Technology Impact on Capital Markets

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1. **Minimum Resting Time for Orders**

Introduction

In March 2013 ASIC released a set of potential regulatory changes to counter possible negative effects of recent technological changes on market operations. This came in response to the rapid increase in high frequency trading (HFT) and dark venue trading.

One proposal is for a minimum resting time to be placed on all orders. Unlike other changes under consideration, formal research on how resting times have changed with the growth in high frequency trade is lacking and there are few case studies from other markets where minimum resting times have been implemented. However, this proposal has received near unanimous support in a survey of buy-side representatives in Baseline Capital's 2012 report as well as in a preliminary survey of FSC sub-committee respondents.

This paper discusses how imposing a minimum resting time for orders in the Australian securities markets could affect liquidity, stability, operational efficiency and cost, market integrity and competitive neutrality. Analysis of the current order resting time in the Australian market is presented alongside the extant academic and industry research. These results are put into the context of current policy proposals internationally and ASIC's specific proposal for the Australian market.

ASIC proposal

In March 2013, ASIC released Consultation Paper 202 which proposes a number of Market Integrity Rules. These have been developed in response to concerns from market operators and market participants over the effect of HFT and dark venue trading on market quality, integrity and fairness.

A minimum resting time has been included in this set of proposals to address excess messaging and increased market noise, primarily from HFT. This would be an entirely new rule in the Australian securities market. The specific details of this ASIC proposal are as follows:

- The minimum order rule will apply to equity trades on ASX and Chi-X, and futures and CFD trades on the ASX 24 market. The current proposal does not apply to derivatives including exchange-traded options.
- Market participants will be required to prevent small orders from being amended or cancelled within 500 milliseconds.
- A small order is defined as being less than or equal to:
    - $500 value for equity trades on ASX and Chi-X;
    - $500 value for CFD trades on ASX 24;
    - 3 futures contracts for the ASX SPI 200 Index Future; and
    - 10 futures contracts for all other contracts traded on ASX 24.
- The minimum resting time will be implemented six months from when the rule is made

If this proposal was implemented today, we estimate this would affect approximately 1% of order amendments and 2.26% of order deletions. This represents approximately 1.25% of all order flow (including executed orders) on the Australian market. The proposed minimum resting time rule

would affect only a small portion of HFT operators. In ASIC Report 331, it is estimated that HFT accounts for 46% of orders and 32% of trades in the Australian equities market, with around 25-35% of small fleeting orders are attributable to high-frequency traders. The next section presents the results of our analysis into order resting times in the Australia market.

Resting times in Australian equities

Resting time is defined as the period from when an order is received by the exchange to when it is amended or cancelled. The proposal to set a minimum resting time for orders will mean that once an order has been received, a given amount of time must pass before the order can be amended or cancelled.

While many markets around the world, including Australia, are now considering the use of minimum resting times as a lever to counter the negative effects of high frequency trading, there is little extant research into order resting times. This report begins with an analysis of order resting times in the Australian market. Specifically, we take all limit orders for stocks in the ASX200 placed between 1010 and 1600 each trading day for the period 1 January to 31 March 2013. In this sample there are 37,596,598 order amendments and 40,344,221 order deletions.

Figure 1 charts the current resting times for limit orders on the ASX200 in half-second intervals up to 10 seconds. Across all three types of orders – executed trades, amendments and deletions – the proportion of orders is decreasing, on average, with resting time. In fact, a significantly larger proportion of orders rest for less than 500 milliseconds than rest for between 500 milliseconds and a second.

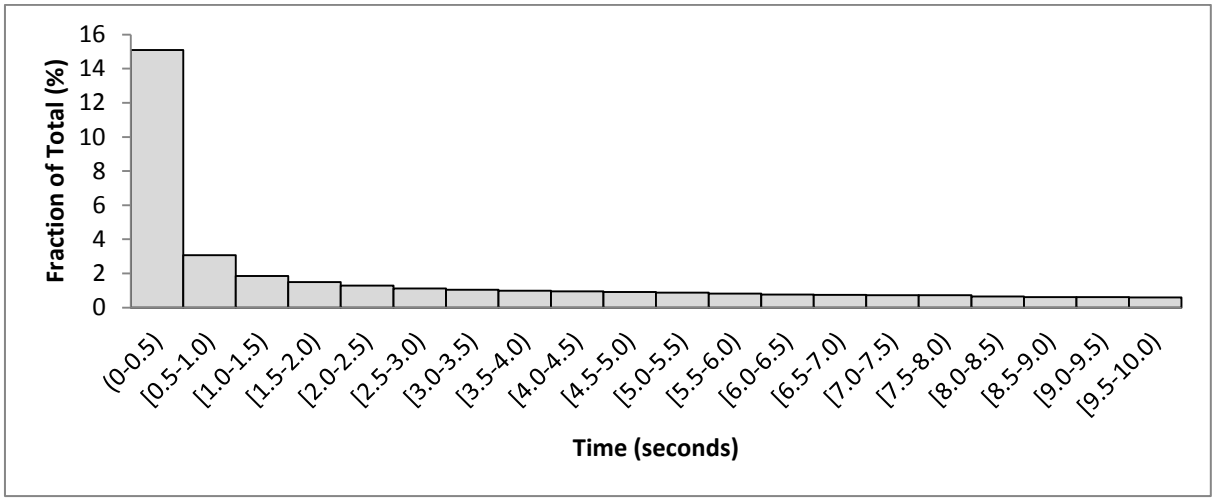
Table 1 presents summary statistics for orders in this sample, separated by resting times for amendments and deletions. Panel A shows the current average resting time for orders which are amended is 97 seconds, while the average resting time for orders which are deleted is 208 seconds. The time an order is left to rest, however, is highly skewed. Half of all amendments take place within around 17 seconds of the order being received by the exchange, while half of all deletions take place within around 30 seconds.

Panel B of Table 1 presents resting time statistics for equities separated by size. These results show that average resting times for equities in the Australian market change depending on the market capitalisation of the stock. On average, larger-cap stocks have lower resting times than smaller-cap stocks. A stock in the ASX50 is amended, on average, after 69 seconds while a stock in the top 51-200 of Australian equities is amended after an average 131 seconds. These results are similar for order deletions. The average time for an equities order in the top 1-50 of market capitalisation is deleted after 134 seconds. This increases to 290 seconds for ASX200 equities outside the top 50.

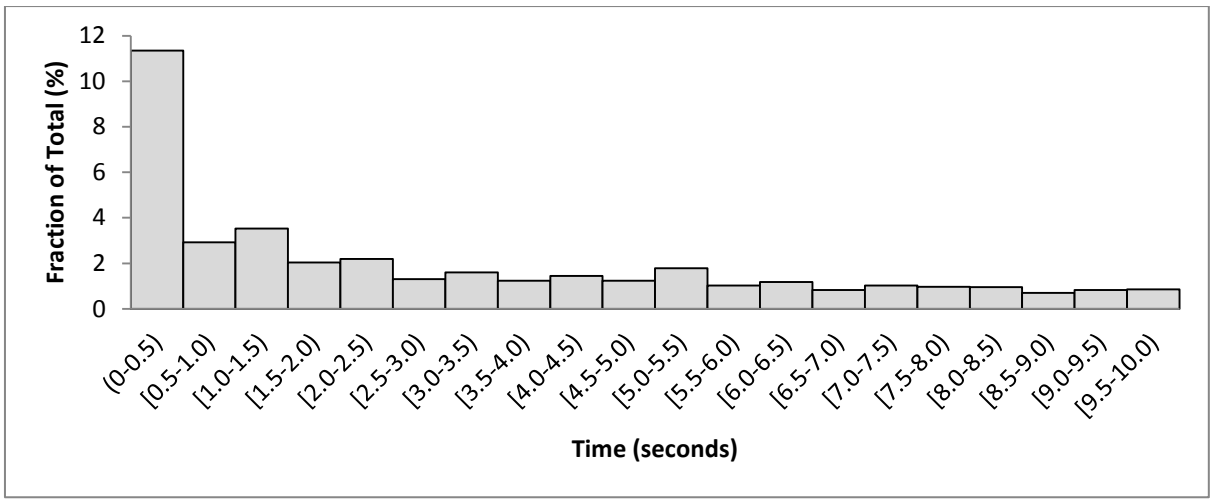
The proposal from ASIC would apply only to small orders. For equities, small orders is defined as orders worth less than or equal to $500. It is interesting then to analyse the current resting time for such orders. Table 2 presents the current average and median resting time for ASX200 equities orders during the sample period which are for a notional order value of $500 or less. Small order amendments represent 14.88% of all order amendments in ASX200 stocks, while 24.19%, or nearly one quarter, of all order deletions in ASX200 stocks is an order worth less than or equal to $500.

