Our analysis indicates that, inclusive of high-frequency trading, approximately 40–45% of all market turnover in Australian equity markets is conducted on a short-term or speculative basis.

108 Certain trading practices give a false impression of trading interest (e.g. layering) and are forms of market manipulation prohibited under Pt 7.10 of the *Corporations Act 2001* (Corporations Act) and ASIC market integrity rules.

109 There are other 'predatory' trading strategies (i.e. which exploit others or unfairly induce them to trade) that concern fundamental investors and market participants, including:

(a) *'Phantom' orders*: Orders that appear to be available which suddenly disappear. This can induce others to trade at prices that might not otherwise have existed or enable the provider of the 'phantom' orders to infer the trading intentions of investors (see also paragraph 109(b)).

(b) *Liquidity detection*: A strategy that seeks to determine the direction of fundamental investor demand (e.g. where a small order executes quickly, a trader may assume a larger order is on the other side) and

steps ahead of the investor on a different venue. By so doing, it creates higher execution costs for the investor.

(c) *Latency arbitrage*: A strategy that relies on a speed advantage to detect price differences between trading venues. Of particular concern to some fundamental investors is latency arbitrage between lit and dark venues (see paragraphs 116–123).

110 We provided further examples of predatory trading in REP 331 at paragraphs 378–401. Predatory trading strategies are often attributed to high-frequency traders but other market users may also engage in these practices.

111 Our analysis and the feedback received during our stakeholder meetings suggest that predatory trading is not excessive in the Australian market. However, it can adversely affect the trading outcomes for investors. Where such behaviour is excessive, it can undermine our objective of confident and informed investors, as fundamental investors lose trust and confidence in our markets and perceive our markets to be unfair. This may result in investors seeking to avoid public markets and, indeed, some investors have told us they actively avoid public markets and instead trade in the dark.

112 We have listened to the concerns. These predatory strategies may constitute a breach of the Corporations Act or ASIC market integrity rules. We investigate instances where we suspect this may have occurred. This is an area where we will prioritise the interests of fundamental investors in ensuring they have confidence and trust in our markets, and continue our focus on ensuring our markets are fair, orderly, transparent and efficient.

113 Market participants must ensure that orders are only submitted to a market if there is a genuine intent to trade. This is a requirement of the Corporations Act and ASIC market integrity rules. All market users should have regard to the effect of their orders on the wider market and on other market users.

114 We routinely examine our markets for patterns of market manipulation. For example, in late-2014 we identified:

(a) possible layering activity in some ASX-listed securities by an overseas securities firm providing intermediary services to proprietary traders. Layering is the creation of large numbers of orders, often at various price points, to create a false impression of demand or supply. These orders are then cancelled, or amended, as they move closer to trading. We raised concerns with the firm's market participants. The firm had its market access terminated by two market participants within a three-month period; and

(b) a persistent pinging strategy in an ASX 20 security trading in exchange dark venues. Pinging is the practice of using the placement of very small orders to test for orders resting in the dark. Key traders were

identified and, after discussions with the market participants and end clients, the behaviour ceased.

115 Some institutional investors are managing their own order flow and execution decisions so they can limit 'information leakage' and interaction with 'predatory' traders. The aim is to improve overall outcomes for the funds they manage. All investors should engage with their brokers to ensure they understand how their orders and confidential information is being handled to ensure their legitimate interests, and those of any beneficiaries to whom fiduciary obligations are owed, are not compromised.

Latency arbitrage between lit and dark venues

116 Some predatory trading strategies are perceived to occur by traders arbitraging between venues. Numerous stakeholders over the past few years have raised the revenue that high-frequency traders are able to generate from this type of arbitrage. Amounts of US$6–12 million a day have been cited as the potential profits in the United States.[37]

117 In REP 331, we commented that latency arbitrage between lit markets was only occurring on a small scale. Our current analysis supports that view.

118 Prices in dark venues follow prices on lit exchange markets, and usually update after price movements on lit markets. This creates latency arbitrage opportunities—traders using fast technology may respond to market events faster than the trading venues. This is illustrated in Table 15 of the appendix.

119 To measure latency arbitrage, we analysed whether dark transactions were occurring outside the best bid and offer available on lit markets over a 500 millisecond window. During 2014, we found that approximately 300 trades per day (less than 1%) occurred outside of the best bid and offer.

120 An estimate of the possible revenue generated from this arbitrage is $1,100 per day (or around $290,000 per year).[38] Of these mispriced transactions, 34% occurred on ASX Centre Point, 10% on Chi-X hidden orders and 56% on market participant crossing systems.

121 A very small group of high-frequency traders were consistently (i.e. 80% of the time) on the right side of these trades. However, these trades formed only a small part of these traders' business.

122 Price latency is an inevitable feature of dark venues because they rely on price formation to occur within lit markets. However, a strategy that seeks to intentionally profit from such price inefficiencies may be inconsistent with ASIC's market integrity rules and we will investigate identified instances.

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[37] S Arnuk and J Saluzzi, *Latency arbitrage: The real power behind predatory high-frequency trading*, white paper, Themis Trading LLC, December 2009.

[38] Potential revenue is calculated as half of the misallocated benefit (i.e. as an arbitrage a trader would seek to immediately crystalise a profit by exiting the mispriced transaction on market).

123 Exchange and crossing system operators should consider their compliance with Rule 4.2.3 of the ASIC Market Integrity Rules (Competition in Exchange Markets) 2011,[39] which requires these trades to occur within the bid–offer spread. It is also important that market participants regularly assess the effect of traders on the fairness of their crossing systems and their ability to effectively deliver best execution to other clients.

Is access to market facilities and services fair?

124 Traders whose trading strategies rely on speed seek to minimise the delay, or 'latency', in transmitting and receiving trading messages. Market operators provide a range of services to facilitate this, including:

(a) allowing market participants to locate their trading systems within the same building as the exchange's matching engine (co-location); and

(b) data feeds with reduced data size (e.g. ASX's ITCH and OUCH), which provides faster transmission of messages.

125 This has raised concerns that market operators are providing low-latency facilities to a targeted client base (e.g. high-frequency traders), and that these services unfairly advantage the traders who use them (and can afford to use them) at the expense of others.

126 Consistent with our assessment in REP 331, we do not regard the fact that market participants can co-locate or use specific data feeds as inherently unfair, provided the services are available to all market users on fair and transparent terms. We believe this is currently the case. However, we acknowledge the concerns of some and will continue to monitor the terms on which these services are provided.

127 We encourage market users, investors and listed entities to raise with ASIC any issues or concerning practices they observe in our markets.

A3 High-frequency trading in the Australian futures market

128 While we did not analyse trading on the Australian futures market in our 2012 review, we have in our current review. This reflects the increasing pervasiveness of high-frequency trading in the futures market, and feedback from investors and market participants about activity at the time of the quarterly futures roll. Our analysis confirms that high-frequency traders are participating significantly in our futures market and that trader activity during the roll required close examination.

[39] In this document 'Rule 4.2.3 (Competition)' (for example) refers to a particular rule of the ASIC Market Integrity Rules (Competition).

Our approach

129 High-frequency traders in the Australian futures market were identified in a manner similar to their equity counterparts: see paragraph 41.

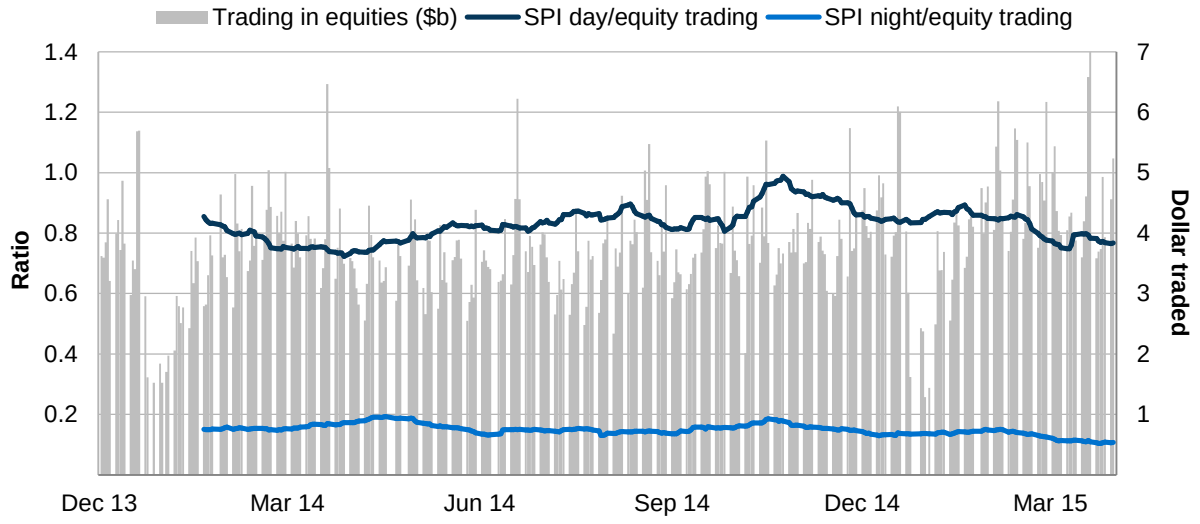
130 Most trading in the futures market is in three contracts—approximately 93% of all trades on the ASX 24 market occur in these core products. For this reason, our analysis was limited to the SPI and bond futures. The period of analysis was limited to December 2013 to March 2015.[40]

131 There is more concentration of trading in the futures market, so our approach to modelling high-frequency traders differed slightly from equities. The futures market has many day-traders that specialise in trading single product contracts on an intraday basis utilising strategies similar to those of high-frequency traders. However, their orders are managed manually not algorithmically. Additional checks on trader reactivity were used to remove these traders from our dataset.

Level of futures trading in the Australian market

132 The volume of futures trading in the Australian market is moderate compared to trading on some international futures markets. Activity is highly correlated with volumes of the underlying market. As illustrated in Figure 10, the ratio of volume traded in the SPI against the underlying equity markets is relatively stable. For every $1.00 of equity traded on the ASX market, there was approximately $0.95 of the SPI traded (of which $0.80 traded in the day session and $0.15 in the night session).

Figure 10: Trading in the SPI relative to activity in the underlying equity markets



133 High levels of trading are evident, every three months, during the contract expiry period when many institutional traders—such as banks or investment

[40] ASIC's surveillance system started collecting data in the futures market in October 2013.

funds—are obliged to extend hedge positions into later expiries. During the expiry period, day session trading volumes increase on average 5.7 times (up to a maximum of 12 times) from normal levels. The expiry period spikes were not included in Figure 10.

134 The expiry period requires detailed attention. The ASX 24 platform facilitates spread trading with the use of a synthetic 'roll market' in which simultaneous sales and purchases between consecutive expirations are packaged within a single order. Roll markets are characterised by long order book queues, high volumes and low volatility. These dynamics attract a class of high-frequency trading which is discussed in detail in paragraphs 158–168.

High-frequency traders in the Australian futures market

135 Unlike equities, the futures market is predominantly a wholesale market. Activity is substantially more concentrated in a smaller number of traders. Consequently, high-frequency traders account for a larger proportion of all market users.

136 We estimate that high-frequency traders account for 1.5% of all traders in the SPI and 4% of traders in bond futures (compared to less than 1% in equity markets). These percentages remained relatively stable over the period 1 December 2013 to 31 March 2015: see Figure 11 and Figure 12, respectively.

Measures of high-frequency trading in the futures market

Volume traded

137 Our analysis shows that high-frequency trading has grown rapidly in the futures market, both in terms of volume and the number of trades over the period 1 December 2013 to 31 March 2015: see Figure 11 and Figure 12, respectively. Over the period, high-frequency trading as a proportion of:

(a) volume traded grew from 9% to 21% in the SPI and from 6% to 14% in bond futures. This is an increase of 130% for both products; and

(b) number of trades grew from 11% to 23% in the SPI and from 15% to 21% in bond futures.

138 High-frequency traders accounted for a larger proportion of the number of trades than the volume traded; suggesting high-frequency traders tend to have smaller-sized orders than other market users. A small reversal in participation rates for bond futures is evident in late October 2014. This coincides with the 'mini-crash' in the United States.[41]

139 The growth in high-frequency trading across the futures market is strong. However, it does come off a relatively low base. It reflects the potential for

[41] US Department of Treasury, *Joint Staff Report: The U.S. Treasury market on October 15, 2014* (PDF 19.26 MB), 13 July 2015.

additional activity by these traders and while current levels are not concerning, we are monitoring growth.

140 Overseas futures markets have also experienced growth of high-frequency trading. For example, in the United States, high-frequency trading accounted for around 30% of trading volume on the CME Group (CME) in 2014,[42] with reports that it was over 60% of traded volume on CME and the ICE in 2012.[43]

Figure 11: Participation by high-frequency traders in the SPI

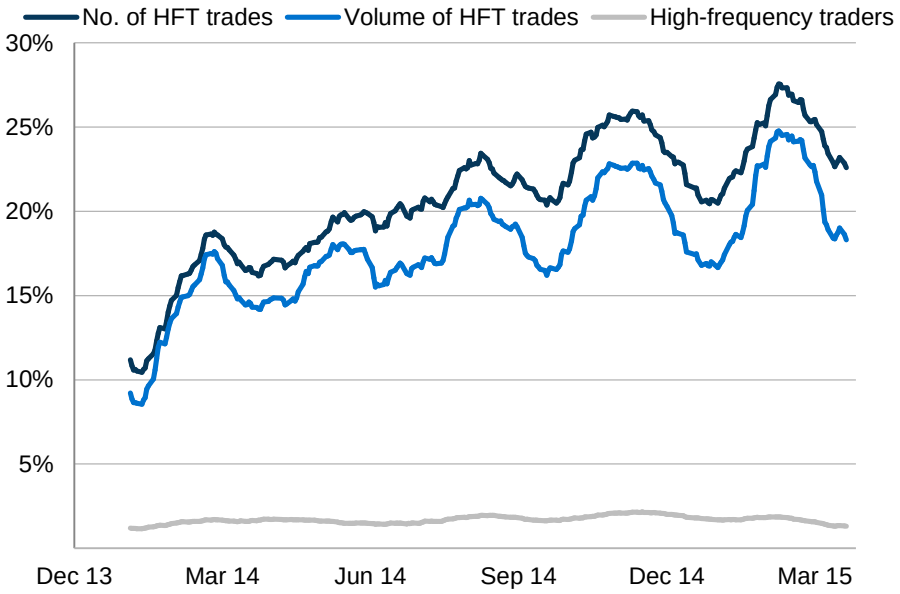
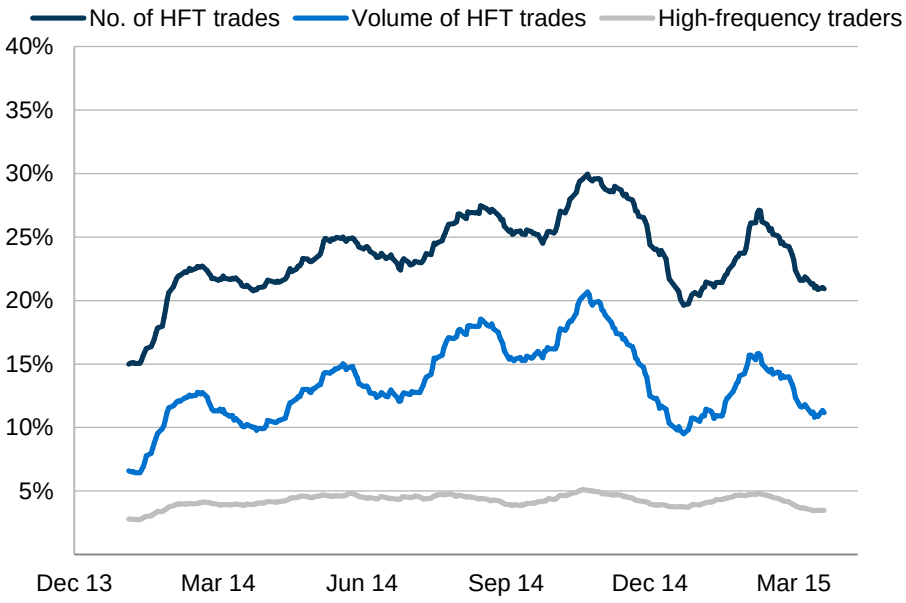


Figure 12: Participation by high-frequency traders in bond futures



[42] Commissioner Scott D. O'Malia, *Keynote address: A Market in transition*, speech, US Commodity Futures Trading Commission (CFTC), 6 May 2014.
[43] Tom Polansek, *CFTC finalizes plan to boost oversight of fast traders*, article, Reuters, 23 August 2013

141 There is less trading in the SPI by high-frequency traders in the night session (when the underlying cash market is closed) than the day session, but it accounts for a higher share of traded volume. In contrast, the proportion of trading in bond futures by high-frequency traders is similar in both day and night sessions.

