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Tick size regulation

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This review has been commissioned as part of the UK Government's Foresight Project, The Future of Computer Trading in Financial Markets. The views expressed do not represent the policy of any Government or organisation.

Executive summary

This note discusses the tradeoffs and provides recommendations about the choice of a tick size. The discussion brings to bear the data and evidence from the US markets, specifically the New York Stock Exchange (NYSE).

The tick size plays an important role in the trading process. The two main effects of a tick size are that it (i) creates a floor for the bid-ask spread and (ii) impacts the price-time priority rules of the limit order book.

Research using data from the NYSE has shown that, prior to a decline in the tick size to one cent, the tick size was binding for the large stocks and kept the bid-ask spread higher than it would have otherwise been. This high bid-ask spread, while enhancing the profits of the market makers and liquidity providers, increased the transaction costs for investors, especially the small retail investors. Given that the provision of liquidity was so profitable for market makers, competition amongst markets arose in the form of Payment-for-Order-Flow and Internalization.[1] Further the high tick size led to a situation where orders did not necessarily flow to the least cost liquidity suppliers. Regulatory pressure along with competition led to the decline in the tick size on the NYSE.

The optimal tick size represents the trade-off between increased transaction costs due to higher bid-ask spreads and increased incentives to market makers to provide liquidity. Setting too high a tick size increases transaction costs but provides incentives to liquidity suppliers to post limit orders. Also, the number of shares offered would be higher in a regime with a high tick size. This would benefit large traders (institutions) at the expense of retail traders. Setting too low a tick size makes it easier to gain priority in order execution and reduces the incentives for liquidity suppliers to post quotes. However, a lower tick size would benefit retail investors since it would lower the bid-ask spread.

While we understand the trade-offs involved in the search for an optimal tick size, these trade-offs are likely to vary over time and across stocks. Given the dramatic changes taking place in markets due to high frequency trading, the choice of an optimal tick size in a dynamic environment has become even more difficult.

Given that it is hard for regulators to choose the correct tick size, it is recommended that the choice of the tick size be left to the exchanges within a competitive environment. The regulator's job should be to ensure a level playing field that fosters competition rather than choose the optimal tick size. Instead of mandating a tick size, it would be better for regulators to facilitate easy entry and exit from the business of providing trading platforms and also fostering competition across exchanges in Europe by, for instance, allowing stocks to be traded across different exchanges as is the case in the US. Mandating a single tick size across all European exchanges may stifle competition and lead to higher transaction costs.

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[1] Payment-for-Order-Flow refers to the practice wherein the liquidity suppliers pay stock brokers for order flow. Internalization refers to the practice wherein brokers match the buy and sell orders internally and pocket the bid-ask spread.

1. Background

In a recent public consultation, the European Commission asked, "Is it necessary that minimum tick sizes are prescribed?" The academic profession has extensively studied tick sizes in the US markets, specifically the New York Stock Exchange (NYSE). This note will examine the regulation of tick sizes in the context of what has happened in the US, and provide an assessment of the costs, benefits and risk of regulation regarding the tick size.

2. Introduction

2.1. What is a tick size?

A tick size is the minimum variation in the price of a security. For instance, on the NYSE the tick size is one cent for stocks priced above one dollar. Thus, on the NYSE, stocks can trade at $20.03 or $20.04 but will not trade at $20.035. Various exchanges around the world have established different tick sizes. European exchanges have adopted rules that will allow tick sizes to vary with share price.[2]

2.2. History of tick size changes on the NYSE

Prior to June 24, 1997 the tick size on the NYSE was $0.125 as per rule 62 of the NYSE Constitution and Rules.

> "Bids or offers in stocks above one dollar per share shall not be made at a less variation than 1/8 of one dollar per share; in stocks below one dollar but above ½ of one dollar per share, at a less variation than 1/16 of one dollar per share; in stocks below ½ of one dollar per share, at a less variation than 1/32 of one dollar per share…"

On June 24, 1997 the NYSE reduced the tick size from 1/8 of a dollar to 1/16 of a dollar (from an eight to a sixteenth). This was the first reduction in the tick size on the NYSE in its 205 year history. The tick size was further reduced to one cent for most of the stocks on January 29, 2001.[3]

We will come back to the question of what may have led the NYSE to reduce its tick size in recent years after keeping it at 12.5 cents for over 200 years.[4]

2.3. The trading process

The ideal trading process is where buyers and sellers of an asset meet and transact without the need of an intermediary. Of course, this requires that (i) the buyers have a need for the asset at the same time as when the sellers want to sell and that (ii) they can spontaneously meet. In case of stocks, an exchange provides a place for buyers and sellers (or, more likely,

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[2] See http://www.fese.be/_lib/files/UPDATED_FESE_TICK_SIZE_TABLES_AS_OF_APRIL_2011.pdf

[3] Decimalization was phased in following a five month test during which about 159 NYSE stocks traded in price increments on one cent instead of a sixteenth of a dollar.