Figure 1: Resting Times for ASX200 Orders

A: Trades



B: Amendments



C: Deletions

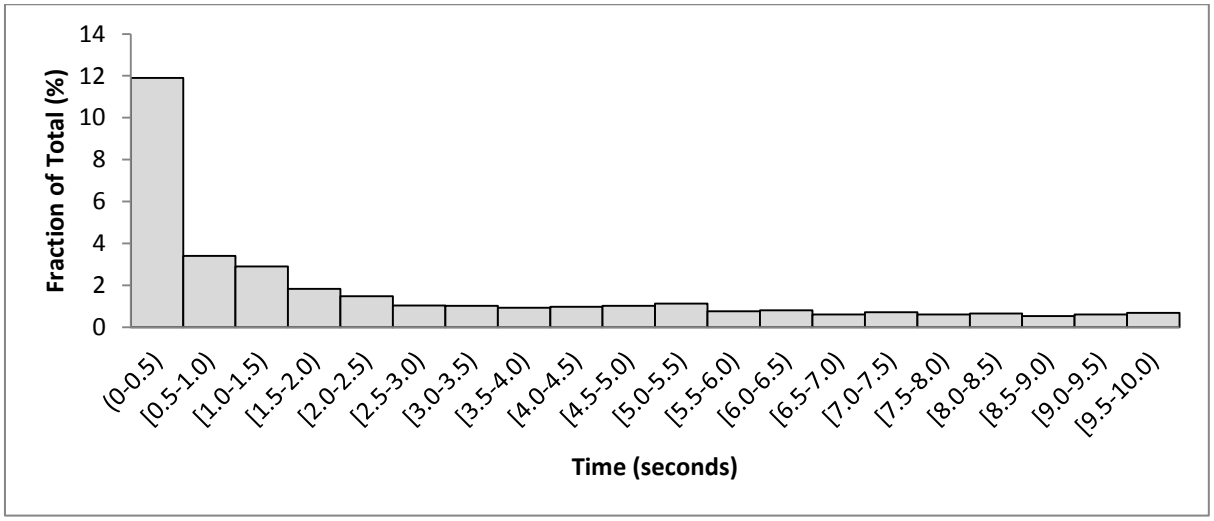


Table 1: Australian Equities Resting Times

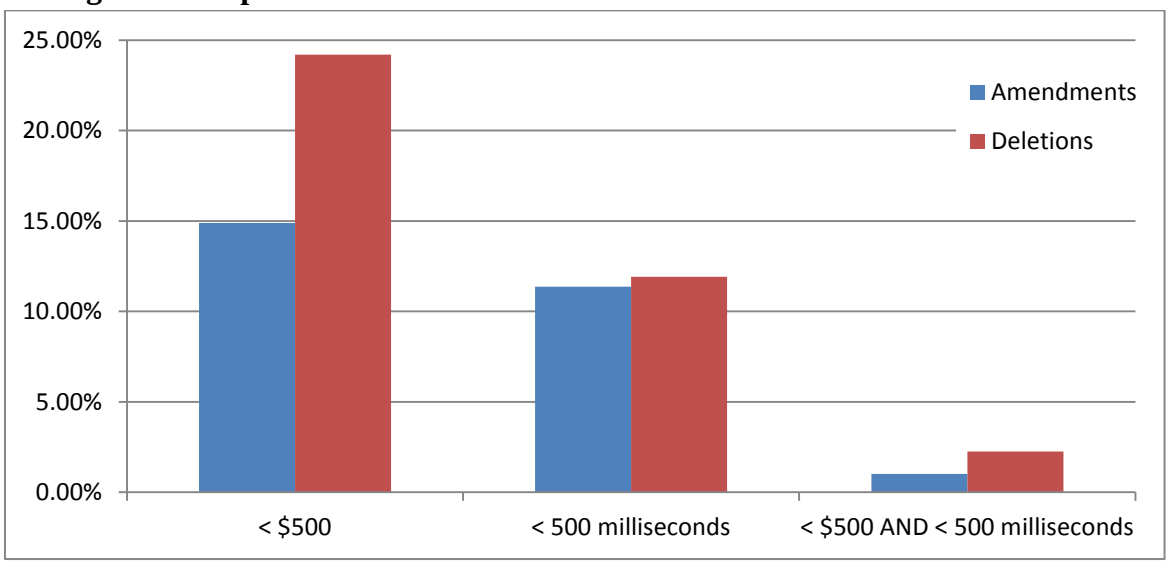
	Amendment		**Deletion**	
Panel A				
Average Resting Time	97.38		208.28	
Median	17.01		30.00	
Panel B	**Top 50**	**51-200**	**Top 50**	**51-200**
Average	69.25	131.27	134.06	290.35
Median	13.63	25.67	20.08	46.95

Table 2: Resting Times for Orders Worth < $500

	Amendment		**Deletion**	
Panel A				
Average Resting Time	102.06		151.83	
Median	28.73		37.75	
Panel B	**Top 50**	**51-200**	**Top 50**	**51-200**
Average	80.63	117.22	110.13	182.00
Median	22.20	30.06	28.13	47.60

The ASIC proposal would require these small orders to be unmodified for at least 500 milliseconds once placed. To determine the significance of this rule on the Australian equities market, the sample data is categorised by size and resting time. Figure 2 shows the proportion of all amended and deleted orders for ASX200 stocks which are either worth less than $500 or rest for less than 500 milliseconds, as well as the proportion which meet both of these conditions.

Figure 2: Proportion of Amended and Deleted Orders that would be Affected



While a significant number of order amendments and deletions are either small (around 15% and 25%, respectively) or rest in the book for a short period (around 11% and 12%, respectively), a small proportion meet both these criteria. Of all order amendments, 1.01% are both small and have a short resting time. The number of order deletions that would be affected by this proposal is

slightly higher at 2.26%. Around 91% of order amendments and 81% of order deletions which currently rest for less than 500 milliseconds would be unaffected by the proposal in its current form as the parcel size is too large. Although there may be implementation costs, restricting the minimum resting time to a small sample of messages will provide a useful examination of the efficacy of this proposal. The next section surveys the international regulatory response to technological changes, and specifically proposals for minimum resting times.

International Context

Market Proposals

Imposing minimum resting times on orders has been widely discussed as a response to the effect of technological change on market activity, although the evidence to date from natural experiments is limited by the reluctant uptake of such regulation. Notable exceptions include interdealer broker ICAP and NASDAQ-OMX's PSX market. ICAP introduced a 250 millisecond minimum quote life (MQL) on five major currency contracts and a 1,500 millisecond MQL on a set of precious metal contracts in June 2009. PSX is a US-based stock-trading platform, focused on exchange traded products. The implementation of a 0.1 second minimum order life is seen as a device to attract long-term investors to the exchange, and as an experiment before a launch of a major Nasdaq exchange.