142 High-frequency traders contribute substantially to the futures order book. In the March quarter 2015, they accounted for 35% (day session) and 57% (night session) of all orders in the SPI. For bond futures, the respective figures were 43% and 48%: see Table 16 and Table 17 in the appendix for more detail.

Inventory traded within a day

143 Participants in a futures contract are required to pay a margin on any exposure held overnight.[44] This may motivate some traders to reduce the number of futures contracts held overnight.

144 Our analysis indicates that high-frequency traders in the futures market hold lower overnight positions, relative to their traded volumes, than high-frequency traders in equity markets.

145 High-frequency traders close out by day's end 97% and 95% of all traded volume in the SPI and bond futures respectively (i.e. only 3–5% of volume traded by high-frequency traders was held overnight).

Order-to-trade ratios

146 Average order-to-trade ratios for high-frequency traders in the futures market are higher than in equity markets.

147 Average order-to-trade ratios for high-frequency traders in the SPI fell from 25:1 to 16:1 during the period December 2013 to March 2015: see Figure 13. However, the variation in ratios was exceptionally high and it was not uncommon for individual traders to sporadically run ratios into the thousands.[45] We are working with relevant participants to lower their ratios.

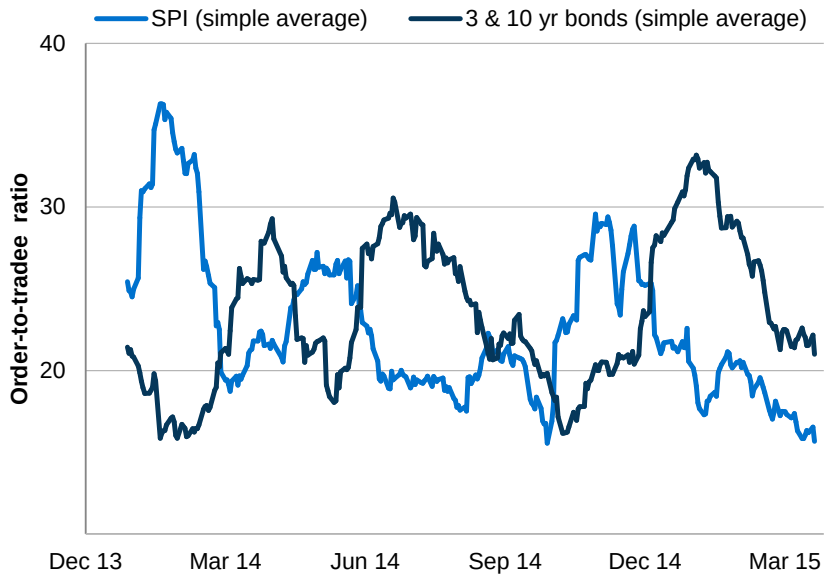
148 Night session ratios are less subdued with levels around five to six times greater than their day-time equivalents. This is probably because there are fewer other market users participating in the night session (i.e. while the underlying cash markets are closed).

149 Figure 13 shows a similar pattern for the bond futures market. Average order-to-trade ratios fluctuate and were 22:1 in the March quarter 2015. While variations between high-frequency traders are wide, there are fewer excessive ratios compared to the SPI. Ratios in the night sessions are much higher.

150 In contrast, other market users maintained lower average order-to-trade ratios of between 4:1 and 5:1 over the analysis period.

[44] A margin is a deposit (in cash or other collateral) made to the clearing house to cover risk.
[45] ASIC's market surveillance fee does not apply to orders in the futures market as it does to orders in equity markets.

Figure 13: High-frequency traders' order-to-trade ratios for the SPI and bond futures during the day session

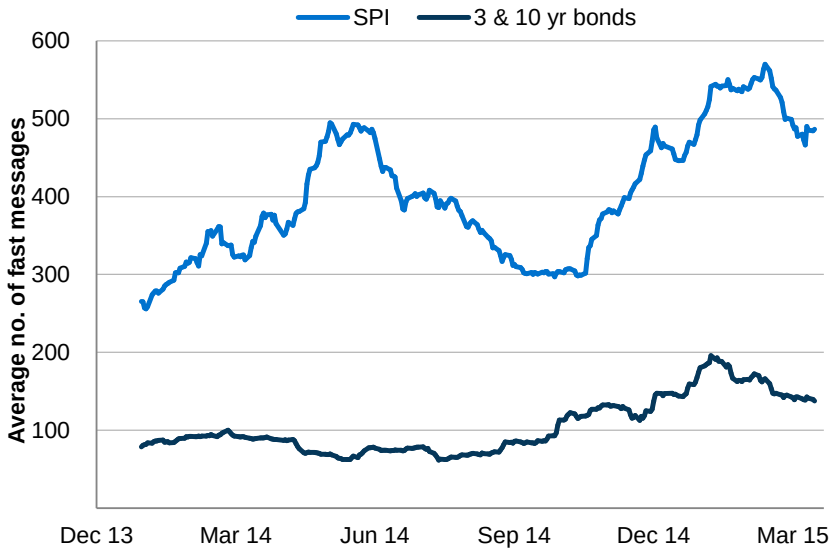


Number of fast messages

151 In the Australian futures market, high-frequency traders tend to specialise in either the SPI or bond futures. Our analysis of fast messages indicates that high-frequency traders are increasing the scale of their operations in futures.

152 Figure 14 shows that the average number of fast messages (i.e. rested in the market for not more than 100 milliseconds) per high-frequency trader per day for trading in both the SPI and bond futures progressively increased by approximately 50% over 2014 to around 500 milliseconds for the SPI and 150 milliseconds for bond futures. While the average number of fast messages in bond futures trading is somewhat muted in comparison to trading in the SPI, both indicate an increase in speed in strategies utilised by high-frequency traders.

Figure 14: Average 'fast messages' submitted to market by high-frequency traders each day in the SPI and bond futures



Holding time

153 During the March quarter 2014, the average holding times (i.e. time between the sale and corresponding purchase (or vice versa) of a contract) of the SPI by high-frequency traders was around 40 minutes. The holding time decreased to 31 minutes in the March quarter 2015. In comparison, holding periods for bond futures were 32 minutes rising to 39 minutes over the same period. This is less than in equity markets: see paragraph 77.

A4 Perceptions of high-frequency trading in the futures market

Contribution of high-frequency trading to market noise

154 The issue of small and fleeting orders is somewhat different in the futures market compared to the equity markets. This is because the value of a single contract represents a notional amount of approximately $130,000 in the SPI,[46] and $100,000 in bond futures.

155 While non-problematic for bond futures (only 0.5% of all orders), 'small and fleeting' orders (i.e. volumes of only one contract and resting time of less than 0.5 second) are prevalent in the SPI (currently 5% of all day session orders and 10% of all night session orders). As shown in Table 4, high-frequency traders are a major and increasing source of this noise.

Table 4: Small and fleeting SPI orders by high-frequency traders (%)

Session	Q1 2014	Q1 2015	% change
Day	26%	48%	↑ 89%
Night	72%	81%	↑ 13%

156 The contribution to 'small and fleeting' orders by high-frequency traders is unusually high in the night session. However, we think this reflects the session's relatively low liquidity and the strategies used to trade against overseas markets.

157 Market participants are required to only enter orders they intend to trade, and they must consider the effect of their orders on the market.[47] We are working with those responsible for the majority of this noise to address the problem.

Futures roll

158 Concerns have been raised with ASIC about the fairness and efficiency of the market during the futures roll on their quarterly expiry. The roll on the ASX 24 futures market is a synthetic market in which two separate contracts, across succeeding expiries, are simultaneously bought and sold.

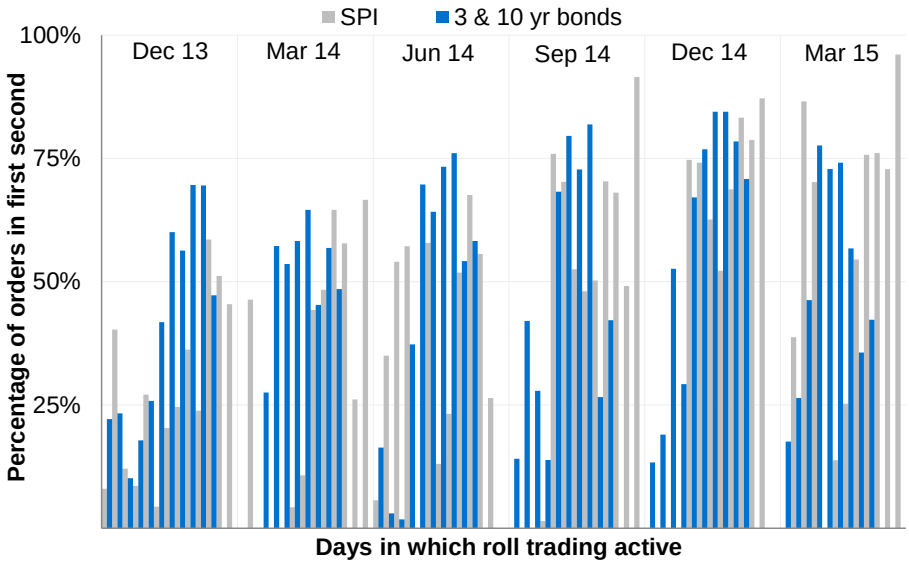
[46] The notional dollar value of one SPI contract will change in proportion to the contracted price.
[47] Rule 3.1.3 of the ASIC Market Integrity Rules (ASX 24 Market) 2010.

159 Roll trading is a large and dominant feature of the futures market. In general, trading is active in the period immediately preceding expiries and trading volume can increase tenfold.

160 Rolls are used by banks and fund managers to extend hedge strategies from one expiry to another. A small number of traders are also very active—they appear to dominate the roll and crowd out other participants. Market users are denied the opportunity to trade without crossing the bid–offer spread (i.e. pay more) and are forced to trade with the same dominant traders.

161 Over the expiry periods December 2013 to March 2015, this tendency to 'crowd out' other market users grew.[48] For example, over 2014, volumes submitted into the roll's opening market increased three-fold. Short-term traders were quick to submit large numbers of orders to dominate the order book queue: see Figure 15.

Figure 15: Orders submitted into the roll market in the first second of trading



162 We looked at the speed of order entry in the first second of roll trading to determine whether these traders benefited from any unusual speed advantage. The fastest time achieved, by both high-frequency traders and other market users, was around 30 milliseconds: see Figure 25 in the appendix for the distribution of orders over time. Speed alone is not the only issue in determining order book queue priority.

163 Until 1 November 2015, ASX 24 gateways could be leased on a monthly basis.[49] A small number of traders increased their usage markedly over the expiry period to simultaneously submit large numbers of orders.

[48] ASIC Market Integrity Update, *Conduct affecting ASX 24 quarterly rolls*, issue 64, September 2015.
[49] ASX announced on 30 September 2015 that it will adjust the minimum contract period for the gateways from one to three months effective from 1 November 2015. See ASX notice reference number 1132.15.09 (PDF 280 KB), 30 September 2015.

164 One ramification of this strategy is that waiting times (i.e. the time between submitting an order and it either being filled or crossing the spread) increased for other users of the market. Table 5 summarises limit order waiting times for each product over expiry periods in 2014 and 2015. Waiting times in the SPI more than doubled from an average of 2.4 hours in March 2014 to 4.9 hours in March 2015. The waiting times for bond futures have fluctuated. They trended higher over 2014 but have since peaked.

165 Excessive quoting, with short-term trading horizons, has the potential to create unnecessary market risk. When traders rely on technical rather than fundamental factors the market order book may become susceptible to gaming. For example, the cancellation of correlated orders can lead to periods of price instability when traders choose to calibrate risk appetite off the depth of market queues.

Table 5: The volume-weighted average waiting time (hours) for roll orders*

Expiry	SPI	3 yr bond futures	10 yr bond futures
March 2014	2.4	6.2	5.0
June 2014	1.5	5.5	6.9
September 2014	4.1	5.8	4.7
December 2014	4.0	3.0	6.9
March 2015	4.9	4.9	3.9

* Roll orders that waited passively in the market queue (at best price) but were subsequently traded across the spread.

166 Longer queue times, greater trading costs and more risk suggest a reduction in market efficiency. We believe that an unfair bias has developed in market access that favours some ambit, short-term strategies.

167 Further, we are conducting inquiries into a number of traders for the submission and cancellation of excessive orders during the roll. Since commencing these inquiries, there appears to have been a change in these traders' behaviour.

168 In December 2014, ASX reduced the tick size (i.e. the increment in which contracts are priced) for the Ten Year Commonwealth Treasury Bond Futures Contract during the roll, which has reduced trading costs in that contract.[50] ASX has also announced that rental periods for its gateways will increase. We have asked ASX to consider what further steps it can take to address these issues.

[50] Prior to this, ASX consulted on options to improve the roll: see ASX, *ASX 3 and 10 Year Treasury Bond Futures Quarterly Roll* (PDF 125 KB), consultation paper, 20 August 2012.

B Dark liquidity

Key points

Since 2012, there has been a shift towards using non-pre-trade transparent ('dark') liquidity for its original purpose for large block trades, that is, to manage market impact. At the same time, there are fewer smaller dark trades and they are now fairer, with price improvement (if any) more equitably shared between counterparties.

Many of the concerning trends with crossing systems that our 2012 taskforce observed, and which we raised in REP 331, have abated.

Segmentation of liquidity by exchange market and crossing system operators may be inconsistent with their fairness obligations where it unduly favours some market users over others, unfairly limits access to market facilities, or otherwise results in the unfair treatment of orders.

There are inconsistent practices across the industry for managing confidential information and conflicts of interest arising from principal trading and facilitation, particularly for active facilitation. Market participants should review their policies and procedures and avoid the use of dual roles and consider physical separation.