[4] Part of the reason was regulatory pressure. The Common Cents Stock Pricing Act of 1997 (H.R. 1053) was introduced into the US Congress and while H.R. 1053 did not mandate a minimum tick size, it called for US equity markets to quote prices in terms of dollars and cents.

their agents) to meet. Further, liquidity suppliers (these used to be mainly specialists on the NYSE, but now the term denotes any investor that stands ready to absorb the demands of others) stand ready to buy from sellers and sell to buyers at a different times, thus providing intertemporal (across time) intermediary services. These liquidity suppliers get their compensation from buying at a lower price and selling at a higher price.[5] At any given point in time, the liquidity providers quote a price at which they are willing to buy (the bid) and the price at which they are willing to sell (the ask). At these bid and ask prices liquidity providers also quote the quantity of shares that they are willing to trade. The ask is higher than the bid and provides compensation to the suppliers of liquidity. The difference in the ask price and the bid price is known as the bid-ask spread. This posting of bids and asks along with the number of shares to be traded is called a limit order and the aggregation of limit orders is called the limit order book. When a market order (market orders only contain the quantity of shares to either buy or sell and do not contain a price) is submitted by traders it is executed against the limit order book.

Consider the following example to clarify the trading process. Consider a stock XYZ with a limit order book that has the inside[6] bid and ask prices of $25.25 and $25.30 respectively with 1000 shares offered to be bought or sold at these prices. There may be other bid and ask quotes outside the above quotes on the limit order book; for instance 2000 shares offered to be bought at $25.20 and 3000 shares offered for sale at $25.35 and so on. Now if a market order comes in to buy 100 shares, then it will cross against the limit order book at a price of $25.30.

2.4. The role of the tick size

The tick size plays an important role in the trading process. The two main effects of a tick size are that it (i) creates a floor for the bid-ask spread and (ii) impacts the price-time priority rules of the limit order book.

2.5. Floor for the bid-ask spread

A large tick size will necessarily result in a large bid-ask spread. In the above example, if the tick size was 12.5 cents then prices could only be quoted on a grid that is 12.5 cents wide. Thus, prices would have to be $25, $25.125, $25.25, $25.375, $25.50 and so on. In the above example, the bid and ask prices would be $25.25 and $25.375 respectively. The bid-ask spread would be 12.5 cents instead of the 5 cents that could obtain in a regime with the tick size of one cent. A larger bid-ask spread results in higher compensation for the provision of liquidity and a higher cost for those who demand liquidity.

Figure 1 shows that the inside bid-ask spread and the quantities offered for trade both declined when the NYSE reduced its tick size from an eighth to a sixteenth on June 24, 1997 and then to one cent on January 29, 2001.[7] A higher bid-ask spread results in larger quantities of shares offered for trade at the inside quotes and thus provides more depth (quantity of shares offered

[5] A number of exchanges provide additional compensation to suppliers of liquidity.