While there are no market-wide restrictions on resting times in the world, minimums have been proposed by regulators in Australia and Europe. In Europe the Markets in Financial Instruments Directive, or MiFID, originally proposed a 500 millisecond minimum resting time for all orders, which was postponed at the time to the MiFID II review currently being undertaken. This differs from the current ASIC proposal which would only apply to small orders. As we have shown, a very small proportion of all order amendments and deletions would be affected by the ASIC proposal. The possibility of minimum resting times as part of a broader set of market rules have been raised in the US and the UK. To date, however, neither the SEC or the FCA has pursued this specific regulation.

Academic Research

Brewer et al (2012) use a stimulation platform to study the effect of alternative regulations following a flash crash, finding that call auctions are a superior method to minimum resting times for stabilising a market. Introducing a minimum resting time has the effect of removing speed of market access differentials between participants (i.e., creating a more level playing field). The advantages of lower latency were estimated at $100 million p.a. to a major brokerage firm from a 1-millisecond speed advantage in 2007 (Martin, 2007); this value is likely to be higher today. Farmer and Skouras (2012) estimate speed in limit order placement is worth $500 billion p.a. globally. Easley, O'Hara and Yang (2011) argue that speed differentials create a negative distortion to market and information access. Easley, Hendershott and Ramadorai (2009) show that removing speed differentials between on and off-floor NYSE traders is beneficial, increasing prices and market activity.

Discussion

In its proposal, ASIC argues that a minimum resting time rule would improve market quality by limiting adverse high frequency trading behaviours at the cost of removing small orders that contribute little to overall market liquidity and efficiency. We broadly agree with this conclusion, though argue that an alternative regulatory lever may be a more optimal approach.

Minimum resting times would lower the order amendment and cancellation ratios, leading to a more stable limit order book. It is possible that some predatory HFT behaviours would be limited by such a move, further improving the market integrity and fairness to long term investors. However, there are a range of unintended consequences that could arise from broad adoption of minimum resting times.

Potential negative externalities include: decreased depth and/or wider spreads from limit-order liquidity providers withdrawing from the market due to 'stale' orders that increase pick-off risk; increased risk/cost to liquidity providers in the market may force their exit leading to decreased competition; worsening impact from predatory algorithmic trading strategies that adapt to this rule; aggressive HFT becomes more prevalent and benefits over passive HFT strategies.

From the analysis presented in this report and the findings of earlier research, we come to the following conclusions:

- Minimum resting times are broadly supported by buy-side participants as a means to curbing potential negative impacts of technological change on markets, while sell-side and exchanges tend to oppose such measures
- However, adoption of the ASIC proposal will impact only a small proportion of the market in its current state, with the potential for many fleeting orders which are above the $500 threshold to still be placed. The size threshold sets ASICs proposal apart from similar minimum resting time proposals from offshore such as MiFID II.

Given the lack of evidence that currently exists in this area, should ASIC decide to proceed with this option their current proposal appears appropriate (given it only affects a small proportion of trading activity) as a means of better understanding the market impacts of minimum resting times. This approach has the benefit of enabling an evidence-based assessment at a later stage which could result in a recalibration of its parameters to ensure the proposal was having its desired effect.

Under either scenario, ASIC should consider exempting genuine liquidity providers from this regulation in order avoid unintended negative consequences from the proposal.

2. Call Auctions

Introduction

In March 2013 ASIC released a set of potential regulations to counter possible negative effects of recent changes to the investment market from new technologies. This included consideration of changes to transaction taxes and minimum trade sizes, tick sizes, and order resting times.

The ASIC proposal did not include a proposal for a change to an intra-day call auction system from the current continuous trading structure of the Australian market. However, the use of call auctions as a potential tool to mitigate negative impacts on market stability and integrity from technological advances has been raised by a number of market participants.

Industry Super Network (ISN), for example, advocated earlier this year for the introduction of 'short-duration' auction calls on the ASX. These would differ from the current opening and closing auctions on the market. In the current continuous auction process, orders are matched to one another continuously as they arrive in the market. Under the proposed intra-day call auctions, all bids in the market are sealed into the auction, of which the duration is potentially randomised, and matched at a single clearing price. Consequently, the ability of any market participant to act on information ahead of others is constrained. Specifically, the advantage of high-speed market participants would be eliminated. This is likely to have an effect on manipulative trading behaviour and informational efficiency.

Call auctions are widely used in financial exchanges at market open and close, as well as following trading halts. However, all major exchanges, including Australia, operate as a continuous auction during normal trading between open and close. This is despite the use of call auction markets prior to electronic trading and theoretical models which show call auctions to have more efficient price discovery than continuous systems (Madhavan, 1992).

Introducing periodic call auctions as a response to high-frequency trading has been considered in Europe as part of the MiFID review. In the UK report *The Future of Computer Trading in Financial Markets*, call auctions as a policy measure are described as "unrealistic and draconian" and likely to be "problematic." The ability of any change to the microstructure to restrict algorithm strategies is also debatable, given the adaptable nature of such strategies, as suggested in Guilbaud and Pham (2012). An alternative may be some hybrid model, as recently launched by the NYSE which gives market participants the choice to execute faster and anonymously through a continuously matched electronic order book or the existing auction mechanism (Hendershott and Moulten, 2011). Any serious proposal must consider the duration and timing of the auction collection.

In this paper we will present a summary of the key literature that examine the impact of call auctions on a number of market factors, including: liquidity, stability, operational efficiency and cost, market integrity and competitive neutrality. This can be extended following consultation to offer thought leadership on how the domestic proposal could affect the market.

Academic Research

In general, research comparing alternative price formation processes has followed one of two methods. The first approach compares market quality measures in call auction and continuous trading phases for the same market (Amihud and Mendelson, 1987; Amihud, Mendelson and Murgia, 1990). The second approach studies the effect on market quality of a structural change in a market's operations (Amihud, Mendelson and Lauterbach, 1997; Chang and Kang, 2007).

Amihud and Mendelson (1987) analyse the effect of trading mechanism – call auction versus continuous – on stock price behaviour. Specifically, price behaviour at the open is compared to market closing transactions. The open trades represent a call auction procedure while the closing transactions represent a continuous market-maker trading system. The authors examine open-to-open returns and close-to-close returns on the 30 Dow Jones Industrial stocks listed on the NYSE for the period 8 February 1982 to 18 February 1983. By comparing the same stocks on the same trading day under two different trading mechanisms the authors attempt to assess the impact of the alternative mechanisms *holding all else constant*.

It is found that the trading mechanism has a significant impact on price behaviour. Under the call auction-style opening: (1) price distributions diverged further from normality (increased leptokurtosis) than under the continuous closing trades; (2) prices demonstrated higher serial correlation, reflecting lower market efficiency; and (3) volatility and volume are higher. Similar findings are reported for the market design of the Tokyo Stock Exchange (Amihud and Mendelson, 1989).

Amihud, Mendelson and Murgia (1990) builds on the work of Amihud and Mendelson (1987) to the case of the Italian market. The Italian Bourse presents an interesting extension in that the call auction mechanism is preceded and followed by a period of continuous trading. A key limitation in the earlier study was that the negative call auction impacts may be a result of reflecting the first trades of the day when there has been a greater accumulation of information in the overnight no-trading period.

In Amihud, Mendelson and Murgia (1990) the market design is shown to affect price behaviour, even after the time of day is taken into consideration. In general, volatility in the call auction mechanism is shown to be higher than during continuous trading. The exception to this is when the market opens with a call auction. In this situation, the volatility is not significantly different from the following continuous trading session. The authors conclude that this evidence supports the call auction mechanism being the optimal price discovery process at the market open.
Amihud, Mendelson and Lauterbach (1997) study the effect of a change in the price formation process on the Tel Aviv Stock Exchange (TASE). Between December 1987 and December 1994 the TASE gradually phased listed equities to a continuous trading mechanism, with an opening call auction. Prior to this change, all TASE stocks were traded once a day in a single call auction.