Purpose

169 This section outlines the findings of the dark liquidity review:

(a) *B1 Analysis of dark liquidity in Australian equity markets*—summarises the characteristics of dark liquidity in Australian equity markets (see paragraphs 179–194);

(b) *B2 Dark trading venues*—outlines the nature and role of dark trading venues (see paragraphs 195–236);

(c) *B3 Segmentation of liquidity in equity markets*–outlines our expectations on liquidity segmentation for exchange market and crossing system operators (see paragraphs 237–252); and

(d) *B4 Principal trading and facilitation*—updates on our work on principal trading and facilitation (see paragraphs 253–269).

170 Unless otherwise stated, when we compare the findings from our 2012 review of dark liquidity (see REP 331) to our current review, we are comparing the September quarter 2012 to the March quarter 2015. While there may be some seasonal variation (i.e. between September quarters and March quarters), we thought it more important to use current data rather than data from the September quarter 2014.

Background

171 Dark liquidity refers to orders that are not known to the rest of the market before they are matched as executed trades. Such trades, known as 'dark trades', can occur on exchange markets (e.g. ASX Centre Point and 'hidden orders' on Chi-X's order book), in dark venues operated by market participants (i.e. crossing systems) and by manual matching of market participant order flow (e.g. block trades).

From our 2012 review of dark liquidity to now

172 In the lead up to our 2012 review, there were concerns about the operational transparency of, and accessibility to, dark trading venues. There were also concerns about the fairness of the operation of market participant-operated crossing systems and their 'toxicity'—that is, the extent to which a market participant's own principal trading desks or traders receive privileged treatment or insights into clients' trading intentions.

173 In response, we introduced a number of ASIC market integrity rules to improve the fairness of, and transparency around, the existence and operation of crossing systems: see paragraphs 202 and 203. We have seen a marked improvement in the integrity and transparency of these systems.

174 Dark liquidity continues to be an area of interest for regulators. Examples of recent developments include:

(a) *Block trading*: In May 2013, we amended the 'block trade' exception to pre-trade transparency (Rule 4.2.1 (Competition)) from a static $1 million to a tiered threshold structure of $1 million for the most liquid equity market products, $500,000 for comparatively liquid products and $200,000 for all others. This enables more trading to be done in large sizes at any price.

(b) *Price improvement*: Australia (in May 2013, see Rule 4.2.3 (Competition)) and Canada (in October 2012)[51] introduced rules requiring certain dark orders to be executed at a meaningfully better price than available on lit exchange markets to address concerns about dark trading undermining price formation and the unfair practice of dark orders stepping ahead of lit orders.

(c) *Payment for order flow*: Payment for order flow is an arrangement where a market participant, securities dealer or fund manager receives a payment from another market participant, in exchange for sending its clients' orders to them. Following our 2012 review, we introduced Rule 7.5.1 (Competition) prohibiting this conduct. The UK Financial Conduct Authority (FCA) undertook a detailed review in 2014[52] and

[51] IIROC, *Amendments to the universal market integrity rules respecting dark liquidity*, 12-0130, 13 April 2012.
[52] FCA, *Best execution and payment for order flow*, TR14/13, thematic review, July 2014.

identified a number of breaches of its guidance on payment for order flow arrangements and identified areas for improvement.

(d) *Dark pool transparency*: There have been a range of developments in dark pool transparency, including some stemming from our 2012 review:

(i) Since March 2014, crossing systems are flagged as trading venues on three-day delayed public trade reports in Australia (Rule 5.1.6A (Competition)). This means that the market now has an insight into the trading occurring on crossing systems; assisting investors to assess the quality of their order execution and informing participants' best-execution decisions.

(ii) Since October 2014, wholesale clients have been able to request that participants disclose on trade confirmations, or otherwise, when they have traded with their clients as principal (Rule 3.4.3 of the ASIC Market Integrity Rules (ASX Market) 2010) (it was already a requirement to disclose this information to retail clients). This has helped to manage participants' conflicts of interest and has been widely used by buy-side clients.

(iii) In the United States, aggregate trading volume information for alternative trading systems is now published on a two- or four-week delayed basis, depending on the security.[53]

(e) *Threshold for dark orders*: In January 2017, the European Union will introduce volume caps for dark orders relying on certain waivers from pre-trade transparency (i.e. 4% per trading venue and 8% market-wide).[54] If the thresholds are reached, future orders need to be pre-trade transparent.

Stakeholder engagement—observations

175 Perceptions about the integrity and operational transparency of crossing systems in our market are largely positive.

176 There were mixed views on the trade with price improvement rule (introduced in 2013) but the majority supported it and we received feedback that it has contributed to improvements within crossing systems.

177 Increasingly, sophisticated buy-side firms are making their own order routing and execution decisions. They are doing this by providing specific instructions to their broker, using order execution algorithms provided by brokers or developing their own bespoke algorithms. In some cases, they have opted out of using market participant-operated crossing systems due to 'information leakage'.

178 We received strong feedback about the importance of preserving the fairness of public exchange markets—to retain open and equal access with non-

[53] FINRA, *Alternative Trading System (ATS) Transparency*.
[54] European Commission, *More transparent and safer financial markets: European Commission welcomes European Parliament vote on updated rules for Markets in Financial Instruments (MiFID II)*, 14-129, press release, 15 April 2014.

discriminatory treatment of users. There were similar comments about the fairness of crossing systems. Liquidity segmentation and profiling on public exchange markets was not supported by the vast majority.

B1 Analysis of dark liquidity in Australian equity markets

179 Dark liquidity has remained reasonably constant at around 25–30% of total turnover in equity markets since 2010: see Figure 16.

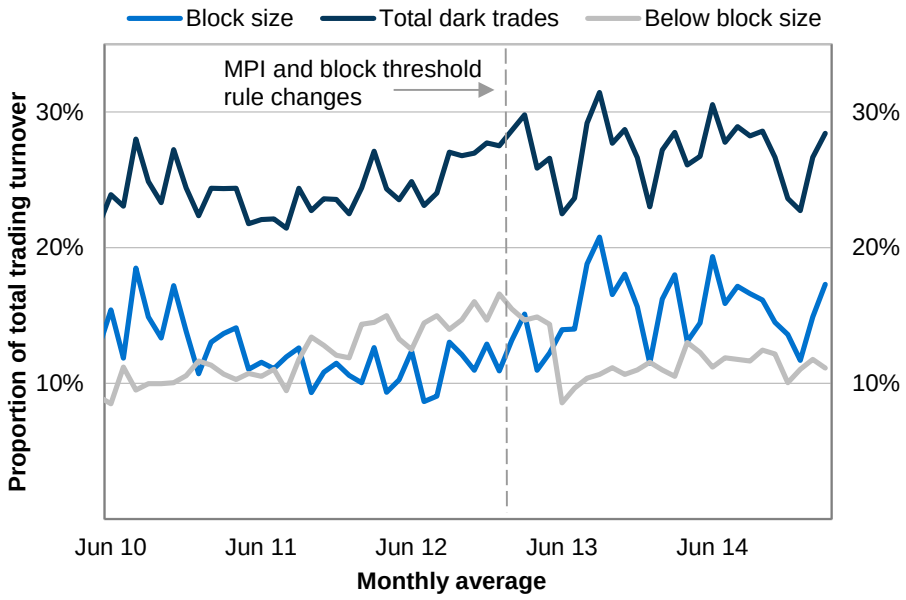
Shift from below block size back to block size

180 The original purpose of dark order types was to facilitate large orders and to manage their market impact. In REP 331, we discussed the concerning trend that dark trades were becoming increasingly smaller in size. We are now seeing a partial shift back to more block size dark trades, consistent with their original purpose, although smaller trades still account for a large proportion of overall dark trades: see Figure 16.

181 For example, block size trades, as a proportion of total turnover, have increased by 46% since our 2012 review (i.e. from 10.3% in September quarter 2012 to 14.9% in March quarter 2015). The number of block size trades per day has fluctuated between 10,000 and 18,000 since 2012.

182 At the same time, there has been a decrease (of 22%) in below block size dark trade turnover (from 14.5% to 11.3%). Interestingly, the number of below block size trades is higher, averaging 49,000 per day in the March quarter 2015 compared to 40,000 per day in the September quarter 2012.

Figure 16: Block size and below block size dark trades as a proportion of total turnover*



* 'Block size' refers to trades executed under the pre-trade transparency exceptions in Rules 4.2.1 and 4.2.2 (Competition)—typically of $1 million ($200,000 since May 2013) or more.

183 These changes were anticipated and are largely due to:

(a) the threshold for block size trades changing (see paragraph 174(a)). The median for block size trades has decreased from over $2 million in the March quarters of 2012 and 2013 to just over $700,000 in the March quarter 2015, supporting feedback from industry stakeholders that they are executing more block trades at the lower thresholds. Figure 16 indicates the trend back to block trading was already underway before the reduction in block trade thresholds (although the reduction exacerbated the move);

(b) the introduction of the requirement for below block size dark trades to offer price improvement (see paragraph 174(b)). This change:

(i) may have discouraged market participants from slicing large orders into smaller orders, so they can trade at any price if they remain above block size;

(ii) means that where there is no opportunity for price improvement in the dark, orders may be routed to lit markets; and

(iii) means where there is opportunity for price improvement, it is now more equitably shared between the counterparties (rather than one counterparty taking all or most of the spread), improving fairness; and

(c) fundamental investors seeking to avoid interacting with high-frequency traders (who they perceive to be predatory and to only trade in small sizes) by trading in larger sizes. This feedback was received from many fundamental investors.

184 We are also seeing a revival of block trading desks and broker facilitation (see paragraphs 253–269), where large orders are manually traded in block size rather than algorithmically in slices.

185 In 2014, we analysed the effect of the block size and trade with price improvement rule changes and reported on them in Report 394 *Review of recent rule changes affecting dark liquidity* (REP 394). The purpose was to assess the effectiveness of the rules in delivering the intended outcomes. We concluded that we were satisfied with the current policy settings. We have not repeated that analysis for this report.

186 In Canada, IIROC also found that the Canadian dark rule amendments achieved the regulatory objectives with acceptable impacts to market quality.[55]

187 In REP 331, we reported that the median size of below block size dark trades was falling and was as low as $300 in August 2012. That is, half of the trades in that month were $300 or smaller. Recently, the median trade size has started to increase. Since the beginning of 2014, it has risen to between $500 and $900.

[55] IIROC, *Impact of the dark rule amendments* (PDF 805 KB), 7 May 2015.

However, there are still some dark venues exhibiting very small trade sizes: see paragraphs 211–213. We will continue to monitor the size of dark trades.

Effect of dark liquidity on market quality

188 In REP 331 we noted research by Comerton-Forde and Putniņš (2012)[56]. suggesting that high levels of dark trading removes valuable information from the price formation process, and leads to increased adverse selection, larger bid–offer spreads and larger price impacts on the ASX market. They found that dark liquidity was associated with a decline in the quality of the lit exchange market when dark trading below block size exceeded approximately 10% of total market dollar volume after controlling for other security characteristics.[57]

189 In REP 331, we built on Comerton-Forde and Putniņš' findings by examining trading in the top 300 securities on the ASX market for the September quarters of 2011 and 2012. We identified the number of securities where the median proportion of below block size dark trading exceeded 10% of the total dollar volume. For each security on each day, we calculated the proportion of below block size dark liquidity, ranked the days based on this proportion and then identified the median value for each security in each quarter.

190 For this report, we conducted the same analysis for March quarter 2015. We found that the proportion of the top 300 securities above the 10% threshold is largely unchanged—39% in March quarter 2015, compared with 40% for September quarter 2012. However, of the securities over the 10% threshold, their actual proportion of dark trading generally declined compared to 2012.

191 In REP 331, we reported that 85% of the top 300 securities experienced an increase in below block size dark liquidity in September quarter 2012 compared with September quarter 2011, with an additional 80 securities in the ASX All Ordinaries Index above the 10% threshold for below block size dark liquidity in 2012.

192 However, in March quarter 2015 there had been a decline in the number of securities above the 10% threshold outside the S&P/ASX 50, and an increase for the S&P/ASX 50 over the same period: see Table 6. We think the increase for the S&P/ASX 50 reflects that many of these securities trade at the minimum price increment (tick size), and dark trading enables improvement of the price on lit markets, or the ability to trade more quickly.

[56] Now published in the Journal of Financial Economics: see Carole Comerton-Forde and Tālis J. Putniņš, 'Dark trading and price discovery', *Journal of Financial Economics*, volume 118, issue 1, October 2015, pp. 70-92.

[57] Research by Comerton-Forde and Putniņš (2012) reports that a large increase in below block size dark trading from 10% to 20% of dollar volume is estimated to increase the informational inefficiency measures by 10% to 15% of a standard deviation. A more modest increase in below block size dark trading from 10% to 12.5% of dollar volume is expected to increase the informational inefficiency measures by 2% to 4% of a standard deviation.

Table 6: Securities in S&P/ASX 300 where median proportion of below block size trading exceeded 10% of total dollar volume

Segment	Q3 2012	Q1 2015	Change
S&P/ASX 50	61%	66%	↑
S&P/ASX 51–200	48%	44%	↓
S&P/ASX 201–300	14%	8%	↓

193 We also re-examined whether 10% remains the relevant threshold for our market given the significant changes that have occurred over the 2008–11 period analysed by Comerton-Forde and Putniņš. Our analysis was inconclusive. However, there is some evidence to suggest that informational efficiency of securities outside the S&P/ASX 200 is affected more by below block size dark liquidity than those in the S&P/ASX 200.

194 Our position has not changed from that in REP 394. We are satisfied that the current policy settings and rule framework have had the desired effect of improving fairness and addressing the concerning trend of increasing below block size trading and declining block size trading. We do not propose to change the current policy and rules on dark liquidity, but we will continue to monitor market developments.

B2 Dark trading venues

195 Dark trading venues in Australia are offered by exchange market operators and a number of market participants. All trading in these venues must comply with one of the exceptions to pre-trade transparency in Chapter 4 of the ASIC Market Integrity Rules (Competition),[58] including exceptions for block trades and trades with price improvement: see paragraph 183.

Australian exchange markets

196 Exchange market operators have been responding to the competitive market environment and developments in technology by innovating with new order types and dark trading offerings.

197 In June 2010, ASX launched its fully hidden Centre Point order book, which is separate from its main central limit order book and matches dark trades at the midpoint. In October 2011, Chi-X launched its market with an integrated order book with a number of completely dark order types that interact with lit orders on its market. These order types include a dark limit order and dark pegged

[58] In this document 'Chapter 4 (Competition)' (for example) refers to a particular chapter of the ASIC Market Integrity Rules (Competition).

order type, whose price is determined by reference to the national best bid and offer (NBBO) (i.e. across all markets). Innovations since then include:

(a) ASX sweep orders which enable market participants, in a single order, to check for a match in ASX Centre Point before the ASX pre-trade transparent central limit order book;

(b) on ASX Centre Point, block orders can be used for orders at any price (previously a minimum executable value of $50,000 was required);

(c) broker preferencing on ASX Centre Point and Chi-X enable market participants to trade with their own or their clients' orders ahead of others' orders at the same price, regardless of their place in the queue;

(d) ASX Centre Point and hidden orders on Chi-X enable users to nominate a minimum executable quantity for an order. ASX requires users to nominate to be filled by only one opposing order ('single fill'), while hidden orders on the Chi-X market will only execute with a single aggressive order with an order quantity larger or equal to it. These tools are used by some investors to avoid interacting with small orders and high-frequency traders; and

(e) Chi-X has introduced a 'market on close' order type. These orders are unpriced and once matched reference ASX closing prices when they become available.