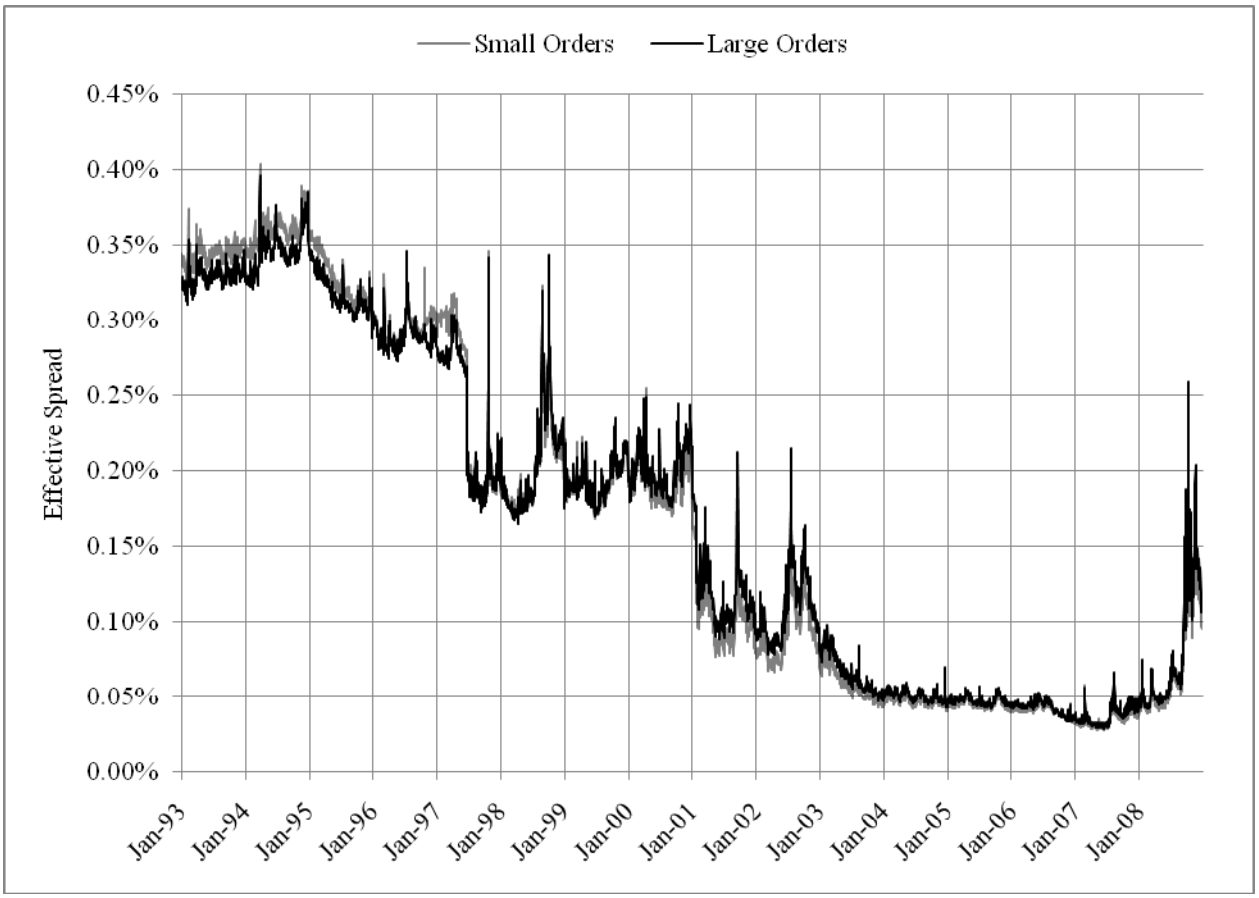
[6] Inside bid and ask prices refer to the highest bid and the lowest ask price.

[7] All figures in this document are replications of those in Chordia, Roll and Subrahmanyam (2011).

for trade) to large traders at the inside quotes.[8] A lower bid-ask spread lowers costs for small traders who trade small quantities.

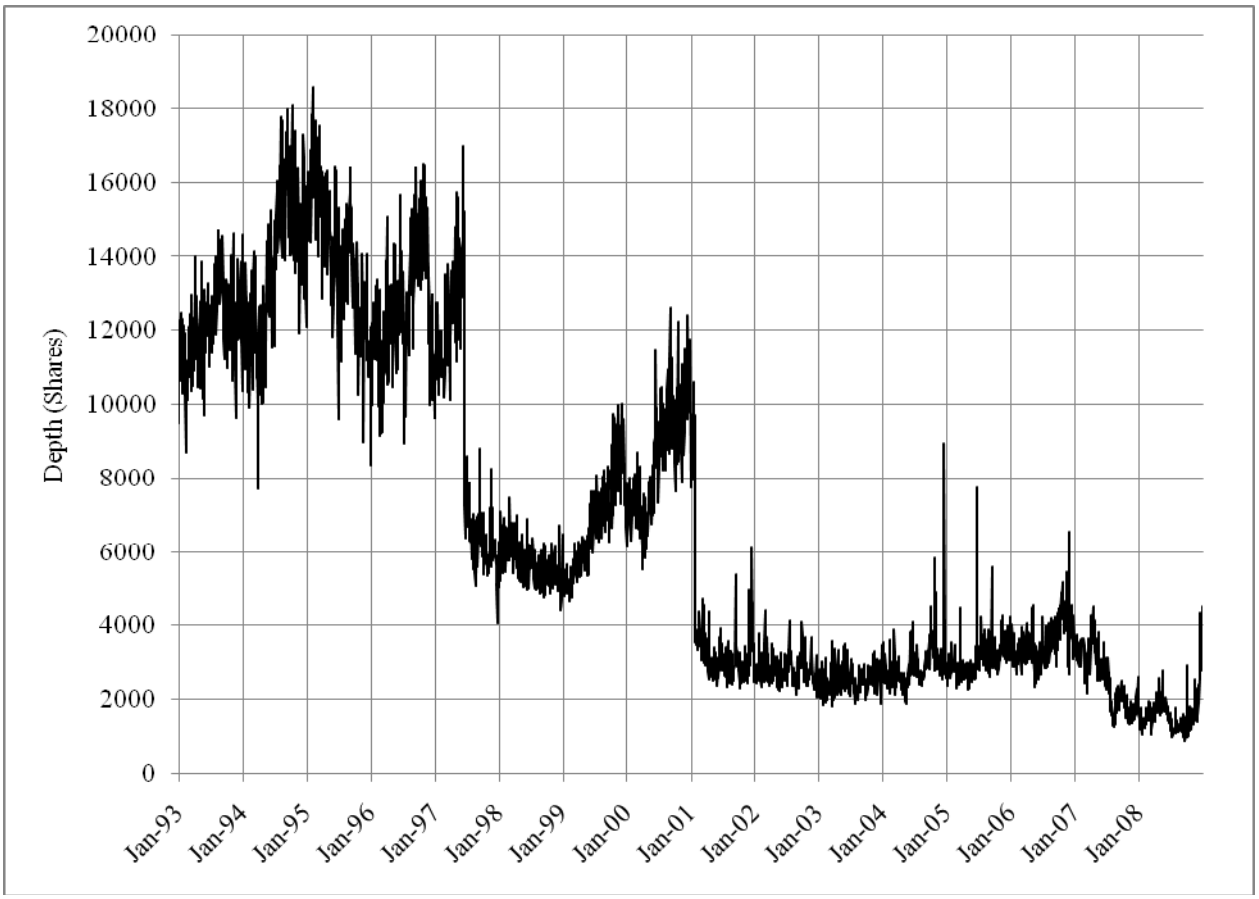
Figure 1. Value-Weighted Effective Spreads for Small and Large Orders and Market Depth, 1993–2008. This figure presents the daily value-weighted average effective spreads for small and large trades (Panel A) and value-weighted mean depth (Panel B) on the NYSE in the period 1993 to 2008. Large trades exceed $10,000 and small trades are all others. Each trade on each day for each stock is classified as either large or small. The effective spread is twice the absolute value of the difference between the transaction price and the mid-point of the bid-ask spread. Depth is the average of the number of shares available for trade at the inside ask and bid, and is averaged for each stock on each day. The value-weighted average over stocks is obtained for both effective spreads and depth for each day over the time period. The data for effective spreads and depths are obtained from TAQ.