The paper identifies key limitations to this call auction mechanism, including:

- Increased inventory risk, decreasing market maker activity and increasing illiquidity costs;
- Reluctance to place large trades which may have large market impact or be only partially executed, further increasing illiquidity costs;

- An exacerbation of these risks in a thin and highly volatile market such as the TASE.

The study analyses prices of stocks following the announcement that they will be added to the continuous trading system and after the transfer day. It is shown that there is a significant, positive, permanent price impact in stocks due to their transfer to the continuous trading system. The authors interpret this as evidence of improved liquidity and lower costs in stocks with continuous trading relative to stocks in a call auction system. They conclude that the TASE move to continuous trading had a positive effect on market quality.

Kairys, Kruza and Kumpins (2000) analyse the effect on market quality from a change to a continuous trading mechanism in the Riga Stock Exchange (RSE). Similar to the TASE case study in Amihud et al (1997), this paper measures price returns and turnover pre- and post-transfer to a continuous mechanism. Prior to this change, commencing in November 1997 and completed by January 1998, all stocks on the RSE were traded in a single daily call auction.

In an extension to the earlier work by Amihud et al (1997), the authors find that the benefits of a shift to a continuous trading regime are not equal to all stocks. Stocks with high liquidity prior to the transfer experienced a significant increase in the traded volume, while liquidity in stocks with low liquidity before the transfer fell further. Consequently, stocks in this category, which in the call mechanism represented 15% of RSE market capitalisation, accounted for less than 1% of market capitalisation post-transfer. While at an aggregate market level, the move to a continuous trading mechanism improved market quality, the results and the anecdotal evidence suggest that the detrimental effect on a large subset of securities of continuous trading relative to a call auction mechanism needs to be considered. Twelve months after this change in market design, low liquidity stocks reverted to the single daily call auction mechanism (though since bundling into the Nasdaq OMX group, trading now takes place on a continuous basis with auction mechanism used at open and close).

Chang and Kang (2007) examine the effect on market quality of the switch to a continuous auction mechanism on the Taiwan Futures Exchange (TAIFEX). On 29 July 2002, the TAIFEX ten-second call auction was converted to a continuous auction during the trading period between market open and close (the call auction was retained for market open and close). This change creates a natural experiment to compare the call auction and continuous auction processes. Using intra-day data covering the 6-month period either side of the change for Taiwan Stock Index Futures (TX) – the most established and actively traded contract on the market – the researchers measure the intra-day liquidity, volume and volatility under the two regimes. The findings show that moving to continuous trading increases liquidity and informational efficiency, leading the researchers to conclude that continuous trading has led to "an improved trading environment" for this market. Cheng, Kang and Fu (2008) extend this work to show that the gains from this change depend on the liquidity of the underlying instrument.

Discussion

Call auctions are currently widely used at market open and close, and following special events (such as trading halts or market disruptions). While there is currently no formal proposal for the introduction of call auctions through the day in Australia, industry groups such as ISN have

advocated their use. The use of intra-day call auctions has also been recently considered and rejected in Europe as part of the MiFID II review and in the UK government commissioned report *The Future of Computer Trading in Financial Markets*.

The appeal of intra-day call auctions is that the advantage of message speed is constrained. That is, market participants can benefit from information ahead of others only as a result of analysis, not latency. Proponents argue that call auctions improve market quality by creating a more level playing field and reducing the presence of manipulative trading behaviour.

The limitation in this argument is that algorithmic strategies are adaptable; introducing call auctions may affect the current algorithms, but the predatory algorithms will likely evolve to whichever microstructure is adopted (Guilbaud and Pham, 2012). Randomised auctions will further limit the advantage of algorithms; it is hard to say how adaptable they would be to the implementation of such a proposal, though their presence in existing auction periods (market open and close) indicates their participation will continue. In its extreme, using call auctions is expected to reduce overall market quality which will have a negative impact on all market participants. An alternative may be some hybrid model, as recently launched by the NYSE which gives market participants the choice as to whether to execute faster and anonymously through a continuously matched electronic order book or the existing auction mechanism (Hendershott and Moulten, 2011).

3. Transaction Taxes

Introduction

Economist James Tobin originally defined the concept of taxing individual transactions as a way of discouraging frequent, short-term transactions and improving market stability. The Tobin Tax was proposed in 1972 for foreign exchange transactions following the end of Bretton Woods, and in this context theoretically could achieve the intended outcomes. The introduction of a Tobin Tax to financial transactions has recently been proposed, and in some cases implemented, in a number of markets. A financial transactions tax has not currently been proposed in Australia (although some states have duties on sale and transfer of assets).

The main arguments in support of a financial transactions tax is that it leads to a reduction in speculative and destabilising market behaviours. Research has found these expected benefits are significantly outweighed by the negative consequences, including increased volatility, spreads and price impact while decreasing market efficiency and volumes. This paper will examine the effect of financial transaction taxes in other developed markets, and outline the policy proposals currently under consideration in similar markets. The academic research in this area is reviewed, and a discussion of the possible consequences of financial transaction tax in the Australian market for long-term investors is presented.

International Experience

The use of transactions taxes has recently increased in a number of developed markets. The European Union's financial transaction tax was proposed in September 2011 and agreed to in 11 of the 27 EU member states. This tax would be equivalent to a minimum of 10bps of the notional value in secondary market transactions and 1bp in derivative market transactions.

Other EU countries, including Italy, have separately introduced their own FTTs. France introduced a 20bps transaction tax on purchases of stocks with market cap greater than €1 billion effective 1 August 2012. In Italy a transaction tax on equities became effective on 1 March 2013. The details of the Italian FTT were as follows:

- 12bps charged on transactions in regulated markets or platforms, scheduled to be reduced to 10bps in 2014;
- 22bps charged on OTC transactions, scheduled to be reduced to 20bps in 2014;
- Applies only to transaction of Italian-domiciled companies with a market cap greater than €500million.

The Italian FTT also included a charge related to the message-to-execution ratio.

The renewed interest from government and regulators in applying transaction taxes is not supported in countries such as Sweden which have previously introduced and subsequently removed transaction taxes. Sweden introduced a 1% tax on all SSE-listed equity transactions in 1984. This tax was increased to 2% in 1986, before being abolished in 1992 due to its negative impact on market quality. During the financial tax period, equity prices fell and trading migrated (where possible) to London. The fall in trading volumes and capital gains tax revenue as a consequence

negated the revenue raised from the transaction tax itself, with no discernible improvement in volatility or market stability.

Literature review

The academic literature finds that transaction taxes reduce turnover through increased direct costs of trading, affecting the overall ability of these taxes to raise revenue. Habermeier and Kirilenko (2003) review the microstructure literature, finding other negative impacts of transaction taxes including widening bid-ask spreads, reduced price discovery, reduced asset price growth, with no effect (or a negative effect) on volatility and market stability. This section presents a brief summary of the key academic research on the impact of transaction taxes.

Chou and Wang (2006) examine the reduction of taxes levied on Taiwan Futures on 1 May 2000 from 5 to 2.5 basis points. Their results show that transaction taxes have a negative impact on trading volume and bid-ask spreads and no impact on volatility. Tax revenues increase in the second and third year after the reduction. This is supported in research that examines the reduction of the Swedish transaction tax in 1992 by Swan and Westerholm (2001). The authors in this study find that reducing transaction taxes leads to lower transaction costs which in turn increase turnover and reduce volatility.

Hu (1998) studies the economic effect of stock transaction taxes using 14 tax changes that occurred in Hong Kong, Japan, Korea and Taiwan in the period 1975 to 1994. He finds that an increase in the tax rates reduces stock prices but has no significant effect on market volatility and turnover.