198 Exchange dark venues are regulated under their respective operator's market licences. As such, there must be transparent rules about their operation—these rules are subject to Ministerial disallowance. Further, all orders and trades on an exchange market are subject to ASIC's real-time market surveillance.

Crossing systems in the Australian market

199 Crossing systems are any automated service provided by a market participant that matches or executes client orders, and in many cases the market participant's own orders, away from lit exchange markets. They are not pre-trade transparent and each system is only accessible by a small fraction of the market.

200 There are currently 17 crossing systems operated by 15 market participants.[59] They accounted for 9% of total dark turnover in March quarter 2015: see Figure 17.

201 Goldman Sachs Australia Pty Ltd and UBS Securities Australia Ltd are the only operators that have disclosed that they may execute orders for retail clients through their crossing systems.

[59] The full list of crossing systems and links to their respective operators' websites is available on our website. ICAP Futures (Australia) Pty Limited is the only crossing system operator that has registered for trading ASX 24 futures (it registered in mid-2015 for trading in energy derivatives).

202 In REP 331, we expressed concerns about the fairness of, and a lack of transparency around, the existence and operation of crossing systems. At the time, many clients lacked trust in the market participants they used. In response to these issues we introduced rules in 2014 that require a market participant that operates a crossing system to:

(a) make certain notifications to ASIC and users of the crossing system (e.g. a description of the order types and their characteristics), and make information about the operation of the crossing system publically available on a website;

(b) provide fair treatment to all users of a crossing system, including:

(i) that a crossing system operator's principal orders are not intentionally interposed between client orders; and

(ii) that clients are able to opt out of having their orders sent to a crossing system without any additional operational or administrative requirements;

(c) monitor activity on the crossing system, report significant breaches of its user obligations and operating procedures to ASIC, and report suspicious activity to ASIC; and

(d) have controls to ensure the efficiency and integrity of the crossing system.

203 The rules in paragraph 202 are in addition to those in paragraph 174(d). While all trades on crossing systems feed into ASIC's market surveillance system in real-time, unlike public dark markets, orders and other activity on crossing systems do not form part of the feed and our oversight.

204 We have seen an improvement in crossing systems following these changes (e.g. the quality of disclosure to clients and ASIC and transparency to the wider market). We have also received feedback from investors that they now have greater insight into how their orders are being managed, especially where the operator is trading with them as principal, and they are rebuilding their trust.

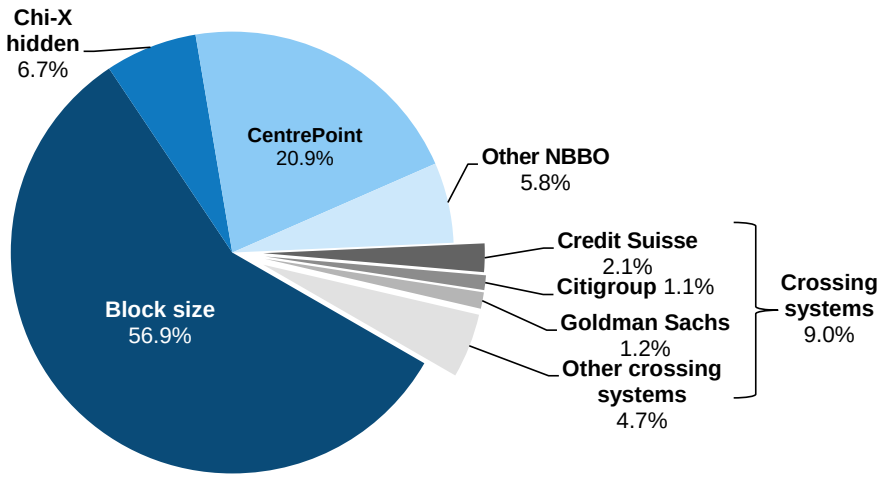
205 Crossing system operators are also providing more options for clients to manage adverse outcomes and market impact (e.g. the ability to nominate to avoid interacting with high-frequency traders and to set minimum execution sizes).

Shining light on dark trading venues

206 Trading in below block size on dark venues (i.e. on ASX Centre Point, Chi-X hidden orders or crossing systems) accounted for around 37% of total dark market turnover in March quarter 2015.

207 ASX Centre Point is the largest dark venue in the Australian market. It has grown considerably (by 112%) from 2.6% of total market turnover in the March quarter 2012 to 5.5% in the March quarter 2015 (and is 20.9% of total dark turnover): see Figure 17 and Table 7. Chi-X's hidden orders have also had strong growth, accounting for 1.8% of total market turnover and 6.7% of dark turnover in March quarter 2015.

Figure 17: Share of dark liquidity turnover (March quarter 2015)

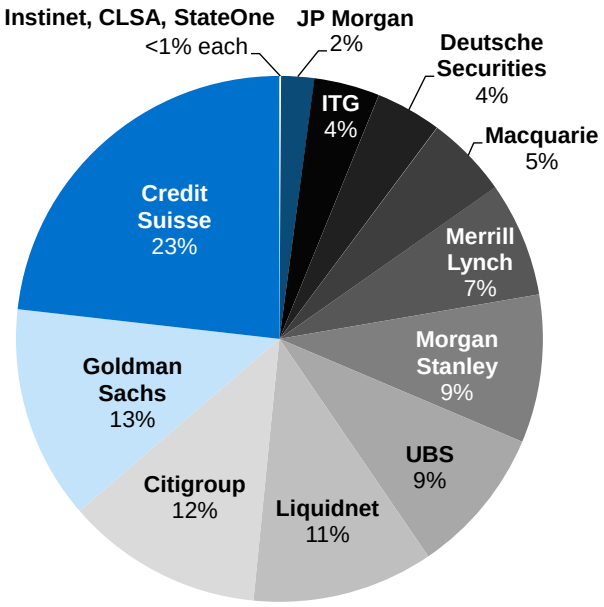


208 Turnover on crossing systems returned to 2010 levels of around 2.4% of total market turnover in March quarter 2015 (compared to 3.1% in March quarter 2012). It now accounts for 9% of total dark turnover (compared to 11.9% in 2012): see Table 7.

209 We understand that this shift is largely due to the trade with price improvement market integrity rule that was introduced in May 2013 and a lack of the necessary price improvement opportunities in crossing systems. This dynamic was explored in detail in REP 394. We have also heard from some investors that they are instructing their market participants to avoid crossing systems and instead route their orders to public exchange markets.

210 In terms of crossing system market share, the largest crossing systems as a proportion of total crossing system turnover are operated by Credit Suisse (23%), Goldman Sachs (13%) and Citigroup (12 %): see Figure 18.

Figure 18: Share of crossing system turnover (March quarter 2015)*



* The data used to compile Figure 18 is publicly available from market operators three days after each transaction: Rule 5.1.6A (Competition). Figures for market participants with more than one crossing system have been aggregated by participant.

Table 7: Key statistics on dark trading venues

Statistic type	ASX Centre Point Q1 2012	ASX Centre Point Q1 2015	Chi-X hidden orders Q1 2012*	Chi-X hidden orders Q1 2015	Crossing systems Q1 2012†	Crossing systems Q1 2015‡
% of total turnover	2.1	5.5	0.0	1.8	3.1	2.4
% of dark turnover	8.6	20.9	0.0	6.6	11.9	8.9
Avg. daily number of trades	36,718	66,127	46	29,834	62,544	51,646
Median trade size ($)	365	976	1,749	1,147	N/A	634
Average trade size ($)	3,154	4,635	5,503	3,269	2,784	5,082
% of turnover by high-frequency traders	2.9	14.4	29.6	27.6	N/A	1.7

* Until May 2012, a minimum value of $20,000 applied to Chi-X hidden orders. The low median trade size reflects an anomaly in Chi-X's systems at the time.
† The 2012 crossing system data is based on daily aggregate figures provided by crossing system operators to ASIC under previous market integrity rule reporting obligations.
‡ The 2015 crossing system data is based on ASIC surveillance system data.

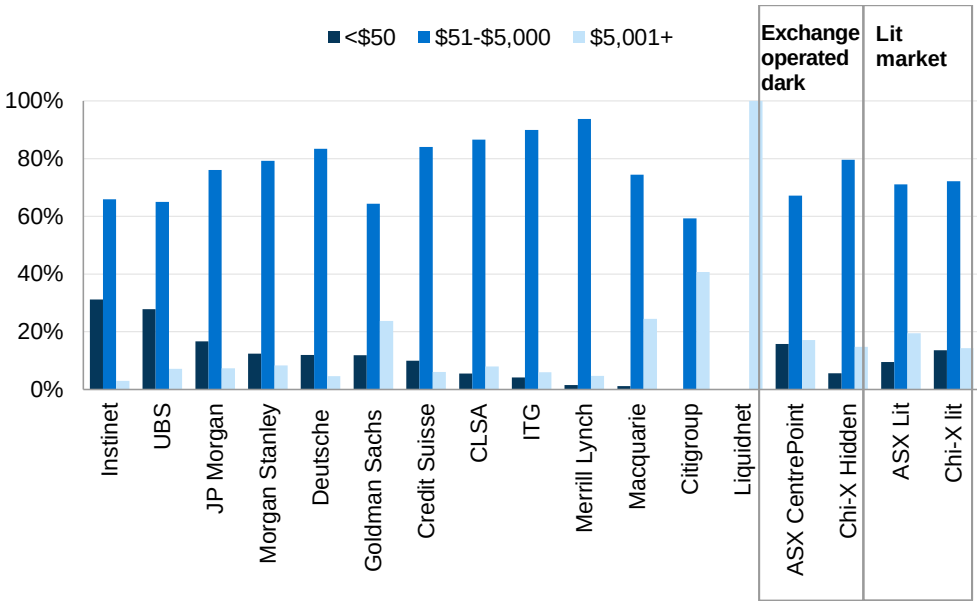
Small trade size

211 Despite the general trend of median dark trade sizes increasing (i.e. for below-block size trades: see paragraph 187), many crossing systems are exhibiting very small median trade sizes. In March quarter 2015, almost half of the largest 10 crossing systems had a median trade size under $500. Citigroup and Macquarie are the exceptions with much larger median trade sizes of $3,700 and $2,300 respectively. Liquidnet, a predominately block venue, had a median trade size of $1.1 million in March quarter 2015. This compares to a median trade size of around $1,200 on lit markets and around $1,000 on exchange dark venues.

212 In March quarter 2015, four venues (ASX Centre Point, Instinet, UBS AG and JP Morgan) had 15% or more of their trades in sizes of $50 or less, Instinet had over 30%: see Figure 19.

213 This suggests that lots of very small trades are still occurring, which is inconsistent with the original purpose of dark trading (for block size trades). However, it is not surprising given the widespread adoption of automated trading and the use of algorithms to search for liquidity in the dark. We will continue to monitor small dark trading to ensure it does not undermine market quality.

Figure 19: Percentage of trades by size and trading venue (March quarter 2015)*

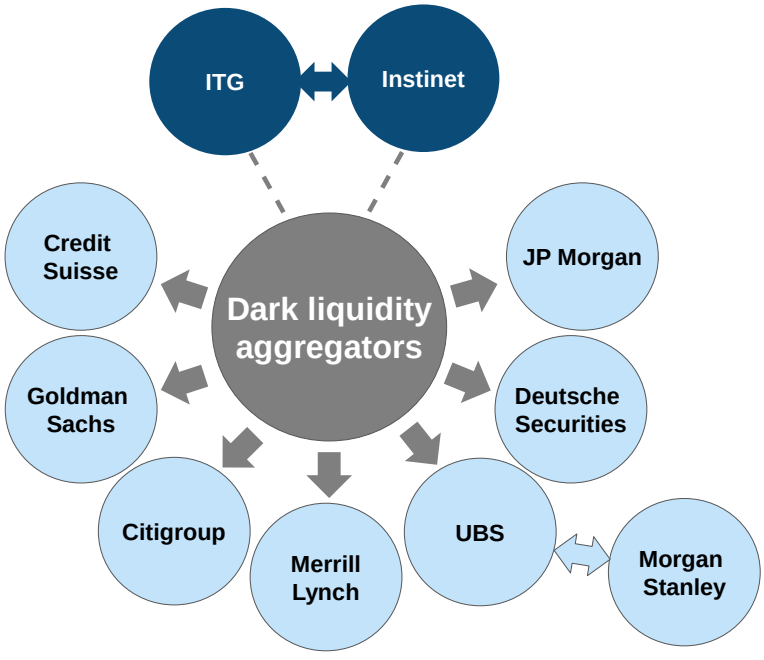


* No trades were reported by StateOne Stockbroking Ltd; therefore it has not been captured. Figures for market participants with more than one crossing system have been aggregated by participant.

Interconnected crossing systems

214 In REP 331, we observed that crossing systems had become more market-like, with 'aggregators' creating multilateral links between market participants and their crossing systems. This trend has continued. The linkages that now exist are illustrated in Figure 20.

Figure 20: Interconnected crossing systems through 'aggregators'*,†



† Credit Suisse and UBS operate more than one crossing system. Only the systems identified as 1101 and 1502 (respectively) are part of the aggregator network.

215 ITG and Instinet operate aggregator algorithms that facilitate the transmission of orders to other crossing system operators. There are currently nine crossing system operators (including ITG and Instinet) that accept orders from one or more aggregators. For example, a client may provide an order to ITG. ITG may execute part of the order and put the remainder through its aggregator to be executed with one or more other crossing systems. This may occur even if ITG's client has no relationship with the other crossing system operators.

216 Direct connections between crossing system operators are starting to emerge (e.g. between UBS and Morgan Stanley).

217 We introduced new market integrity rules in 2013 for crossing system operators to address the more 'market-like' attributes of these facilities: see Chapter 4A (Competition). We consider these rules are adequate and effective at this stage but we will continue to monitor market developments.

Types of order flow in dark venues

218 The nature of liquidity in dark trading venues (e.g. crossing systems and dark venues offered by exchange markets) is important for some users. This is because they perceive that interaction with certain types of counterparties can affect execution quality, signal trading intentions and lead to adverse trading outcomes: see paragraphs 107–123. Many fundamental investors are also concerned about the potential conflicts of interest when a market participant trades with its client as principal.

219 There is a general perception that trading in dark venues offers a 'safe harbour' from high-frequency trading. We understand that this is a factor for many fundamental investors in their venue selection.

220 However, high-frequency traders (as determined by our measures outlined in paragraphs 39–43) are active in exchange market dark venues and the majority of crossing systems.

221 The level of high-frequency trading in Chi-X hidden orders in March quarter 2015 was 27.6%.[60] There has been considerable growth of high-frequency trading on ASX Centre Point, from 2.9% to 14.4% over the period: see Table 7.

222 High-frequency traders were less active in crossing systems (1.7% of turnover across 11 crossing systems). In these crossing systems, high-frequency trading ranged from 0.02% to 31% of turnover and 0.32% to 34% of total trades. Three of these crossing system operators have disclosed to ASIC and their clients that there is no high-frequency trading in their pool (although we recognise that some may adopt a narrower definition of 'high-frequency trading').

[60] The figure for March quarter 2012 in Table 7 (i.e. 46 hidden trades) for Chi-X should not be used as a comparison to March quarter 2015 because it was based on an anomaly in Chi-X's trading system at the time.