Panel A: Effective Spreads for Small (≤$10,000) and Large (>$10,000) Trades



[8] However, note that the overall depth may have actually gone up due to the spreading of depth over the increased number of choices on the price grid. Thus, even though the depth has decreased at the inside quotes due to the decrease in the tick size, the overall depth at the earlier tick size may have actually increased. The TAQ data from the NYSE does not provide information on depth other than that at the inside quotes.

Panel B: Market Depth, 1993–2008



The reduction in the bid-ask spreads on the NYSE due to a reduction in the tick size, suggests that the tick size was indeed binding, in that it forced the bid-ask spread to be higher than it otherwise would be. Ball and Chordia (2001) provide evidence that prior to decimalization the tick size was indeed binding for the large stocks trading on the NYSE.

During the eighths regime, with high and binding bid-ask spreads competition in the provision of liquidity occurred not by reducing prices (bid-ask spreads) which could not be reduced due to the tick size but by other means including Payment-for-Order-Flow and Internalization. Payment-for-Order-Flow was a practice pioneered by Madoff Securities whereby the suppliers of liquidity would pay one (or more) cents per share for order flow that was sent to them by stock brokers. Execution of these trades was profitable for the liquidity suppliers even after paying for order flow. The brokers were happy to receive this kickback in exchange for routing the small orders in the large stocks. Over time as the brokers came to understand the profitability of these trades, they began to “internalize” these trades by matching buys and sells and pocketing the bid-ask spread. Chordia and Subrahmanyam (1995) show that with Payment-for-Order-Flow, the orders did not flow to the least cost providers of liquidity and led to inefficiencies that could be eliminated by reducing the tick size.

Competition in the form of Payment-for-Order-Flow and Internalization could have been one reason why the NYSE reduced its tick size. These practices of Payment-for-Order-Flow and Internalization that had become ubiquitous in US markets prior to the reduction in the tick size

to one cent are no longer so.

2.6.Price-time priority rules

Priority rules are important in determining the sequence in which limit orders are executed. Suppose liquidity provider X submits a buy limit order at $20.25 for 1000 shares at 10:35 am and then at 10:37 am liquidity provider Y submits a buy limit order also at $20.25 for 1000 shares. Now if a market order to sell 1000 shares arrives, who should trade against this order? In our example, with price-time priority rules in place, the market order is executed against the limit order of X because X provided his limit order first. To gain priority, Y would have to improve on the existing limit order price. Y could do this by submitting a limit buy order for 1000 shares at a price of $20.26 if the tick size is one cent.

The tick size determines the price improvement Y has to offer in order to gain priority. If the tick size were 12.5 cents then Y would have to submit a limit buy order at $20.375 to gain priority. Alternatively, if the tick size were $0.001 then Y could gain priority by submitting a limit buy at $20.251.
Setting a tick size that is too large reduces the chances of price improvement. However, setting too low a tick size could result in reduced liquidity as liquidity suppliers are hesitant to expose their orders because their orders could be very easily improved upon and would then lose priority. In theory it is indeed possible that liquidity decreases by setting too low a tick size. However, the reductions in the tick size in the US markets to date have led to an increase in liquidity. It is possible that reductions in the tick size beyond one cent could result in lower liquidity and regulators have to be cognizant of this possibility when debating the choice of a tick size.