Using a theoretical model of stock price behaviour, Kupiec (1996) demonstrates that although a transactions tax can reduce the volatility of the risky asset's price, the reduction in price volatility is accompanied by a fall in the asset's price as agents discount the future tax liability associated with risky asset ownership. Consequently, although price volatility may decrease slightly, the fall in equilibrium prices more than compensates, and the volatility of risky assets returns unambiguously increases with the level of the transactions tax.

Umlauf (1993) studies the effects of transaction taxes on the behaviour of Swedish equity returns during 1980-1987. Evidence provided shows that volatility did not decline in response to the introduction of taxes and stock price and turnover drops. Large proportions of trading activity migrated overseas to London when the tax rate was increased to 2% in 1986.

Using a model of heterogeneous interacting agents, Westerhoff (2003) finds that the Tobin tax generally has the potential to reduce volatility and market distortions. By imposing a small transaction tax, the profitability of trading declines and speculators leave the market; however, taxation affects all types of traders. Clearly, a reduction of fundamentalism always goes hand in hand with an increase in misalignments. If the tax rate exceeds a critical value, deviations of exchange rates from fundamentals start to rise. It is then the emergence of bubbles that makes destabilizing trading behaviour profitable again.

A recent study by Colliard and Hoffmann (2013) examines the impact of a financial transaction tax (FTT tax), and a further HFT tax, on a sample of French stocks. The FTT tax of 20 bps of the

transaction price was applied to all French firms with market capitalisation in excess of one billion euros. Transactions emanating from market making firms are excluded, leaving the primary target of the tax buy-side investors. The FTT tax led to immediate significant reductions in trading volume (predominantly in the first month after implementation), and significant reductions in market depth.

Discussion

Proponents in support of transactions taxes argue they discourage short-term speculative behaviour, thereby improving market stability and driving a return to long-horizon investing approaches. For long-term investors, including fund managers and superannuation funds, a transaction tax would have a minimal direct impact on operations. However, there would be significant indirect impacts to all market participants from a transaction tax in the Australian market. By increasing the costs of trading, the theoretical and empirical research finds that trading activity (predictably) falls, leading to increased spreads and, by potentially discouraging the participation of investors with information, decreasing price efficiency. This leads to higher costs for all market participants and inefficient capital allocation in the economy.

In a survey of FSC participants undertaken for this report, transaction taxes were unanimously seen as having a negative impact on liquidity, and a generally negative impact on market stability, integrity and efficiency. In the 2010 Future Tax System (Henry) Review in Australia, transaction taxes on financial instruments were rejected as being inefficient and regressive. The Australian Financial Markets Association (AFMA) have also rejected consideration of a transactions tax in Australia, highlighting the significant falls in transaction volume it could cause.

The European Commission estimates that the transaction tax in the EU could result in a 10% fall in secondary market transactions, and as much as a 70% fall in derivatives transactions (including currency and commodity derivatives). Despite this, there are EU-specific motivations for a transactions tax. The objectives of the proposed EU tax are threefold: raise revenue, add to market stability, and streamlining the taxation system in the EU. However, European Commission tax commissioner Algirdas Semeta goes further, describing the tax policy as a measure designed "to temper irresponsible trading". However, herein is the core problem with a transaction tax. A transaction tax is a blunt instrument. It does not discriminate between types of trading – that is, the tax applies equally to the "good" which contributes to market stability and price discovery and the "bad" which destabilises markets. For this reason, a transaction tax is not considered an optimal policy to implement in the Australian market.

4. Minimum Thresholds in Dark Pools

ASIC Proposal

ASIC has identified a risk that if a certain proportion of trade is executed in dark markets, market fairness and efficiency are adversely affected. In CP202 and REP 331 paper ASIC highlight three reports that look at dark trades:

1. Weaver, *Internalization and market quality in a fragmented market structure*.
2. The CFA Institute study separately considers internalisation and dark pools in the measurement of dark liquidity.
3. Comerton-Forde and Putnins, *Dark trading and price discovery*.

These form the basis of the proposal to set a minimum threshold to transact in dark markets (currently the limit is 0).

ASIC is seeking feedback on two proposed options. Each option has a trigger, which once exceeded effects a minimum trade threshold for execution in dark pools. The commonality in triggers between options B1.1 and B1.2 is the proportion of trading in dark pools i.e., 10%; the differences between the options relate to whether spreads in lit markets increase by 4% or 20%, and whether depth at the top five price levels in lit order books decreases by 15% or 20%. If triggered the minimum thresholds would be $50,000 or $20,000 based on stock classification. Under option B1.1 stocks are classified by their ASX300 ranking, under option B1.2 stocks are classified by block trade tiers

This proposal follows the change to rule 4.2.3 (Competition) to be implemented on 26 May 2013; this rule requires dark trading (other than large blocks) to be done with meaningful price improvement of one price increment within the bid–offer spread or the midpoint. ASIC expect this change will reduce trading activity in dark pools.

International Context

Several regulators have intimated the idea of setting a minimum trade size threshold, however none has imposed one. In October 2012, the Investment Industry Regulatory Organization of Canada (IIROC) enacted rules similar to those to be introduced May 26, 2013 in Australia. These rules relate to the minimum price improvement for dark orders. In terms of setting a minimum trade size IIROC raised this option, however given the strong opposition it received from investors who believe setting a minimum threshold would restrict liquidity, IIROC and the Canadian Securities Administrators (CSA) have decided not to set a minimum and will evaluate the need for a minimum trade size at a later date.

Literature Review

Despite the ex-ante benefits of having a consolidated market (liquidity begets liquidity, Pagano, 1989), today many securities are traded across a variety of different venues and structures, which can be described as ‘lit’ or ‘dark’ markets. This fragmentation of liquidity across venues has required market participants to interact and connect with more than one venue, all of which may offer different liquidity. This slicing of liquidity may be beneficial for the overall market or simply

complicate buy-side objectives of transacting large orders quickly and with little information leakage.

Three competing theories exist on the likely effects and rationale for market fragmentation. One school argues that fragmentation increases liquidity search costs, reducing the quality of markets overall (Mendelson, 1987). The second school hypothesises a clientele effect, where market fragments exist to cater for different investor groups (Harris, 1993; Petrella, 2009). The final school posits fragmentation as a means of fostering competition among markets for liquidity, reducing the size of transaction costs (Parlour and Seppi, 2003; Hendershott and Mendelson, 2000).

Burdett and O'Hara (1987) model the various interactions among large traders to devise an optimal pricing and syndication strategy which traders should implement in their search and construction of potential cohort(s) of counterparties for block trade execution. Their results illustrate upstairs markets (the earliest form of restricted dark pools) assist investors in locating counterparties, and thereby enable investors to execute large trades without fully revealing their orders to the downstairs markets or suffering any information leakage as they would normally via a specialist system of trading.

Seppi (1990) argues block trading is an optimal form of trading for both informed and uninformed traders. Informed traders prefer to trade large due to the inherent short life of private information, while liquidity traders similarly prefer to trade large in order to rebalance their portfolios efficiently. The problem a dealer faces is how to evaluate whether a block trade is motivated by liquidity or information. Seppi (1990) shows traders who can credibly signal their trading intentions as purely liquidity motivated, execute large trades off-market with minimal price impact. Specifically, if traders enter into trading commitments with dealers in upstairs markets, such that they trade only in the upstairs market when they have no information and with the specialist when they have information, the effective bid-ask spread faced by block traders is lower in the upstairs market. This so-called reputation contract has the added benefit in that it does not force a trader to break up their orders as they would in downstairs markets. Seppi (1990) argues the non-anonymous feature of the upstairs market enables dealers to enter into 'no bagging' commitments to screen traders and later punish those who 'bag the street'. Harris (1997) conversely states that if intentions are unveiled, traders are exposed to the risk that others will learn of their motives and compete with them. Competition may result in loss of proprietary information, or loss of liquidity by front-runners.