223 Falling within our classification of high-frequency trader does not necessarily mean that the trader is exhibiting high-frequency trading characteristics in the crossing system. We are discussing this matter with the relevant market participants. We also encourage all market participants to carefully review their disclosures and make any necessary amendments to accurately reflect the operation of their crossing systems.

224 There is considerable principal trading in market participant crossing systems (i.e. where a client trades against the crossing system operator or an associated entity). Eight crossing systems conducted principal trading in the March quarter 2015, the same number as in 2012.[61] Principal trading represented 39% of value traded on these crossing systems in 2015 (compared to 38% in 2012) and 53% by number of trades on crossing systems. That is, more than one dollar in every three traded by clients was against the operator of these crossing systems and its associated entities.

225 Market participants should be aware of the growing number of cases against dark pool operators in the United States on the misuse of client information or misleading clients about the nature of liquidity in the pool (e.g. high-frequency trading or the market participant's principal orders). They include Pipeline (fined US$1 million), Liquidnet (US$2 million), UBS AG (US$14.4 million) and ITG (US$20.3 million). Further, there are reports that Barclays and Credit Suisse are being investigated in relation to their dark pools in the United States. In Hong Kong, BNP Paribas was fined HK$15 million for operating its crossing system in a manner that did not prioritise better-priced orders. We encourage Australian market participants to review their operations and ensure they comply with the market integrity rules, broader legal obligations relating to misleading conduct and their licensing obligations.

226 Controversy about high-frequency trading over the past two years has heightened client sensitivity to these traders. Many market participants have responded by allowing their clients to nominate the types of counterparties they would like to avoid (e.g. high-frequency traders or the market participant itself trading as principal).

227 Exchange market operators have also provided tools for their dark venues aimed at limiting or avoiding trading with high-frequency traders, including the ability to nominate a minimum execution quantity or to only trade with a single counterparty (because high-frequency traders tend to trade in small sizes).

Who is benefiting the most in dark venues?

228 Some investors are concerned that high-frequency traders and market participants trading as principal may have an unfair advantage when trading

[61] The 2012 crossing system data is based on daily aggregate figures provided by crossing system operators to ASIC under previous market integrity rule reporting obligations. The 2015 data is based on ASIC surveillance system data.

in the dark. In response to these concerns, we sought to measure the outcomes achieved on crossing systems and on ASX and Chi-X dark venues.

229 For the period 1 August 2014 through to 31 March 2015, we looked at all dark trades where the difference between the bid and offer prices on lit markets (ASX and Chi-X) was wider than one price increment and where it is possible under the market integrity rules to trade at a price other than the midpoint (and, therefore, also possible for an adverse or beneficial outcome compared to the midpoint).

230 We assessed how the traded prices compared to the midpoint price at the time to identify if there were any consistent winners (i.e. traders that received a price more than half of the bid–offer spread) or losers (i.e. traders that received a price less than half of the bid–offer spread) for three categories of orders:

(a) agency (i.e. trades on behalf of clients);

(b) high-frequency-traders; and

(c) market participants trading as principal that are not also high-frequency traders.

231 It is important to note that the majority of trades on these dark venues are done at the midpoint with the price improvement equally shared between counterparties. This analysis is, therefore, only looking at a small subset (i.e. less than 12% of trades done on these dark venues).

232 We also note that all counterparties trading in the dark in sizes below block size must receive price improvement. So despite this analysis presenting a relative 'winner' and 'loser', both counterparties still gain some price improvement compared to the best 'lit' bid and offer.

Crossing systems

233 Our analysis did not reveal any obvious winners or losers within crossing systems. Rather, on average across all crossing systems, all users are achieving comparable outcomes.

Exchange dark venues

234 Our results are quite different for trading on exchange dark venues. We found that just over 52% of these trades had agency (i.e. client) counterparties involved and they were on the losing side around 68% of the time: see Figure 26 in the appendix. Whereas, high-frequency traders are highly adept at:

(a) being on the winning side (85% of high-frequency trading trades);

(b) avoiding interacting with other high-frequency trading counterparties (92% of the time). This was also observed for their interactions on lit exchange markets (see paragraph 49–52); and

(c) interacting with (or intermediating) agency orders (62% of high-frequency trading trades).

235 We think the propensity for high-frequency traders to be on the winning side is a combination of:

(a) their speed (i.e. how quickly they submit and amend orders in response to movements on the lit markets);

(b) their trading strategies (e.g. immediately submitting orders after trading on a lit market or vice-a-versa); and

(c) possibly, the types of orders and prices entered by the different counterparty categories. For example, if agency orders are being entered as un-priced 'market' orders, they are accepting the prices set by others. Whereas, high-frequency traders may be submitting more granular pricing instructions enabling greater price improvement.

236 We highlight these findings because it is illustrative of the dynamics in our equity markets.

B3 Segmentation of liquidity in equity markets

237 Liquidity segmentation occurs where an exchange market or crossing system operator enables differentiated order execution priority (or other treatment) based on the user or type of user. Market operators may seek to segment liquidity in this way in a response to:

(a) investor concerns about high-frequency trading—by enabling them to avoid interacting with high-frequency traders;

(b) investor distrust of market participants—by enabling them to avoid interacting with the market participant's own principal orders; and

(c) competition between exchange market operators and market participant-operated crossing systems.

238 We have seen two phases of liquidity segmentation. The first was 'broker preferencing' on equity exchange markets, which currently exists in our market to a limited extent. This enables market participants to trade with their own or their clients' orders ahead of others' orders at the same price, regardless of their place in the queue. The second phase involves 'liquidity profiling' and 'liquidity categories'.

239 Recent developments overseas and in our markets have caused us to review our policy settings and our approach to liquidity segmentation.

Broker preferencing

240 Until recently, broker preferencing was unique to Canadian markets and possibly one or two smaller markets. In the past two years, it has emerged as a feature in Australia and the United States for dark trading. Unlike Australia and the United States, off-market crossings are not permitted in Canada—where preferencing emerged to allow participants to cross client orders on-market.

241 One Canadian market proposed to allow market participants to enter 'internalise only' orders (i.e. orders that would not interact with other market users' resting orders). The Ontario Securities Commission (OSC) did not approve these order types. In February 2011, the OSC stated that:

> '…a marketplace that offers order types that allow for an order to be systematically restricted from interacting with the orders of other participants is operating in a manner that is inconsistent with the fair access requirements…'[62]

242 Broker preferencing emerged in the Australian market in 2013, initially on ASX Centre Point, followed by Chi-X hidden orders a few months later. It was a response to changes in the regulatory settings, including the introduction of the trade with price improvement rule (Rule 4.2.3 (Competition)). At the same time, ASX removed its long-standing on-market crossing functionality known as 'priority crossings'.

243 Broker preferencing on both ASX and Chi-X has a feature known as 'preference and/or kill', which enables market participants to submit orders that will only interact with other orders from the same participant. This feature is used in around half of all preferenced trades across the market.

Liquidity profiling and liquidity categories

244 Liquidity profiling is where the operator of an exchange market or crossing system profiles clients or market users and groups them into categories (e.g. high-frequency traders, retail investors and institutional investors) or provides the capacity for market participants to profile their clients.

245 Once grouped into categories, the operator can apply different treatment to the categories. For example, the priority in which orders are matched may favour one or more categories over another; or enable market users to nominate the categories or individuals they want to interact with or avoid.

246 A recent example is Aequitas, which launched in Canada in March 2015. It is the first exchange to introduce differentiated access standards in Canada. One of its key objectives is to level the playing field between high-frequency traders and those without a speed advantage. Its features include a 'speed

[62] That is, that market operators should not unreasonably prohibit, condition, or limit access to its services. The OSC assessed the impact of the order type when competitor Alpha ATS LP sought to launch a similar order type referred to as IntraSpread: see OSC, *Alpha ATS LP: notice of completion of staff review of proposed changes*, statement, 14 December 2012.

bump' applied to certain orders of high-frequency traders and an order execution priority where non-high-frequency traders take priority over certain high-frequency trader orders.

247 In Australia, there have been a number of proposals presented to ASIC from exchange market and crossing system operators over the past few years that seek to differentiate or discriminate against some users (e.g. differences in order execution priority) based on their characteristics or categorisation. In some cases, these innovations have been developed overseas in response to specific attributes of those market structures, and they may not be appropriate for our market structure and regulatory framework. For example, we do not currently consider that high-frequency trading is problematic enough in our market to warrant a market operator offering differentiated treatment in the order of that offered by Aequitas.

ASIC's expectations of exchange markets and crossing systems

248 We are concerned that these developments have the potential to undermine the fair, open and non-discriminatory nature of Australian public exchange markets and the fairness of crossing systems. This was also the view expressed in many of our stakeholder meetings. Liquidity segmentation also sets an undesirable precedent in the Australian market for the interpretation of fairness obligations, it may adversely affect confidence for those that are disadvantaged or by those that perceive our markets as unfair, and it creates unnecessary complexity.

249 On this basis, it is our view that liquidity segmentation may be inconsistent with exchange market operators' obligations to maintain a fair, orderly and transparent market.

250 In the context of market participants that operate crossing systems, we recognise that some level of profiling may be appropriate to fulfil client instructions (e.g. to avoid high-frequency traders). However, systematically disadvantaging some clients over others (e.g. by giving some clients priority (or lower priority) in the order execution queue) is inconsistent with:

(a) the requirement to provide fair treatment of all users of a crossing system;

(b) the best execution obligations owed to all clients; and

(c) the requirement to provide financial services efficiently, honestly and fairly.

251 We are unlikely to support any form of liquidity segmentation on exchange markets or crossing systems that unduly favours some users over others, unfairly limits access to the facilities, or otherwise results in the unfair treatment of orders or users.

252 As to broker preferencing on exchange markets, the preference and/or kill feature provides an advantage to some market users and unfairly discriminates against others by denying them the opportunity to interact with that order flow. We intend to closely monitor broker preferencing here and overseas. We will do this as we continue our forward-looking review of the purpose of markets and their fundamental role in an environment of rapid change. As part of this, we will review whether the preference and/or kill feature of these order types needs to be wound back in order for market operators to more fully meet their fairness obligations.

B4 Principal trading and facilitation

253 Our 2012 dark liquidity taskforce identified differences in market participants' approach to principal trading and facilitation. We have examined this issue more closely as part of this current review. Paragraphs 254–269 summarise industry practice and set out our expectations.

254 Principal trading includes proprietary trading and client facilitation. Facilitation can be passive, which is where a client initiates a trade request that results in the market participant taking a principal position as counterparty to the trade. Facilitation can also be active—which by its nature is not passive and includes building a position in anticipation of client demand (and using that inventory to respond to a client-initiated request)—market making, or indicating to one or more clients a willingness to trade. Even when a request for a facilitation trade is initially passive, conflicts of interest need to be managed where hedging or backing out of the principal exposure occurs.

255 Market participants need to be mindful of the potential for insider trading and market manipulation when in the receipt of confidential information regarding client orders or trading intentions. ASIC market integrity rules introduced in 2014 following our 2012 review of dark liquidity require market participants to disclose to clients when transacting against them as principal, to deal with clients' orders fairly and in due turn, and to take reasonable steps to protect confidential order information.

Stakeholder engagement—observations

256 Many buy-side firms value the execution certainty, liquidity and reduced signalling risk that facilitation may provide. Some buy-side firms also consent to their facilitation traders having access to all of their unexecuted order information as they believe it may provide improved risk pricing.

257 However, the buy-side firms also raised concerns about active facilitation and non-genuine indications of interest (IOIs). Some suggested that IOIs are used by market participants to gather information about client trading intentions without holding the requisite securities to trade immediately. Also, market

participants may use information obtained through informal discussions with clients about potential orders to build their inventory or issue IOIs, which can result in the market participant competing directly against the client. This may result in the client paying a higher price for the securities compared to acquiring them without facilitation. Our concerns and guidance in relation to IOIs is set out in Regulatory Guide 223 *Guidance on ASIC market integrity rules for competition in exchange markets* (RG 223) at 223.406.

258 The ASIC market integrity rule requiring disclosure when a trade is executed as a crossing or as principal is considered by the buy-side to be an important safeguard for investors. However, this information is not always provided in a user-friendly format, is difficult to use and sometimes only available for a short period of time. We recommend that market participants review the post-trade information they provide to ensure it is clear and easy to use.

259 Many overseas regulators share our concerns. They focus on ensuring that the principal and agency trading staff are appropriately separated or subject to more stringent controls such as information barriers and disclosure.[63]

ASIC's expectations

260 Market participants should review their arrangements and ensure that:

(a) order information and trading intentions are effectively protected;

(b) conflicts of interest are adequately managed through disclosure, controls or avoidance, where appropriate;

(c) internal compliance and supervision arrangements are adequate, including in relation to insider trading; and

(d) remuneration arrangements are structured so as not to incentivise inappropriate behaviour.[64]

Order information, trading intentions and conflicts of interest

261 Market participants consulted in our review use a range of physical and technological segregation or separation to protect confidential information.[65] Most conducted active and passive facilitation and, although it is generally accepted to be a loss-making business, some market participants with the most active facilitation desks advised that facilitation was profitable.

[63] Most larger market participants in Australia are affected by the Volcker Rule in the United States, which has an effect on their facilitation activities. Deposit-taking institutions operating in the United States, and their affiliates, are prohibited from engaging in some proprietary trading unless they meet one of the exemptions, which includes market making or anticipatory hedging.
[64] We expect market participants to review their existing practices for principal trading and facilitation and implement any necessary changes by 30 June 2016.
[65] Segregation refers to facilitation traders performing their activities in a secure area with technological and physical separation from the trading floor (i.e. a 'bubble'). Separation refers to facilitation traders performing their duties from a physically separated desk, but on the same floor as other traders.

262 Some market participants provide their facilitation traders (both passive and active) with access to unexecuted order information and sit within close proximity to the sales desk. Some facilitation traders also performed other roles with access to the order book, including acting as a designated trading representative ('DTR') or institutional sales ('dual roles'). It is argued that this enables the facilitation traders to better understand market dynamics, to interact more efficiently with the sales desk and offer improved risk pricing. One market participant managed this conflict by always providing the client with order priority regardless of the time the principal order was placed, however, most adhered to strict price–time priority.

263 Alternatively, a number of market participants have dedicated facilitation traders who are technologically segregated from the order book but sit within an open plan trading floor and on a separate desk from the sales traders and DTRs.

264 To manage the inherent conflicts of interest that arise when a market participant trades against its clients we consider that all facilitation traders should be restricted from accessing confidential information. This includes technological segregation, by removing access to any unexecuted order information on order management systems, crossing system order books and internal chat and messaging systems. Consideration should also be given to the need for physical segregation or separation to ensure confidential information cannot be accessed and used inappropriately. It is also appropriate to have restrictions in place to limit access of principal and facilitation traders to internal meetings where client orders or trading intentions may be discussed. Market participants will need to consider arrangements to cover short-term absences from the desk or leave arrangements. We remind market participants that facilitation is principal trading and careful consideration needs to be undertaken to ensure the participant is managing the risks of insider trading.

265 We consider the conflicts of interest for staff with dual roles that have access to unexecuted order information is too great to be managed through traditional methods such as disclosure or controls. This is particularly the case for active facilitation and, in most circumstances, merely disclosing the conflict and imposing internal controls will be inadequate.