2.7.Optimal tick size

The optimal tick size represents the trade-off between increased transaction costs due to higher bid-ask spreads and increased incentives to market makers to provide liquidity. Setting too high a tick size increases transaction costs but provides incentives to liquidity suppliers to post limit orders. Also, the number of shares offered would be higher in a regime with a high tick size. This would benefit institutions at the expense of retail traders.

Setting too low a tick size makes it easier to jump priority and reduces the incentives for liquidity suppliers to post quotes. However, a lower tick size would benefit retail investors since it would lower the bid-ask spread.

The optimal tick size may change over time and may be different across stocks. For instance, with IBM trading more than once ever second (i.e., the time between trades during the trading day is less than a second for IBM), there is no reason to have a tick size larger than a cent. In fact, for a deep and liquid stock such as IBM there may be no need for intermediaries. Liquidity could easily be supplied by investors themselves. On the other hand a larger tick size may be optimal for more illiquid stocks.

Also, note that listed companies can themselves influence the relative tick size[9] by means of stock splits and reverse splits. A stock split will increase the relative tick size and a reverse split will decrease the relative tick size.

[9] Relative tick size is defined as the tick size divided by the stock price.

3. Risk assessment

The current market structure in Europe has no uniform minimum tick size across all exchanges in Europe. In the US, the minimum tick size is one cent at the NYSE as well as at Nasdaq. European exchanges have tick sizes that vary with the stock price. The Deutsche Borse has tick sizes ranging from Euro 0.001 for stock prices less than Euro 10 to Euro 0.05 for stock prices greater than Euro 100. The London Stock Exchange has tick sizes that vary with price and by type of stock as well. The tick size on the LSE is more granular than the Deutsche Borse for certain stocks, for instance, the FTSE 100 stocks. The idea is that more liquid stocks should have lower tick sizes.

The current system seems to be working. However, liquidity has been improving over the past few years and this process can be expected to continue if it is related to the reductions in computing power. Markets need to evolve over time with these changes in liquidity.

4. Options

There are different options for the setting of the tick sizes across European exchanges:

1. Do nothing and keep the current tick size regime in place.
2. Put in place a uniform tick size regime in Europe by regulatory fiat.
3. Let the markets choose their own tick sizes but promote competition across markets.

5. Costs, risks and benefits

We will now discuss the costs, risks and benefits of each of the above options.

1. The do nothing option has the least cost in terms of implementation. However, the risk is that markets do not evolve with the changing environment. For instance, tick sizes could be set lower as trading volumes increase and liquidity improves. The benefit of the do nothing option is that the markets have adapted to the existing system and will continue to work without disruption.
2. The proposed measure of harmonizing tick sizes across Europe needs to address the question, about minimum tick sizes. Setting too high a tick size will cause orders to flow elsewhere. For instance, the Tokyo Stock Exchange has a minimum tick size of one Yen for stocks priced less than 100 Yen. This tick size is too large as it imposes a cost of about 1% for a round-trip trade on a stock priced at 99 Yen. A large tick size not only increases the bid-ask spread and impedes trading but it may also impact the corporate cost of capital. Given that the markets have adapted to the current tick sizes it would not be prudent to set too high a tick size across Europe. It would be better to leave the current system in place than to choose a system with too high a tick size. The danger is that a reasonable tick size today may become too high over time as liquidity improves.
3. The proposed measure of letting markets set their own tick sizes but promoting competition across markets has the benefit that the cost of changing the tick size is borne by the markets. Competition across markets will lead to lower spreads and trading costs.[10]