Pirrong (2001) models the positive and normative implications of upstairs markets. Pirrong (2001) notes many exchanges endogenise a selectivity bias when, for example, brokers are only able to trade in upstairs markets if their trades are of a certain size or in a particular stock. Evaluating eight permutations of interaction between centralised and decentralised markets which include and exclude informed trading, Pirrong (2001) concludes the viability of the upstairs market hinges on its ability to free-ride off price discovery in the downstairs market. Pirrong (2001) also adds that if barriers exist to trade in the third market, the existence of a third market reduces welfare unless its competitive threat induces the exchange to expand.

Buti, Rindi and Werner (2001) model the dynamic trading strategies of traders between dark pools and a transparent limit order book. They prove dark pools supplement the traditional limit order book and increase overall trading volume. Buti, Rindi and Werner (2001) highlight that liquidity

benefits of dark pools are contingent on a stocks pre-existing level of liquidity, for example in illiquid stocks the competition amongst venues decreases execution probabilities causing the spread to increase, while in liquid stocks the converse is true. Moreover, Buti, Rindi and Werner (2010) find the expected gains from trading in dark pools increases for institutional traders in liquid stocks and decreases in illiquid stocks. The total welfare gains for retail traders decreases.

Degryse, Van Achter and Wuyts (2009) model the competition between a crossing network and a dealer market under three different transparency regimes. They show that the introduction of a crossing network creates new liquidity from traders that would otherwise have abstained from trading. However, the crossing network also exerts a negative crowding-out effect on the dealer's willingness to provide liquidity. Overall welfare is shown to increase when the spread is high to begin with, but decreases when spreads were low.

Zhu (2011) models the introduction of dark pools to determine if they are detrimental to price discovery. Zhu (2011) finds informed traders, who typically trade on one side of the market, are less likely to be executed against in dark pools. This execution risk in dark pools forces them back into the lit markets to ensure trade completion based on short lived information. This greater concentration of information in transparent order books improves price discovery, at the cost of increased spreads.

The theoretical literature discussed above is limited by the assumptions which determine the rules of engagement among market participants. Consequently, it is expected one would observe different conclusions associated with the introduction of fragmentation or dark pools. The empirical literature discussed below similarly provides mixed results.

Focused on the relative execution cost benefits across platforms, Barclay, Hendershott and McCorrmick (2003) find significantly lower execution costs on electronic communication networks (ECN) in comparison to NASDAQ, if and when this liquidity is actually present, and that ECNSs are associated with greater information asymmetry, particularly around intense trading periods and volatility. Næs and Skjeltorp (2003) show that competition from crossing networks (CN) appears concentrated in large and liquid stocks. While trading in CNs increases the risk of non-execution, they show using simulations that a strategy of trying to cross all shares is optimal. Using the same dataset, Næs and Ødegaard (2006) show that while execution costs on CNs are lower, this is offset by higher costs of non-execution, which is difficult to quantify in traditional measures of transaction costs. Gresse (2006) investigates the competition between the London SEAQ quote-driven market and a CN. Dealer market spreads are found to be negatively related to CN volumes. Given the significant participation of dealers in CNs, CNs are argued to improve risk sharing among dealers.

In relation to upstairs markets, Keim and Madhavan (1996) argue that the optimal number of counterparties to the trade depends on the size of the block. Increasing the number of counterparties minimises the price impact of the block trade, but results in an increase in the cost associated with information leakage. This leads to a trade-off, and therefore a non-linear relationship exists between the number of shares traded and the temporary price impact. In addition, they report significant movements in pre-trade prices, which they attribute to information leakage prior to the upstairs trade. Madhavan and Cheng (1997) examine the execution costs in upstairs and downstairs markets

for Dow Jones stocks. While they find significantly better execution costs for large trades in upstairs markets, they argue that these benefits are economically small.

Madhavan and Cheng (1997) also report that trader reputation is an important attribute in upstairs markets reducing total and permanent price effects associated with block trades. This is consistent with the theoretical propositions developed by Seppi (1990) and empirical evidence provided by Smith, Turnbull and White (2001) for the Toronto Stock Exchange (TSX); Fong and Swan (2001), Fong, Madhavan and Swan (2001), and Fong, Madhavan and Swan (2003) for the ASX; and Gottardo and Murgia (2003) for the Italian Stock Market (ISM).

Smith, Turnbull and White (2001) analyse adverse information and the price effects of block trades in upstairs markets for brokers trading on principal and agency business. Smith, Turnbull and White (2001) document traders in upstairs markets obtain favourable execution and suffer little or no adverse selection costs vis-à-vis traders transacting in downstairs market, irrespective of trade size. This is because the upstairs market does not cannibalise liquidity from the downstairs market. On average the information or permanent price effects of block trades in the downstairs market are 95% higher than block trades executed in the upstairs market. Further, the permanent price effect of block trades executed on principal and agency business in upstairs markets are indifferent. These results suggest dealers in upstairs markets are able to effectively screen out information motivated orders. Moreover, Smith, Turnbull and White (2001) find for the TSX that the upstairs market provides a complementary role in supplying liquidity to large traders and that traders do not free-ride off the prices in the downstairs market.

Fong and Swan (2001), Fong, Madhavan and Swan (2001) and Fong, Madhavan and Swan (2003) similarly acknowledge that while there may be a threat that upstairs markets and crossing networks may harm liquidity, they provide evidence that this form of alternative trading is Pareto improving for all investor classes and market participants. Further, Fong, Madhavan and Swan (2003) show the parallel existence of a downstairs and upstairs market improves execution costs for traders who are able to execute trades in all markets. In deciding whether ASX brokers facilitating customer orders in the upstairs market use information gathered from their clients to unfairly take advantage of them, Fong and Swan (2001) find brokers on the ASX upstairs market are not profit driven. On the contrary, they find support for the liquidity provisions hypothesis developed by Burdett and O'Hara (1987) and Aitken, Garvey and Swan, (1995) which argues dealers are willing to trade-off short-term information gains for long-term customer relationships. Moreover, Fong Madhavan and Swan (2001) show the decision of which market a trader finally decides to execute a large transaction hinges on the size, depth and spread of the central limit order book and the ability of the trader to signal his intentions of trade.

Booth, Lin, Martikainen and Tse (2002) similarly examine trading and pricing in upstairs and downstairs markets for the Helsinki Stock Exchange (HSX). They show traders in upstairs markets are able to obtain favourable execution, due to the existence of a large number of liquidity traders. Consequently, Booth, Lin, Martikainen and Tse (2002) find adverse selection costs and the price effects of block trades are significantly lower in upstairs markets vis-à-vis downstairs markets. Moreover, Booth, Lin, Martikainen and Tse (2002) argue traders in upstairs markets utilise price discovery in the downstairs market to formalise their trading prices, and better price uninformed liquidity traders in the upstairs market. Conversely, upstairs market prices have inconsequential

price effects on price in the downstairs market. Booth Lin, Martikainen and Tse (2002) interpret these results in addition to documenting that traders in upstairs markets internalise/facilitate customer orders, as evidence consistent with concepts espoused by Seppi (1990) and Grossman (1992). Specifically, dealers in the upstairs market inherently know their customers and their unexpressed trading interests which correspondingly translate into price improvement for liquidity motivated upstairs traders vis-à-vis downstairs traders.

Bessembinder and Venkataraman (2004) provide direct empirical support for Grossman's (1992) model. Reconstructing the limit order book each time an upstairs trade is executed on the Paris Bourse, Bessembinder and Venkataraman (2004) evaluate the indicative cost of routing upstairs market trades to the downstairs market. This is undertaken to evaluate how the expressed liquidity in the downstairs market fares against the unexpressed liquidity in the upstairs market. They document upstairs traders incurred execution costs of 0.20%, as opposed to 0.58% if they were alternatively executed in the downstairs market. Further, Bessembinder and Venkataraman (2004) document that a trader who can participate efficiently in an upstairs market will achieve better execution. The authors argue this is because upstairs participants are able to screen and certify block traders as uninformed or informed, consequently tapping into unexpressed liquidity. As a result, Bessembinder and Venkataraman (2004) report any random large trade in the upstairs market does not necessarily attain favourable execution.