266 With active facilitation, the market participant may be competing with client orders to acquire a position, or encouraging trading to clear a house position that may not be in the client's best interests. In addition to the avoidance of dual roles, market participants could also consider implementing controls such as:

(a) additional segregation or separation of active facilitation traders and enhanced monitoring of facilitation trading;

(b) disclosing to clients at the time of transacting against them as principal (and recording this disclosure) on each and every trade;

(c) recording the rationale for taking on an active facilitation trade, and getting trader confirmation that they do not have any information about unexecuted client orders in the relevant security; and

(d) the facilitation trader obtaining internal sign-off from appropriate senior staff (compliance, responsible executive or director) before entering an active facilitation trade.

267 Some market participants commented that greater segregation or separation of facilitation may result in inefficiencies in the form of wider spreads on risk-based pricing and reduced liquidity. It may also create situations where a market participant is unknowingly trading ahead of client orders in the same security. We recognise the benefits of improved risk pricing for clients, but there is a broader concern about conflicts of interest when principal traders have access to unexecuted order information. This concern is reinforced by the insider trading laws which prohibit persons in possession of inside information from engaging in conduct, including trading, procuring other persons to trade, and communicating inside information (tipping). The only exceptions to the insider trading prohibitions are those contained within the Corporations Act.

Compliance and supervision

268 We expect the compliance and supervision arrangements that market participants have in place for their principal trading and facilitation activities to cover:

(a) internal policies for managing conflicts of interest, staff trading, avoiding insider trading and market manipulation, information barriers, allocation policies, trader mandates and remuneration;

(b) periodic reviews of facilitation activities to test that the policies and procedures are being adhered to and to identify areas for improvement;

(c) periodic training to reinforce the requirements of the policies;

(d) post-trade monitoring of facilitation trading to test for matters such as potential front running, wash trades, profitability of trading, market manipulation and insider trading;

(e) clear responsibilities for responsible executives and management about the supervision of facilitation activities, including the conduct and culture of the trading desk and how to escalate issues that arise; and

(f) conflicts and wall-crossing registers, and restricted lists.

Remuneration arrangements for staff

269 Market participants should review the appropriateness of their remuneration structures for staff engaged in facilitation: see Regulatory Guide 181 *Licensing: Managing conflicts of interest* (RG 181) at RG 181.38. They should consider adopting a ‘balanced scorecard’ approach that includes a range of criteria and provides material weight to factors such as client satisfaction and acceptable compliance behaviours.

Appendix: Supplementary analysis

High-frequency trading—our methodology

270 To identify high-frequency trading in Australian markets, over the period January 2012 to March 2015, we scored individual traders daily on six measures that relate to the characteristics of high-frequency trading: see paragraphs 27–28 and 41. Table 8 outlines the rationale for selecting each of these measures, and the specific metrics used.

Table 8: Measures used to identify high-frequency trading in equity market products

Measure	Metric used	Rationale for measure
Order-to-trade ratio	Number of orders submitted to market (new orders, amendments and deletions) divided by the number of trades executed.	High-frequency trading typically involves placing many orders for short periods over various price levels. High order-to-trade ratios suggest automation, agility, and lower risk tolerance.* High-frequency traders tend to have a high order-to-trade ratio.
Inventory traded within a day	One minus the overnight residual value held divided by total turnover in each security. Values are weighted by relative turnover in each security.	This metric captures the extent to which intraday positions are liquidated before day's end. High-frequency traders tend to close out a high proportion of their trading. Their overnight positions are relatively small. This metric distinguishes high-frequency traders from execution algorithms which trade in one direction over a day.
Total turnover per day	Total dollar value bought plus the total dollar value sold.	High-frequency trading is typically a low-margin strategy, which means traders need to be active in the market in order to be profitable. High-frequency traders tend to have high turnover.
Number of fast messages	Absolute number of messages successfully submitted within a 40 millisecond window from a defined event.†	High-frequency trading tends to be fast and will demonstrate an ability to respond to events over a 40 millisecond interval. There is no single method that high-frequency traders use to manage their orders. Some delete and send new orders, others submit a rolling sequence of amendments.
Holding time	Dollar volume-weighted time that a position is held.	High-frequency trading typically involves trading in and out of positions many times in a day. Frequent, shallow and changing positions are core to this trading style. High-frequency traders tend to have low holding times.
Sophistication	Gross revenue divided by total turnover.	High-frequency traders run strategies that benefit from high turnover and focused risk management. Sustainable high-frequency trading demonstrates sophistication.

* In this analysis the number of trades is restricted by trade identification. An order that trades many times (e.g. an offer may be hit by five different bids before being exhausted) is counted only once. This more accurately captures large active orders which trade through multiple passive orders resting in the order book.

† An event is either:
1 when an existing order is amended or cancelled in the order book within 40 milliseconds from the previous action on that order; or
2 when a better-priced order is posted following a break in the market.

271 To remove 'outliers' we introduced a small number of 'hard barriers' that a trader had to exceed for consideration as a candidate. We determined that a high-frequency trader should submit at least 1,000 orders per day and demonstrate an average holding time of at most three hours. In addition, an equity trader had to demonstrate turnover of at least $1,000 per day and a futures trader had to demonstrate sub-second reactivity to a market event (order-book changes or trades).

272 Individual traders were scored and ranked across each metric. An individual overall score was then determined by summing together the ranks across the six metrics. Traders with an overall score equal to, or greater than, 50% of the top score were selected as the day's high-frequency traders.[66]

273 This process was repeated daily for equity, the SPI and bond futures traders.

274 Our method of identifying high-frequency traders is based on data in ASIC's surveillance system. It is objective and based solely on the relative behaviour between individual traders. While some movement in and out of the high-frequency trader classification was observed, a small group of dominant traders tended to identify with our classification on a consistent basis.

High-frequency trading—supplementary analysis

275 This section supplements the findings in the main body of the report.

Equity markets

Table 9: High-frequency trading's share of average daily turnover across bands of securities

Securities	2012	2013	2014	Q1 2015
Band 1 (1–50)	26%	26%	26%	27%
Band 2 (51–100)	24%	25%	27%	29%
Band 3 (101–150)	22%	24%	27%	29%
Band 4 (151–200)	19%	21%	24%	24%
Band 5 (201–300)	12%	15%	18%	17%

[66] Our approach to identifying and ranking traders differs slightly from REP 331. Comparable runs across 2012 selected similar, but non-identical, sets of traders. In general, there was little sensitivity in the selection process because the bulk of high-frequency activity is undertaken by a relatively small group of traders.

Figure 21: Percentage of all orders submitted to market by high-frequency traders

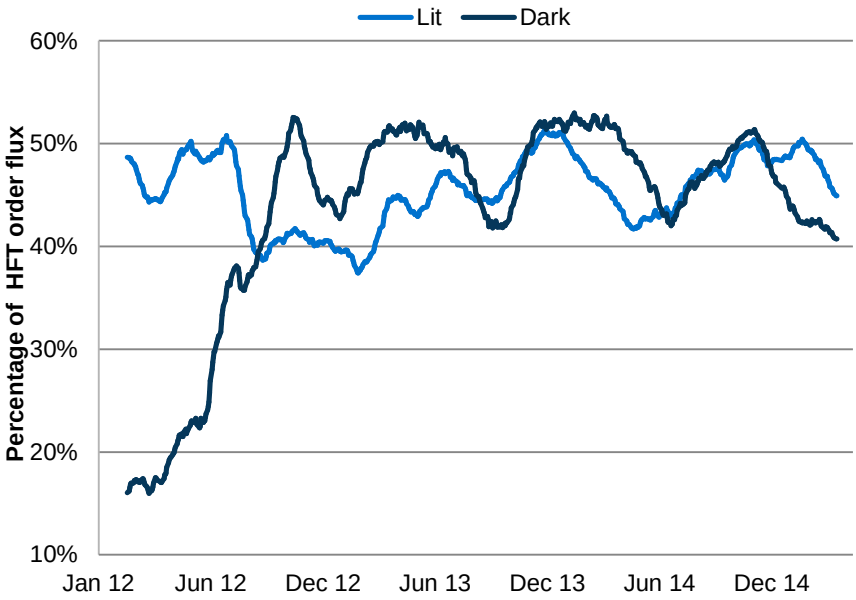


Table 10: Average daily order-to-trade ratios for high-frequency traders across bands of securities

Securities	2012	2013	2014	Q1 2015
Band 1 (1–50)	19.0	14.1	12.7	13.6
Band 2 (51–100)	20.0	11.7	11.7	12.8
Band 3 (101–150)	21.6	12.0	11.3	14.0
Band 4 (151–200)	22.3	11.6	10.8	12.6
Band 5 (201–300)	24.6	14.0	11.0	11.5

Intraday volatility regression analysis

276 In Figure 22 we show how high-frequency trader market share changes with excess risk. For clarity, only Bands 1 and 4 are included in the chart. Differences are evident over the trading bands:

(a) *Band 1*—market share is (almost) negatively proportional to excess risk. Participation is insensitive to low levels of market risk, it remains high even within quiet markets. However, as relative market risk picks up, participation rates tend to fall; and

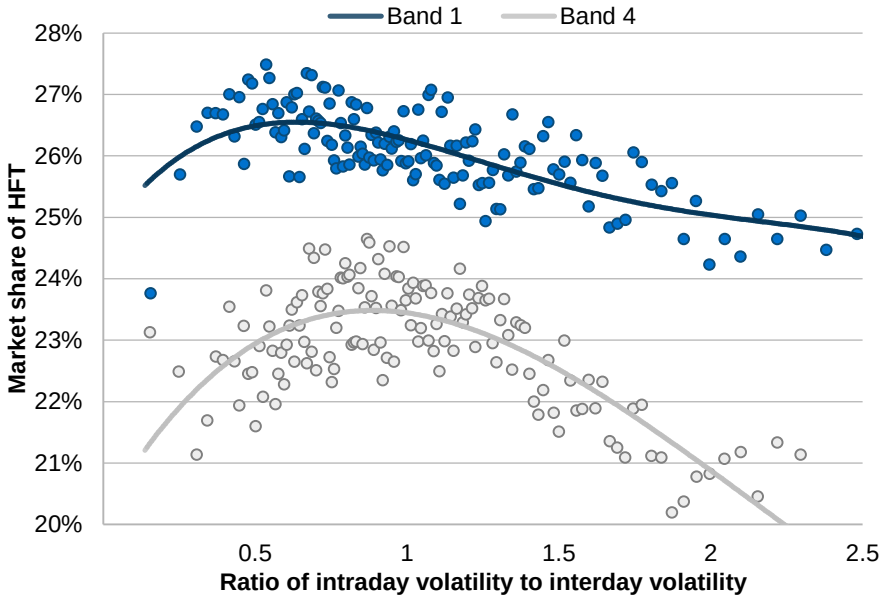
(b) *Band 4*—market share peaks within the mid-range 0.8 to 1.2 but falls across higher, and lower, levels of relative market risk. The rate at which participation tends to fall increases into the lower bands.

277 Market volatility appears to work in two different ways. Participation is suppressed at:

(a) *low levels*—the number of trade opportunities might be falling away; and

(b) *high levels*—either the risk management frameworks adopted by traders cause a reduction in participation rates or the additional volatility is indicative of, or associated with, increased investor participation.

Figure 22: Share of turnover by high-frequency traders against excess market risk (March quarter 2012 to March quarter 2015)



278 The relationship illustrated in Figure 22 does not differentiate between trader dilution and reduction. An alternate approach is to explore correlations in intraday volatility against a range of other concurrent factors which could explain, or drive, some of the observed variations. To do this we used multi-variate analysis[67] to explore the correlations in intra-day volatility.[68]

279 We adjust standard errors for correlation across securities and trading days using a method outlined by Samuel B. Thompson.[69] Regressions are run within trading band-defined subsets of normalised variables: see Table 11.

[67] A multi-variate analysis is a statistical tool designed to identify and separate the output of a system against a range of simultaneous inputs. The analysis assists in inferring the likelihood that any individual factor may have influenced a system's behaviour in isolation from other, contemporaneous, factors.

[68] Using the model $\text{Intraday\_volatility}_{it} = \alpha 0 + \alpha 1.\text{month\_volatility}_{it} + \alpha 2.\text{natural\_turnover}_{it} + \alpha 3.\text{market\_dark}_{it} + \alpha 4.\text{absolute\_imbalance}_{it} + \alpha 5.\text{order\_size}_{it} + \alpha 6.\text{hft\_share}_{it,}$ where 'i' is indexed over all securities and 't' is indexed over all trading days.

[69] Samuel B.Thompson, 'Simple formulas for standard errors that cluster by both firm and time', *Journal of Financial Economics*, 99, 2011, pp. 1–10.

Table 11: regression variables for intraday volatility

Variable name	Variable description
month_volatility	The one month running volatility for each security.
natural_turnover	The turnover for each security after removing all high-frequency turnover.
market_dark	The percentage of the total market for each security that was executed outside of a lit market venue. All fills executed within an exchange dark venue (ASX Centre Point or Chi-X's hidden order book) or a private dark venue (i.e. a market participant's crossing system) were included in this calculation.
abs_imbalance	The absolute imbalance of institutional buy and sell orders* over the day, expressed as a percentage of turnover, for each security.
order_size	The daily average size of orders submitted to a market for each security.
hft_share	The percentage of traded turnover attributable to high-frequency traders over the day for each security

* For each security and each trading day we aggregate all transactions into identifiable 'parent orders'. After determining the distribution of values we notionally separate all orders into two sub-sets: retail (the sub-set of smaller orders) and institutional (the sub-set of larger orders).

280 If high-frequency traders were causally responsible for increased noise (or lower pricing efficiency) then we would expect a positive correlation between market share and short term volatility. Our findings (in units of annualised volatility per unit of standard deviation) are set out in Table 12.

281 The trade data used in the regression calculations in Table 12 was taken from the period January 2012 to March 2015. The statistical significance referred to in Table 12 is the likelihood that the relationship posited by the regression value is caused by something other than mere chance. A significance code of '***' implies the probability of this is more than 99.9% (or 1 minus the significance code of 0.001). The coefficient of multiple correlation (or R^2) was calculated across the bands as Band 1 = 0.17; Band 2 = 0.14; Band 3= 0.19; and Band 4 = 0.19.

Table 12: Regression values for the intraday volatility model over the four trading bands

Variable	Band 1	Stat. sig.† (Band 1)	Band 2	Stat. sig.† (Band 2)	Band 3	Stat. sig.† (Band 3)	Band 4	Stat. sig.† (Band 4)
Constant	24.06	***	29.82	***	34.80	***	36.81	***
month_volatility	7.15	***	7.47	***	9.51	***	11.47	***
natural_turnover	-1.43	***	-0.26		0.52	•	-1.35	***

Variable	Band 1	Stat. sig.† (Band 1)	Band 2	Stat. sig.† (Band 2)	Band 3	Stat. sig.† (Band 3)	Band 4	Stat. sig.† (Band 4)
market_dark	-0.90	*	-1.73	***	-1.88	***	-1.26	***
abs_imbalance	0.12		0.10		0.05		0.21	•
order_size	-0.22	•	-0.03		0.11		0.34	***
hft_share	-1.65	***	-1.19	*	-0.45		-1.93	**

† Statistical significance. Significance codes: *** '0.001' ** '0.01' * '0.05' • '0.1' (blank).