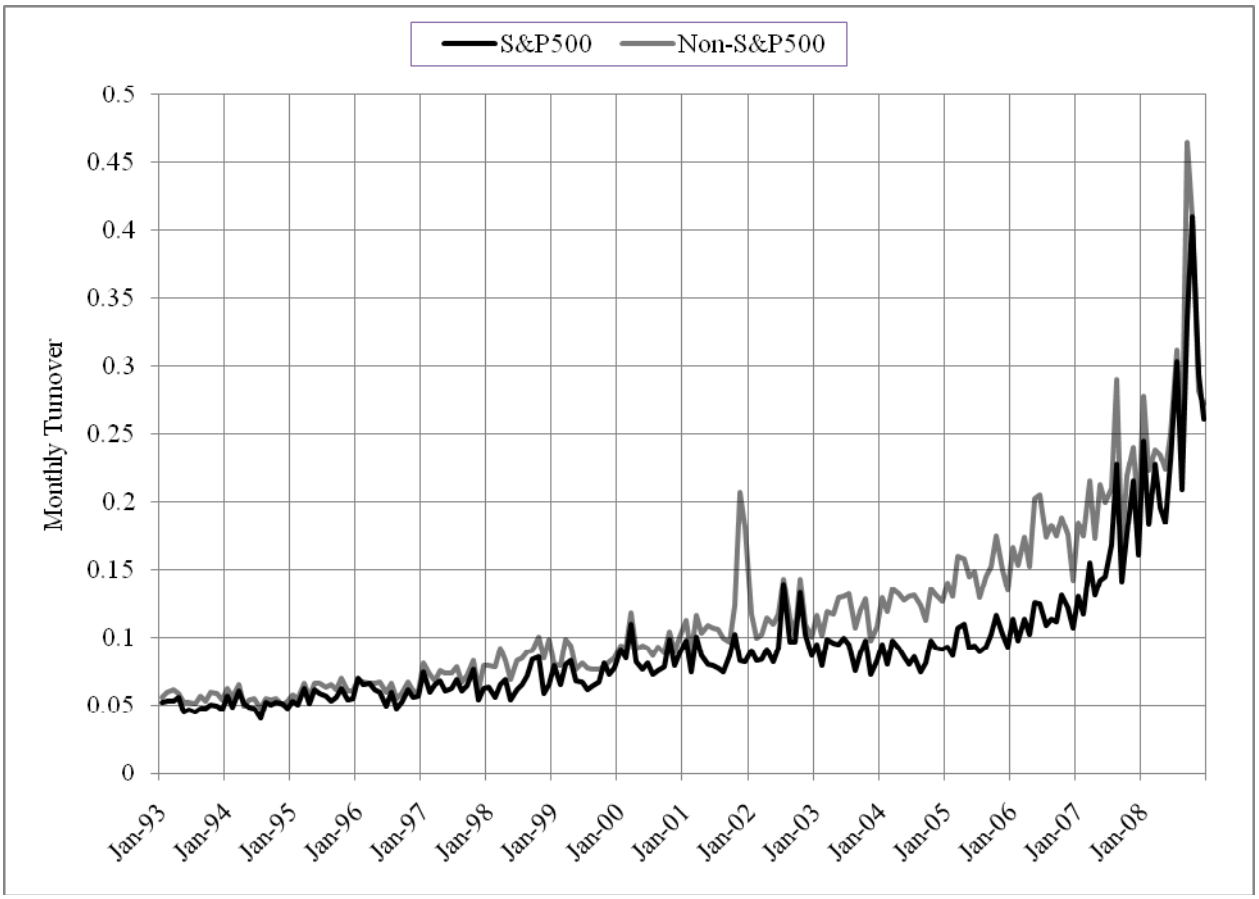
[10] Bourghelle and Declerck (2004) document that stocks that are cross-listed on the NYSE and the Euronext, experience a significant decrease in the relative spread during the common trading period.

A major benefit is that markets will evolve over time in response to competitive forces. Moreover, regulators will not have to be knowledgeable about the tick size tradeoffs or choose the optimal tick size for different stocks at different points in time. The risk is that regulators do not remain vigilant enough to ensure that free and fair competition takes place across markets and other potential entrants to market making services.

6. The future

Advances in computing power have led to dramatic changes in the trading environment in recent years. Figure 2 documents the tremendous growth in trading volumes. Chordia, Roll and Subrahmanyam (2011) have suggested that this increase in trading volume is due to High Frequency Trading (HFT). HFT represents the use of highly quantitative and sophisticated tools to analyze market data to implement proprietary trading strategies. HFT usually implies rapid trading in and out of a large number of small positions and holding on to a position for very brief periods of time, even a few seconds. These trades are typically submitted by computer algorithms without any human intervention and the HFT computers are often co-located with (i.e., located physically close to) the exchange servers. Today, almost 70% of trades on US exchanges are typically originated by high frequency traders. European exchanges are moving towards increased high frequency trading as well.