Boni, Brown and Leach (2012) examine large block trades (50,000 share or more) executed in US Liquidnet Classic (a dark pool exclusive to buy-side institutional investors) relative to other dark pools. They find, even after controlling for trade execution difficulty, Liquidnet Classic trades are associated with better execution quality as measured by information leakage and front-running proxies. Domowitz, Finkelshteyn and Yegerman (2008) similarly evaluate execution quality as measured by implementation shortfall costs across periodic crossing networks, continuous crossing networks and liquidity aggregation algorithms in 10 dark pools. They find differences in execution costs across platforms supporting Boni, Brown and Leach's (2012, p.23) conclusion that it "… is important to consider, in empirical, theoretical and policy-orientated discussions, that not all dark pools are created equal. Venue design features related to exclusivity factor into dark pool performance".

Ready (2010) investigates the relation between changes in institutional holding and trading volume on 3 dark pools used exclusively by institutional traders. Ready (2010) finds dark pools usage is lower for stocks with the lowest spreads. He and Lepone (2010) investigate the determinants of dark pool activity on the ASX. Their results show that the level of trading activity in the dark pool (in this case CentrePoint) is higher for larger stocks with lower prices. Dark pool's share of total volume is higher when quoted spreads are wider, best depth is thicker, and when order imbalance, volatility and adverse selection are lower in the central limit order book. Execution probability of CentrePoint orders increases when dark pool trading is most active and when average CentrePoint order size is greater. He and Lepone (2010) find no evidence of dark pool trading being detrimental to market quality on the main exchange.

CentrePoint trades are also examined by Comerton-Forde and Putnins (2012). They evaluate the price impact and price discovery implications of an increase in dark pool and off market trading. They find as dark pools garner market share, traditional or lit markets suffer in terms of price

discovery; no such impact is associated with large off market trades. Moreover, they find that bid-ask spreads and adverse selection costs increase on the lit market as dark pool trading activity increases. Degryse, Jong and van Kervel (2013) similarly are able to flag trades originating from visible or dark fragmented markets (Comerton-Forde and Putnins sample includes the introduction of Chi-X). Examining 52 securities across European markets, Degryse, Jong and van Kervel (2013) evaluate (1) consolidated liquidity across markets (2) local or traditional market liquidity and (3) best market liquidity for a given trade size. They find when lit markets fragment liquidity improves, while market fragmentation caused by the introduction of dark pools impairs market quality. Specifically they report "an increase in dark trading of one standard deviation lowers consolidated liquidity by 9%" (p.4), and consistent with Comerton-Forde and Putnin (2012), an increase in adverse selection costs and informed trading. Nimalendran and Ray (2012) report similar increases in quoted spreads as trading activity increases in dark crossing networks.

Discussion

ASIC is seeking responses to whether:

1. A minimum size threshold should exist?
2. Are the triggers sufficient to identify degradation in price formation?
3. Does the FSC have a preference for a particular option?

The above summary demonstrates the verdict on the impact of dark pools remains an open question. This is particularly true as data on dark trades is not readily available. Many of the above studies lump together dark pools, all of which may have different protocols (See Butler 2007 for a summary on 24 dark pools in the US) and treat internalisation and crossing networks as similar mechanisms. To better understand the impact these features have on markets one needs greater qualitative attributes than simple classifications of dark or lit markets. As the meaningful price improvement proposal is due to be implemented in late May, we believe it is not yet appropriate to introduce additional controls until such time as the efficacy of this measure can be considered. Once the effectiveness of meaningful price improvement has been assessed, we will be better position to assess further regulatory levers on dark.

In the interim, based on the evidence, by imposing a minimum threshold dark pool, the ASIC proposals in CP 202 on minimum thresholds may substantiate claims summarised by market participants that the purpose of dark pools is to effect large block trades; not a means to feed internalisation and proprietary HFT which some of the studies have included as dark trades. We agree that bid-ask spreads and market depth are sufficient to at least explain whether market liquidity has deteriorated. In terms of preference, option B1.1 is preferred. We believe price discovery should be based on lit markets and the earlier triggers in B1.1 will limit the extent to which markets degrade. Under option B1.1 minimum size thresholds are enacted if dark pool trading in a stock exceeds 10%, bid-ask spreads increase by 4% and depth reduces by 15%. The minimum threshold would be $50,000 ASX/S&P50, and $20,000 for all other stocks.

Dark pools, by providing anonymity ex-ante, are expected to deliver benefits to those who wish to trade large and avoid adverse selection costs. This is best achieved when they are dealing with other large traders, and not small or pinging traders. Dark pools should exist to house unexpressed liquidity of buy-side investors, and changes that promote this will benefit the market.

5. Minimum Tick Sizes

ASIC Proposal

Currently

a) for securities priced ≥ $2, the tick size is $0.01;
b) for securities priced between $0.10 and $2, the tick size is $0.005; and
c) for securities priced < $0.10, the tick size is $0.001.

ASIC is proposing to either:

a) Increase the middle tick tier for $2-$5 stocks to move to a $0.005 tick; or
b) reduce tick size of severely tick constrained stocks. (ie trade 90% of the time at the minimum tick) to a reduced spread.

International Context

Tick size reductions or increases have occurred across equity and derivative market in most markets, the most extensively studied is perhaps the decimalisation of US markets.

Literature Review

Harris (1991 and 1994) are the seminal studies surrounding minimum price movements, in effect minimum ticks. Harris in his 1991 paper, develops an econometric model explaining price clustering, the anomaly that price in NYSE stocks are completed on round fractions. Harris (1991) finds that price clustering is related to a firm's stock price. In his 1994 paper, Harris examines the impact on bid-ask spreads, quoted depth and trading volume caused by a halving of the minimum tick on the NYSE. Harris assumes that in a market which is often trading at the minimum price increment, a decrease in minimum tick could result in a more efficient market. He hypothesises that in the event of a reduction in tick size, dealers may be willing to quote smaller orders to maximise their gains. Also, quote matching may become more prevalent as the cost of front-running is reduced.

Harris finds a strong correlation between the inverse price level and the bid-ask spread. He notes that the correlation is high because the variation in price levels is relatively high compared to the variation in relative spreads. Further, he finds a strong correlation between volume and spreads. Finally, Harris postulates that the importance of the change in the minimum price variation is related to the size of the tick relative to the stock. The bid-ask spread should be positively related to the tick size, especially in the case of trading being constricted at the minimum tick.

Golstein and Kavajecz (2000) examine the June 1997 move by the NYSE to reduce tick sizes from eighths to sixteenths. They find a significant decline in average quoted and proportional bid-ask spreads and average quoted depth. Golstein and Kavajecz (2000) report that reductions in quoted spreads and depth are greatest for frequently traded stocks, while average quoted and limit order spreads increase for the most infrequently traded stocks, consistent with Harris (1994). Depth at the best prices decreases with the largest decline in the most frequently traded stocks. Results also indicate a decline in cumulative depth for frequently traded stocks, with little variation across stock

groups. Overall, results support Harris (1994) that tick reductions are most beneficial for more actively traded stocks, while illiquid stocks experience a decline in market quality. Jones and Lipson (2001) also examine the June 1997 tick size reduction on the NYSE. Like Goldstein and Kavajez (2000), they find that quoted and effective spreads, and quoted depth, decline post-period. However, Golstein and Kavajecz (2000) find that trading costs increase after the tick size is halved, indicating that quoted and effective bid-ask spreads are not an adequate measure of market quality. This is particularly true for institutional investors, as it is common practice for institutions to separate large orders into several smaller trades to minimise price impact. To address these issues, Jones and Lipson (2001) examine a large sample of proprietary trading by institutions. They find that while small traders may have benefitted, large orders consisting of 10,000 shares or more are more expensive to execute after the tick size is halved, with one way transactions costing an additional 3.4 basis points. Orders exceeding 100,000 shares cost a third more after the tick size reduction. Isolating the effect of the tick size reduction from individual firm characteristics and order types, the authors find that across all firms, average execution costs increase by 22.5 basis points.