282 While co-linearity between the data points is low, there is a distinct relationship between volume and volatility—both factors can increase together. We use natural turnover rather than total turnover as our measure of traded volume in order to reduce correlation between the regression parameters.

283 After controlling for long-term volatility and turnover, our analysis suggests:

(a) the market share of high-frequency traders is negatively correlated with intraday volatility. We previously found that relative turnover increases for securities with higher trading ranges (i.e. high-frequency participation is greater in securities with volatile prices). After correcting for the long-term component and isolating participation to the intraday premium it would appear that high-frequency trading acts to dampen relative volatility. High-frequency trading does not add to volatility, rather after correcting for other factors, tends to reduce it; and

(b) there is a negative correlation between the use of dark venues and intraday volatility. This could be because:

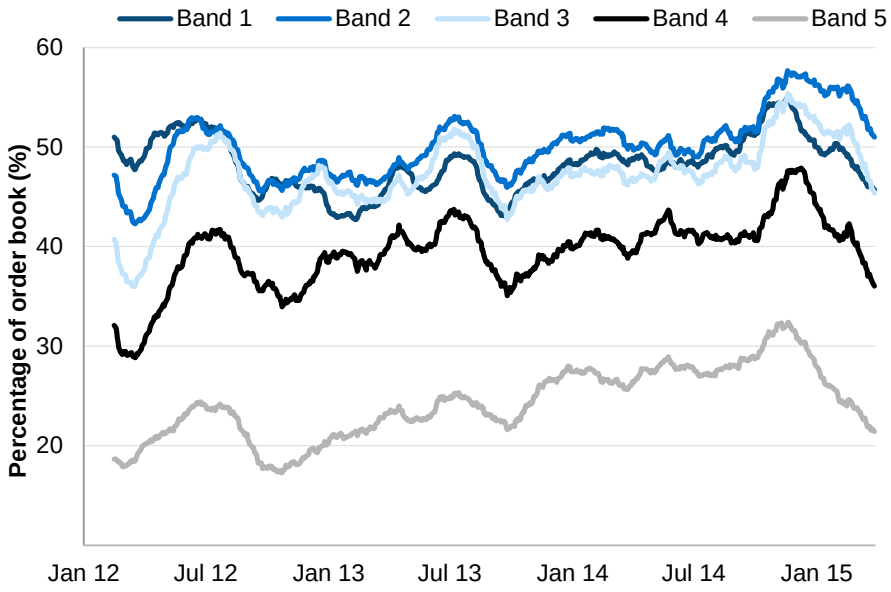
(i) low volatility may drive trading into the dark; or

(ii) the relative efficiency of lit trading simply increases during times of stress.

Passive and aggressive trading

284 There was a noticeable spike in high-frequency trading participation around best prices in late-2014. This is, in part, driven by the layering activity by a high-frequency trader discussed in paragraph 114 and explains why the effect was relatively short lived. This effect has more than reversed in the March quarter 2015 with high-frequency traders' contribution to order book depth at the end of the quarter at levels last seen in 2013.

Figure 23: Contribution of high-frequency traders' orders within three price increments of the best bid and offer



Analysis of transaction costs in the equity markets

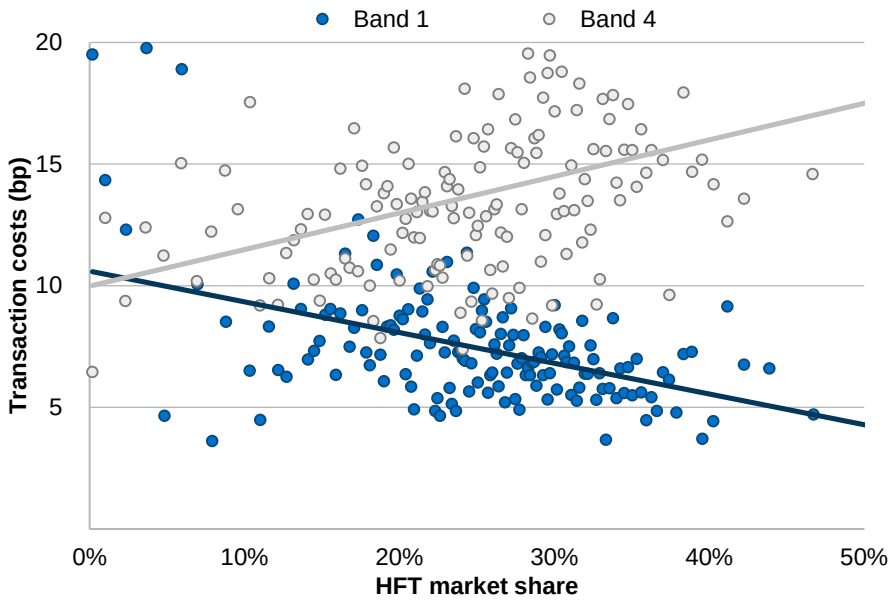
285 Figure 24 shows the correlation between levels of high-frequency trading and institutional transaction costs[70] within the trading quartiles (for clarity, only Bands 1 and 4 are included in the figure). Our analysis suggests the following:

(a) *Band 1*—higher levels of high-frequency trading are associated with lower transaction costs. Every percentage point increase in high-frequency trading is associated with a 0.13 basis point decrease in execution costs; and

(b) *Band 4*—higher levels of high-frequency trading are associated with higher transaction costs. Every percentage point increase in high-frequency trading is associated with a 0.12 to 0.15 basis point increase in execution costs.

[70] These costs are calculated for all nominated 'institutional' orders that were executed in a series of transactions over a minimum period of four hours.

Figure 24: Dollar-weighted transaction costs compared to high-frequency trader market share for Band 1 and 4 securities



286 This simple correlation does not imply causality nor does it capture all effects. For example, an institutional investor seeking to complete a large time-constrained order may intentionally pay for liquidity. The higher costs incurred may attract additional high-frequency traders and increase participation rates. It is possible that the correlation implied in Figure 24 reflects a demand–supply relationship rather than trader toxicity.

287 To explore this relationship further we regressed transaction costs against a range of normalised factors.[71] Standard errors are adjusted for correlation across both securities and trading days: see Table 13.

Table 13: Regression variables for transaction costs

Variable name	Variable description	Variable type
parent_value	The total dollar value of the parent order that was executed over the day.	Internal
num_trades	The number of trades, or execution slices, used to complete the final order.	Internal

[71] Using the model $Transaction\_Cost_{it} = \alpha 0 + \alpha 1.parent\_value_{it} + \alpha 2.num\_trades_{it} + \alpha 3.dark_{it} + \alpha 4.time\_period_{it} + \alpha 5.turnover_{it} + \alpha 6.volatility_{it} + \alpha 7.market\_dark_{it} + \alpha 8.order\_size_{it} + \alpha 9.imbalance_{it} + \alpha 10.hft\_share_{it}$, where 'i' is indexed over all securities and 't' is indexed over all trading days.

Variable name	Variable description	Variable type
dark	The percentage of the total order that was executed outside of a lit exchange market. All fills executed within an exchange dark venue (ASX Centre Point or Chi-X hidden order book) or a private dark venue (i.e. a market participant's crossing system) were included in this calculation.	Internal
time_period	The length of time taken to execute the total order. The time period is measured from the moment of execution of the initial trade to that of the final trade in the series of transactions.	Internal
turnover	The total turnover for each security executed over the day.	External
volatility	The intraday volatility for each security.	External
market_dark	The percentage turnover for each security executed within an exchange dark venue (ASX Centre Point) or a private dark venue (i.e. a market participant's crossing system).	External
order_size	The daily average size of orders submitted to a market for each security.	External
imbalance	The net imbalance of institutional buy and sell orders, relative to the direction in which the regressed order is worked, over the day for each security.	External
hft_share	The percentage of traded turnover attributable to high-frequency traders over the day for each security.	External

288 Notionally these variables separate into two group:

(a) *internal*—within the control of the person executing the order. These variables are unique to the executed order; and

(b) *external*—environmental and common to all orders in the same security over the same day.

289 Details were collected for all large unidirectional orders executed across the four trading bands, over a period exceeding four hours, every day over the period January 2012 to March 2015. The 'cost of execution' was calculated by marking the volume-weighted average price against the first traded price in each series of transactions. The cost, for each parent order, was expressed in basis points. Subsets of costs and their associated (normalised) variables were collated for each quartile. The parameters in Table 13 may be cross referenced with our estimated sensitivities in Table 14.

290 The trade data used in the regression calculations in Table 14 was taken from the period January 2012 to March 2015. The statistical significance referred to in Table 14 is the likelihood that the relationship posited by the regression value is caused by something other than mere chance. A significance code of '***' implies the probability of this is more than 99.9% (or 1 minus the significance code of 0.001). The coefficient of multiple correlation (or R^2) was calculated across the bands as Band 1 = 0.039; Band 2 = 0.030, Band 3 = 0.033; and Band 4 = 0.013.

Table 14: Regression values for the transaction cost model over the four trading bands

Variable	Band 1	Stat. sig.† (Band 1)	Band 2	Stat. sig.† (Band 2)	Band 3	Stat. sig.† (Band 3)	Band 4	Stat. sig.† (Band 4)
Constant	1.78	***	3.68	***	4.95	***	6.53	***
parent_value	1.42	***	1.20	**	1.41	***	0.55	
num_trades	0.38	**	0.78	***	1.08	***	1.52	***
dark	0.31	**	-0.29	**	-0.69	***	-1.41	***
time_period	-0.82	***	-1.33	***	-1.31	***	-0.56	***
turnover	-0.97	***	-0.30	**	-0.36	*	-0.40	**
volatility	0.27	•	1.03	***	1.36	***	2.25	***
market_dark	-0.07		-0.11		-0.12		-0.26	
order_size	-0.22	*	-0.37	***	-0.34	**	-0.20	•
Imbalance	10.82	***	11.36	***	10.66	***	7.57	***
hft_share	0.06		0.23	*	0.17		-0.54	***

† Statistical significance. Significance codes: *** '0.001' ** '0.01' * '0.05' • '0.1' (blank).

291 Our estimated sensitivities are expressed in basis points per unit of standard deviation.[72] The sign (positive or negative) indicates the direction of sensitivity—a negative sign implies an association with lower transaction costs, a positive sign implies an association with higher transaction costs. Co-linearity between the various factors, while non-zero, was low.[73]

292 Unlike Figure 9 and Figure 24, where transaction costs are dollar-weighted, the sensitivities in Table 14 control for order size. Accordingly, the expected averages are lowered, ranging from 1.8 to 6.5 basis points for Bands 1 and 4.

293 Our calculations suggest:

[72] A standard deviation speaks to the level of variation. This may be framed in terms of a time series' variability. Approximately 68%, 95% and 99.7% of the data points will lie within a one, two and three standard deviation range from the series' average.
[73] The variance inflation factors, as measured for all variables, were below 1.3.

(a) High-frequency trading is not a key driver of transaction costs for the upper three bands. The magnitudes of the correlations are low; and for Bands 1 and 3, statistically insignificant. Low statistical significance is evident in Band 2 (i.e. more high-frequency trading is associated with higher transaction costs). At the lower end, high-frequency trading appears to lower transaction costs. This pattern supports an earlier study of ours which suggested that short-term price predictability of these traders is most efficient over mid-tier securities.

(b) Competition between investors (as expressed by our imbalance parameter) is the single largest factor affecting transaction costs. Institutional buying on days when other institutions are net buyers is associated with higher transaction costs. Alternatively, institutional buying on days when other institutions are net sellers is associated with lower transaction costs. The same relationship is evident for institutional selling. Sensitivities are an order of magnitude larger than any other factor. Between 84% and 97% of the explainable variance may be attributed to institutional competition.

(c) The second most significant factor is the total dollar value of order executed over the day. Larger orders are associated with higher transaction costs. However, this sensitivity is lost in the lower trading range, both in terms of magnitude and significance.

(d) Volatility is another material factor in transaction costs. Although immaterial for the largest securities, elsewhere, higher volatility is associated with higher transaction costs. Moreover, those sensitivities increase towards the lower trading range.

(e) Venue selection (as expressed by our dark parameter) also has some bearing on transaction costs. For Band 1 securities a greater choice of the dark is associated with higher transaction costs, but for Band 2–4 securities a greater choice of the dark is associated with lower transaction costs. As market turnover decreases, the marginal benefits realised by trading in the dark appear to increase.

Predatory trading

Table 15: Example of 'latency arbitrage'

Time	Dark price	Lit price	Event	Consequence
t_0	20.5	20–21	Sell order submitted to a lit market	Market bid is traded out and the market ticks down. A price update message is disseminated to subscribers of trading data.

Time	Dark price	Lit price	Event	Consequence
t_1	20.5	19–20	Price update received by high-frequency trader	High-frequency trader simultaneously submits two orders—a sell order at 20.5 to a dark venue and a buy order at 20 to a lit market.
t_2	20.5	19–20	Sell order received by dark venue	High-frequency trader sells at 20.5.
t_3	20.5	19–21	Buy order received by a lit market	High-frequency trader buys at 20.
t_4	19.5	19–20	Price update received by dark venue	Dark venue receives price update from a lit market. Price is amended to 19.5 to reflect the new NBBO.

Futures market

Table 16: Orders by high-frequency traders in the SPI

Session	Order Type	Q1 2014	Q1 2015	Change
Day	Enter*	27%	37%	39%
Day	All†	24%	35%	43%
Night	Enter*	75%	59%	-22%
Night	All†	66%	57%	-14%

* Submission of new orders only.

† Submission of new, amended and cancelled orders.

Table 17: Orders by high-frequency traders in bond futures

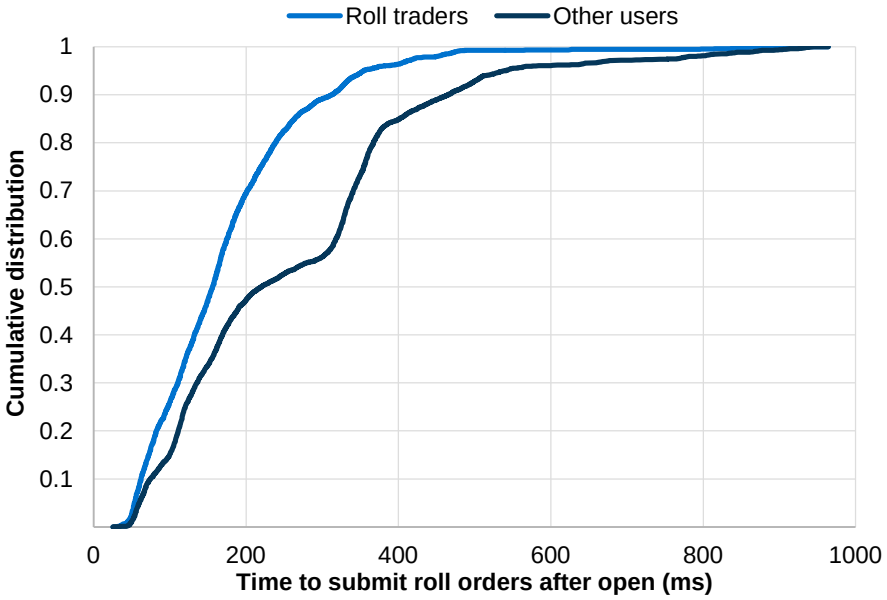
Session	Order Type	Q1 2014	Q1 2015	Change
Day	Enter*	40%	43%	7%
Day	All†	41%	43%	6%
Night	Enter*	49%	54%	11%
Night	All†	40%	48%	18%

* Submission of new orders only.