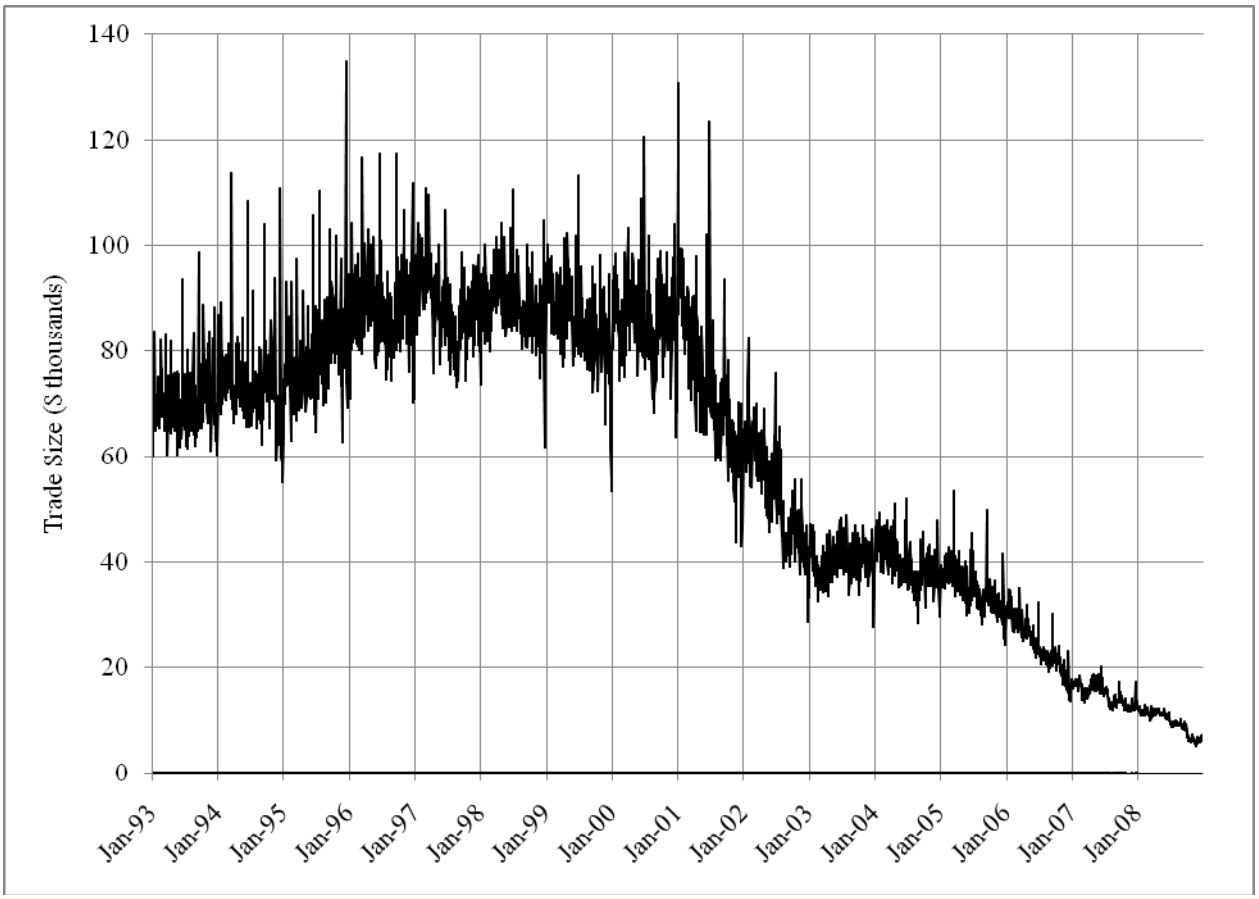
Figure 2. Average Turnover, S&P500 Stocks and Other Stocks, 1993–2008. This figure plots the monthly value-weighted average turnover for New York Stock Exchange stocks from 1993 to 2009. Stocks in the S&P 500 index and others are shown separately. Each month, the value-weighted average turnover is computed using the market capitalization at the end of the previous year. The turnover data are obtained from CRSP.