Bessembinder (2003) examines the move to decimalization on the NYSE and Nasdaq in 2001. Bessembinder (2003) finds that quoted spreads decline both across markets and across market capitalisation groups, with large capitalisation stocks in both markets experiencing the largest reductions. Conversely, quoted depth levels in both markets are substantially reduced. Intra-day return volatility is reduced after the move to decimal trading. Analysing trading costs, Bessembinder (2003) finds that average effective spreads for Nasdaq stocks remain unchanged after decimalisation, while NYSE stocks experience a decline in effective bid-ask spreads. While depth is reduced, a fall in effective bid-ask spreads, lower volatility and a general decrease in the costs of trading lead Bessembinder (2003) to conclude that overall market quality is increased.

Using a proprietary data, Chakravarty, Panchapagesan and Wood (2005) compare institutional transactions costs before and after decimalisation on the NYSE. Using the implementation shortfall measure, they find that trading costs for institutional traders decrease by 32%. In contrast to Jones and Lipson (2001), Chakravarty, Panchapagesan and Wood (2005) find that total trading costs decline by 22.6 basis points, with the greatest decrease in costs occurring in the largest size group. Consistent with previous literature, they find significant disparity between changes based on activity levels, with stocks trading at minimum tick experiencing the greatest bid-ask spread reductions and illiquid stocks experiencing an increase in bid-ask spreads. Large traders who aggressively seek liquidity experience cost increases of 10 basis points, while large traders that execute orders over several days experience cost reductions of around 32 basis points.

Bacidore (1997) addresses the decimalisation debate by analysing the move to decimal trading on the Toronto Stock Exchange (TSE) in April 1996. As the TSE had a tiered tick regime prior to the move to decimal trading, Bacidore examines differences in various levels of tick size changes. Their results highlight that when ticks are reduced from an eighth to a cent, bid-ask spreads are reduced with no adverse effect on market quality, while for stocks which move from 5 cents to 1 cent, the reduction does not impact on market quality. The findings of Bacidore (1997) are supported by Smith, Turnbull and White (2006) who analyse the 2001 move to decimal trading on the TSE, finding that the move to decimal trading leads to reduced spreads, with an overall reduction in quoted spreads of 12%. The reduction in quoted spreads is greatest for the most actively traded

stocks. The authors note that, unlike in Goldstein and Kavajecz (2000), the Toronto Stock Exchange *does not* experience a change in quoted depth. The reduction in bid-ask spreads, but not quoted depth, leads to a reduction in trading costs for large traders, consistent with Chakravarty, Panchapagesan and Wood (2005).

Ahn, Cai, Chan and Hamao (2007) examine the 1998 reduction in tick size on the Tokyo Stock Exchange, and the resulting impact on liquidity and overall market quality. The Tokyo Stock Exchange is an order-driven market, and similar to Toronto, has a tiered tick regime. Results indicate a significant decrease of 20-60% for quoted bid-ask spreads across stocks, with no significant change in trading volume. Analysis of changes in bid-ask spreads across each size quartile show that the largest stocks, with the largest tick size, experience the greatest tick size reduction, exhibiting an average quoted spread reduction of 51.09%.

Aitken and Comerton-Forde (2005) also examine the reduction in tick size in a tiered tick regime on the Australian Stock Exchange. Unlike previous studies, this study has a control group of stocks which do not undergo a tick size reduction, thus providing a control sample. Results indicate that the reduction in bid-ask spreads is greatest for lower capitalisation stocks. The largest stocks, with already small relative tick sizes, experience an increase in the average bid-ask spreads. The authors find that across all stocks, depth at the best bid and ask quotes is significantly lower following the move to smaller minimum price increments. The control sample experiences no significant change in either bid-ask spreads or quoted depth. Moreover, Aitken and Comerton-Forde (2005) examine the percentage of market orders, percentage of undisclosed order and the percentage of off-market trading pre- and post- the 1995 tick change and report no significant differences. However they find the value of the order book weighted by execution probability value of the order book, a measure espoused as capturing the four elements of liquidity, is shown to improve for certain stocks, and decrease for others. Consistent with previous literature they report "reducing the tick size too much, particularly for low volume stocks with smaller relative tick sizes may even reduce the provision of liquidity" (p.182).

Coughenor and Harris (2003) examine the specialist's profitability surrounding decimalisation. They find decimalisation which decreases the cost of being first in the order book queue enabled specialists trading in low priced stocks to increase their profits from short term trading strategies. Harris and Coughenor (2003, p.1) argue "regulators must balance the benefits specialists provide to the market with the costs they impose on the market through their special privileges". Ronen and Weaver (2001) similarly examine the occurrence of queue jumping by examining the extent to which trades are executed inside the quote. They find following the introduction of trading in sixteenths stepping ahead of the queue increased, except for the least tick constrained stocks. Ronen and Weaver (2001) confirm this result when they examine only specialists trading, suggesting the tick size has resulted in poorer execution quality for limit order traders.

Recently, tick size literature has expanded to understand tick sizes and their impact on dark pools. Most dark pools offer price improvement, typically at the midpoint of lit market prices; this however enables subversion of minimum tick rules. Kwan, Masulis and McInish (2012) investigate whether the proportion of dark pool trading is related to sub-penny trading. They find that as stocks become more tick constrained their dark pool trading activity increases. Kwan, Masulis and McInish (2012) argue tick sizes should be based on a firm's stock price level and liquidity; similar

calls have been made for European market (see Guillot 2012). Weild, Kim and Newport (2012) go one step further and argue that it should not just be regulators that set minimum price ticks, but firms listed on the exchange should have input on determining the parameters of trade in their stocks.

Discussion

ASIC highlights the implication of this change could impact HFT and the extent of price improvement offered in dark pools. ASIC wants to know if:

1. The FSC agrees there are tick constrained stocks
2. Should ASIC overhaul the tick size or just target the most affected stocks?
3. Does the FSC have a preference for Option D1.1 or D1.2?
4. Is a pilot desirable?

The FSC agree that certain stocks are tick constrained as defined by ASIC. The literature survey highlights that the impact of changes in tick size are not common across stocks, indicating a one model fits all is not the appropriate solution. If tick constrained stocks are the more liquid stocks a benefit may be provided however this has to be counteracted by the impact on depth. A trial for tick constrained stocks would be preferable.

Minimum tick sizes set the minimum cost of trading. While a reduction in tick size by definition should result in a decrease in bid-ask spreads, this is only one component of liquidity. The literature above demonstrates that changes to tick size also impact depth. Moreover the literature highlights the impact of tick size is different for trader groups and firms.

Appendix – FSC Survey response

Aim: To determine the aggregate buy-side perspective on the proposed regulatory levers

Please complete this questionnaire by indicating in each square of the matrix the impact you expect of the given regulatory lever (left-hand side) on the various market factors. Indicate your expectation with the following symbols:

Positive effect: +
Negative effect: –
Uncertain effect: ?

FSC Questionnaire – Summarised responses

	Liquidity	Market Stability	Trade Costs	Market Integrity	Price Efficiency
Minimum resting times rules	++?	+++	+??	+++	+++
Call auction randomisation	-+?	-+?	-??	-+-	-?+
Transaction tax changes	---	-?+	---	-+?	--+
Minimum trade size requirements to access dark venues	+-?	+??	-?+	+?+	+?+
Minimum tick size changes	+??	-?-	+-?	+?-	+--

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