† Submission of new, amended and cancelled orders.

Bond futures roll

Figure 25: Time taken to submit orders into the bond futures roll within the first second of the market open



Dark liquidity—supplementary analysis

Types of order flow in dark venues

294 The methodology used for this analysis is consistent with an immediate mid-point benchmark of implicit transaction costs at time of trade. There are three components to Figure 26:[74]

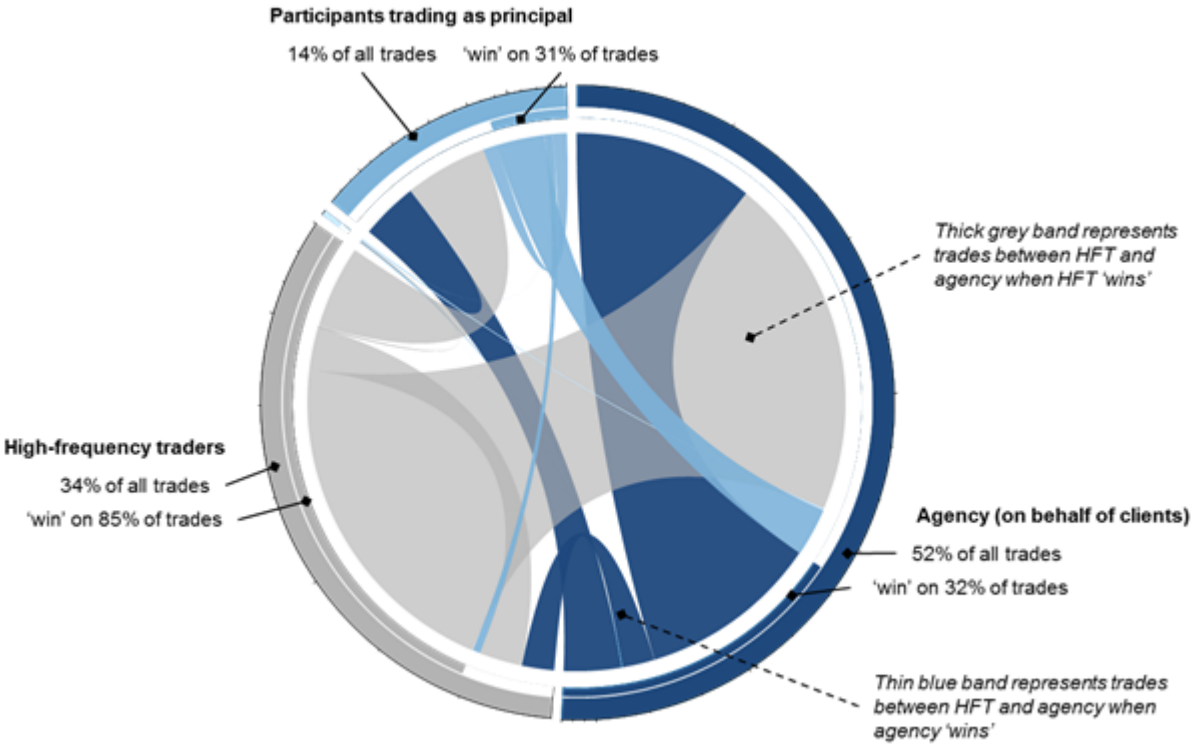
(a) the outer ring shows the aggregate value of the 'win' or 'loss' by counterparty category. For example, the dark blue part of the outer ring is just over half of the ring and reflects that agency (i.e. trades on behalf of clients) accounted for 52% of all of these trades;

(b) the inner ring shows the proportion of trades (i.e. a subset of the outer-ring) that were 'winners' for each counterparty category. For example, the dark blue part of the inner ring is 32% of the dark blue outer ring, suggesting agency 'wins' on 32% of trades they are involved in; and

(c) the internal flows show the origin of the 'winner' counterparty category and are mapped to the 'loser's' unshaded inner ring. For example, the thick grey band running through the middle shows that for 62% of the trades that high-frequency traders 'win', the counterparty is agency.

[74] Figure 26 is based on a data visualisation procedure first developed by Zuguang Gu, Lei Gu, Roland Eils and Matthias Schlesner, Benedikt Brors, 'Circlize implements and enhances circular visualization in R', Bioinformatics, vol.30, no. 19, 2014, pp 2811-2812.

Figure 26: ASX Centre Point and Chi-X hidden order liquidity mid-point arrival flows—comparison of beneficial and adverse price outcomes (categorised by the type of counterparty)



Key terms

Term	Meaning in this document
agency	Where a market participant acts on behalf of a client
aggregator	An aggregator provides connections between multiple crossing systems and facilitates the transmission and receipt of orders from a market participant to a crossing system (e.g. through an algorithm or smart order router)
aggressive order	An order that is priced so that it is immediately executable (i.e. priced to buy at or above the current offer, or to sell at or below the current bid). An example of an aggressive order is a market order
algorithm	Automated strategies using programmable logic/system-generated orders (rather than human-generated orders) based on a set of predetermined parameters, logic rules and conditions. These include algorithmic trading, automated order generation, high-frequency trading and automated market making
algorithmic trading	Electronic trading activity where specific execution outcomes are delivered by predetermined parameters, logic rules and conditions
arbitrage	The process of seeking to capture pricing inefficiencies between related products or markets
ASIC	Australian Securities and Investments Commission
ASIC Market Integrity Rules (Competition)	ASIC Market Integrity Rules (Competition in Exchange Markets) 2011—rules made by ASIC under s798G of the Corporations Act that are common to markets dealing in equity market products and Commonwealth Government Securities depository interests quoted on ASX
ASX	ASX Limited or the exchange market operated by ASX Limited
ASX 24	The exchange market formerly known as Sydney Futures Exchange (SFE), operated by ASX Limited
Australian market licence	Australian market licence under s795B of the Corporations Act that authorises a person to operate a financial market
automated order processing (AOP)	The process by which orders are registered in a market participant's system, which connects it to a market. Client or principal orders are submitted to an order book without being manually keyed in by an individual (referred to in the rules as a DTR). It is through AOP systems that algorithmic programs access our markets
basis points	One basis point is the equivalent of 0.01%

Term	Meaning in this document
below block size dark trades	Trades executed during normal trading hours that are not pre-trade transparent and that are not block size trades
best available bid and offer	See 'NBBO'
best execution	A requirement under Chapter 3 (Competition) for a market participant to achieve the best outcome for its client
bid–offer spread	The difference between the best bid and the best offer (also known as 'bid–ask spread')
block size trade	Trades that rely on the exception to the pre-trade transparency obligations in Rules 4.2.1 and 4.2.2 (Competition)
bond futures	Three Year and Ten Year Commonwealth Treasury Bond Futures Contracts traded on ASX 24
buy-side	Advising institutions typically concerned with buying, rather than selling, assets or products. Private equity funds, mutual funds, unit trusts, hedge funds, pension funds and proprietary trading desks are the most common types of buy-side entities
Centre Point	An ASX-operated dark execution venue
Chapter 4 (Competition) (for example)	A chapter of the ASIC Market Integrity Rules (Competition) (in this example numbered 4) unless otherwise specified
CHESS Depository Interest	A unit of beneficial ownership in a financial product of a foreign body, where the underlying financial product is registered in the name of a depository nominee for the purpose of enabling the foreign financial product to be traded on ASX
Chi-X	Chi-X Australia Pty Limited or the exchange market operated by Chi-X
Chi-X hidden orders	Orders in the Chi-X order book that are not transparent to the rest of the market prior to their execution
co-location	Facility offered by a market operator where market participants (and possibly clients of market participants) are able to place their trading processing servers within the same physical location as the market operator's processing servers to minimise latency
Corporations Act	*Corporations Act 2001*, including regulations made for the purposes of that Act

Term	Meaning in this document
crossing system	An automated service provided by a market participant to its clients that matches or executes client orders with orders of the market participant (i.e. against the participant's own account) or with other users with orders in the system. These orders are not matched on a pre-trade transparent order book
crossing system operator	Market participant that operates a crossing system
dark liquidity/trading	Orders that are not pre-trade transparent (i.e. not known to the rest of the market before they match): see paragraph 171
dark pools/venues	Electronically accessible pools of liquidity that are not pre-trade transparent, including crossing systems and dark venues operated by exchange market operators
depth	Volume of orders on an order book available to be traded
direct electronic access	The process by which an order is submitted by a client, agent or participant representative directly into a market participant's automated order processing system. Direct electronic access enables a client to access a market without being a direct market participant and without being directly bound by the operating rules of the market they are accessing
DTR (designated trading representative)	Representative of a market participant that has been authorised by the participant to submit trading messages to the execution venue on behalf of the participant
equity market products	Shares, interests in managed investment schemes, rights to acquire shares or interests in managed investment schemes under a rights issue, and CHESS Depository Interests admitted to quotation on ASX
exchange market	A financial market operated by a licensed market operator (under Pt 7.2 of the Corporations Act)
exchange market operator	An operator of a licensed market
facilitation trade	Where a market participant acquires securities directly from its client and holds the securities briefly as principal for prompt resale
financial market	As defined in s767A of the Corporations Act, a facility through which offers to acquire or dispose of financial products are regularly made or accepted
fleeting orders	Orders that fail to rest within a market for a meaningful period of time. This liquidity, although posted, is effectively inaccessible because investors are unable to trade purposefully against it

Term	Meaning in this document
fundamental investor	A person who buys or sells a security based on an assessment of the intrinsic value of the security (sometimes referred to as 'long-term investors')
futures roll	The roll on the ASX 24 futures market is a synthetic market in which two separate contracts, across succeeding expiries, are simultaneously bought and sold
high-frequency trader	Term used in this report to refer to a specific sub-group of traders within our analysis of equity and futures markets: see paragraphs 44 (equities) and 136 (futures)
high-frequency trading	There is no internationally agreed, formal definition of high-frequency trading. For the purposes of this report, we have used the description provided by IOSCO: see paragraph 27 for more detail
holding time	The period of time a trader holds a position
institutional investor	See 'buy-side'
IOI (indication of interest)	A non-binding, electronic expression of trading interest that may contain information such as the security name, capacity (agency or principal), volume and price instructions to identify potential counterparties
IOSCO	International Organization of Securities Commissions
intermediation	In the context of high-frequency trading, where a trader steps in between other buyers and sellers in the market
latency	An expression of how much time it takes for data to get from one point to another
layering	The creation of large numbers of orders, often at various price points, to create a false impression of demand or supply. These orders are then deleted, or moved, as they move closer to trading
limit order	An order for a specified quantity of a security at a specified price or better
liquidity	Volume of orders
liquidity segmentation	Where an exchange market or crossing system operator enables differentiated order execution priority based on the user or type of user
listed companies	Companies that are listed on an exchange market
lit (exchange) market	An exchange market where orders are displayed on the order book of a market operated by a market licensee and the orders are therefore pre-trade transparent

Term	Meaning in this document
maker–taker pricing	A fee model, offered by exchange markets, that rewards market participants that make prices by paying a rebate or charging a lower fee than for price takers, Maker–taker pricing is common in overseas markets
market integrity rules	Rules made by ASIC, under s798G of the Corporations Act, for trading on domestic licensed markets
market licence	An Australian market licence
market licensee	Holder of an Australian market licence
market maker	An entity that provides liquidity to a market when it is generally absent or weak, and manages short-term buy and sell imbalances in customer orders by taking the other side of transactions. Market makers often take on this role in return for fee rebates or other incentives
market manipulation	As defined in Pt 7.10 of the Corporations Act
market order	An order matched at the best price currently available
market participant	A participant of a licensed market
national best bid and offer (NBBO)	The highest bid (best buying price) and the lowest offer (best selling price) for a product that is available across all pre-trade transparent order books at the time of the transaction
order book	An electronic list of buy orders and sell orders, maintained by or on behalf of a market operator, on which those orders are matched with other orders in the same list
order execution priority	The order in which bids and offers are executed
order-to-trade ratio	The number of times orders submitted into an order book are amended or cancelled relative to the execution of a trade
payment for order flow	An arrangement where a market participant, securities dealer or fund manager receives a payment from another market participant in exchange for sending its clients' order flow to them
pegged order	A specified quantity of a product set to track the best bid or offer on the primary market
pinging	The practice of using the placement of very small orders to test if there is liquidity
post-trade transparency	Information on executed transactions made publicly available after transactions occur
pre-trade transparency	Information on bids and offers being made publicly available before transactions occur (i.e. displayed liquidity)
price formation	The process of determining the price of a security through the interaction of buyers and sellers

Term	Meaning in this document
price improvement	Rule 4.2.3 (Competition) provides an exception to the pre-trade transparency obligations where the dark trade provides price improvement of one tick size or the midpoint between the best available bid and best available offer
price–time priority	A method for determining how orders are prioritised for execution. Orders are first ranked according to their price; orders of the same price are then ranked depending on when they were entered
principal trader	A market participant that can only trade on behalf of itself
profiling	Where the operator of an exchange market or crossing system profiles clients or users of the market and groups them into categories or provides the capacity for market participants to profile their clients
Pt 7.10 (for example)	A part of the Corporations Act (in this example numbered 7.10), unless otherwise specified
REP 331	An ASIC report (in this example numbered 331)
retail client	Has the meaning given in s761G and 761GA of the Corporations Act
retail investor	A retail client as defined in s761G of the Corporations Act
RG 223 (for example)	An ASIC regulatory guide (in this example numbered 223)
Rule 4.2.3 (for example)	A rule of the ASIC Market Integrity Rules (Competition) (in this example numbered 4.2.3), unless otherwise specified
S&P/ASX 200	The index known as the S&P/ASX 200
S&P/ASX 300	The index known as the S&P/ASX 300
S&P/ASX 50	The index known as the S&P/ASX 50
s795B (for example)	A section of the Corporations Act (in this example numbered 795B), unless otherwise specified
sell-side	Firms that sell investment services to the buy-side, or corporate entities, including broking–dealing, investment banking, advisory functions and investment research
SPI	The ASX 24 futures contract over the S&P/ASX 200 Index
spread	The difference between the best bid and offer prices
tick size	The minimum increment by which the price for an equity market product or Commonwealth Government Securities depository interest may increase or decrease
trading messages	Messages submitted in relation to trading functions, such as orders, amendment or cancellation of orders, and the reporting or cancellation of market transactions

Related information

Headnotes

algorithmic trading, below block size dark trade, block trade, bond futures roll, conflict of interest, crossing system, crossing system operator, dark liquidity, dark pool, facilitation, fundamental investor, high-frequency trading, IOSCO, latency arbitrage, liquidity segmentation, market integrity, market operator, market participant, market quality, price improvement, principal trader, profiling

Regulatory guides

RG 181 *Licensing: Managing conflicts of interest*

RG 223 *Guidance on ASIC market integrity rules for competition in exchange markets*

RG 241 *Electronic trading*

Legislation

Corporations Act

Consultation papers and reports

CP 202 *Dark liquidity and high-frequency trading: Proposals*

REP 331 *Dark liquidity and high-frequency trading*

REP 394 *Review of recent rule changes affecting dark liquidity*

Market integrity rules

ASIC Market Integrity Rules (ASX 24)

ASIC Market Integrity Rules (ASX)

ASIC Market Integrity Rules (Competition)