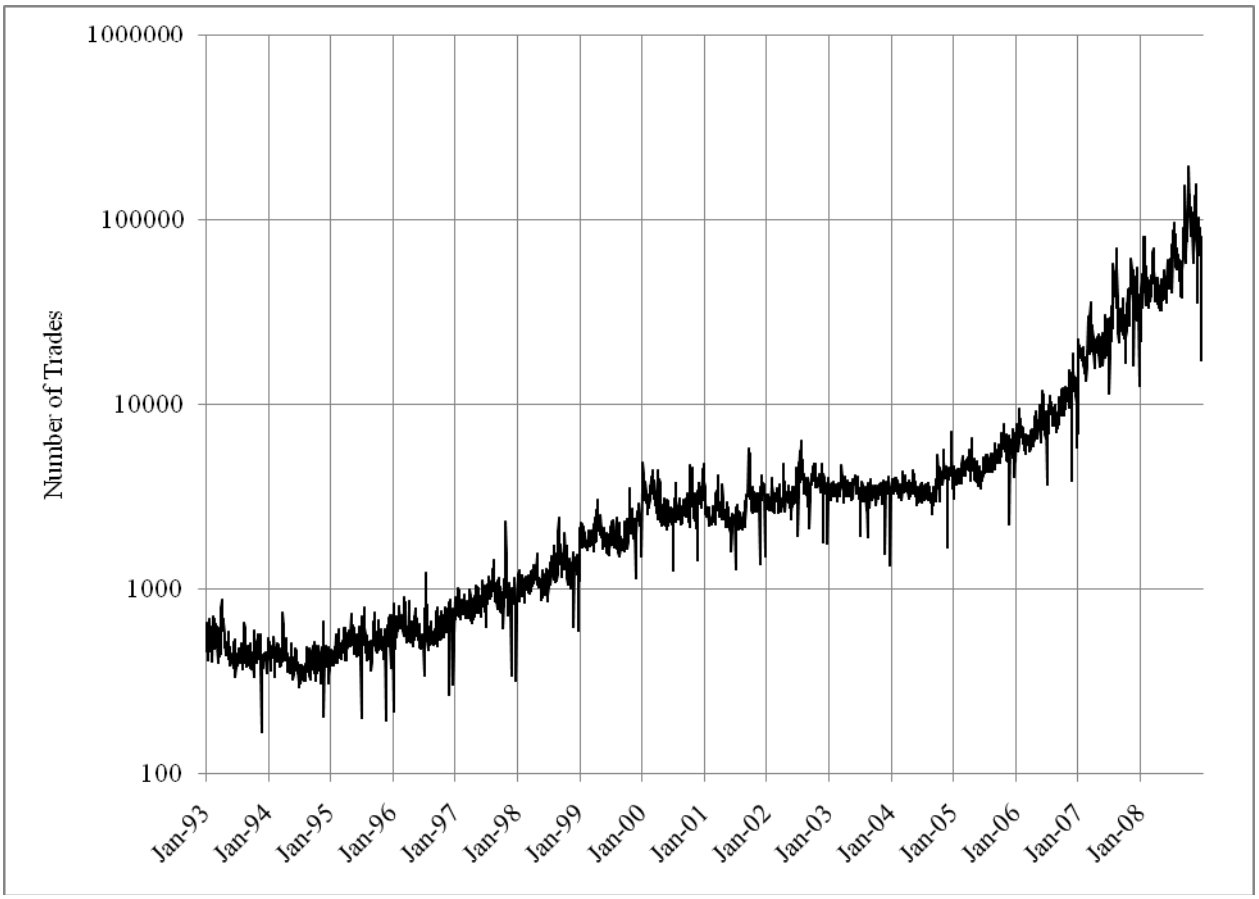
In the past, in US markets, large investors (institutions) preferred to have larger depth on the bid-ask quotes to trade against, whereas small investors (individual) traded small quantities and preferred narrower spreads. However, in recent years, with the advent of algorithmic trading institutions are breaking up their trades and submitting small orders, sometimes less than the lot size of 100 shares. Thus, this trade-off between institutions and retail investors may no longer be as important. Traders have adapted to the one cent tick size and the low bid-ask spreads in the US markets by submitting smaller orders, often by breaking up larger orders. Figure 3 documents the recent increase in trades and the decline in the size of each trade for NYSE listed stocks.

Figure 3. Average Dollar Trade Size and Average Daily Number of Transactions, 1993–2008. This figure shows the value-weighted average daily dollar trade size (Panel A) and value-weighted average daily number of transactions (Panel B) on the NYSE, 1993 to 2008. The number of transactions and the average dollar trade size are calculated for each stock on each day and then value weighted across stocks using market capitalization at the end of the previous year. Data for the number of transactions and dollar trade size are obtained each day from the TAQ dataset.

Panel A: Average Dollar Trade Size, 1993–2008


Trade Size (S thousands)
140
120
100
80
60
40
20
0
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08

Panel B: Average Daily Number of Transactions, 1993–2008



The other major change in US financial markets is the availability of numerous trading venues available to traders. NYSE listed stocks trade on the NYSE, on Nasdaq, on the regional exchanges, and on other electronic communication networks (ECNs) including dark pools. Traders or more often algorithms often search for liquidity amongst the different venues.

It can be argued that competition amongst the different trading venues keeps trading costs down since it is relatively easy for algorithms to search for the best trading venue. Further, Chordia, Roll and Subrahmanyam (2011) have suggested that high frequency trading has improved market quality for NYSE stocks in recent years.

Given that high frequency trading has in general improved market quality and liquidity, the concern of lower supply of liquidity due to too low a tick size is allayed. Looking to the future, it seems likely that high frequency trading will only increase (unless constrained by regulations) and this will improve liquidity and market quality even in a regime of low tick sizes.

7. Recommendation for choice of a tick size

The third option above is recommended.

The US system relies on competition to ensure low transaction costs. While the tick size is one cent on the NYSE, trades can take place within the tick on some dark pools and trading

networks. Prior to 1997 when the NYSE reduced its tick size from $0.125 to $0.0625 there was hardly any competition in the business of trading platforms. Competition arose in the form of internalization and payment-for-order flow. Today, a trader has numerous different trading options available to him and the different trading venues compete vigorously for order flow.

It is hard for academics, let alone regulators, to account for the many different trade-offs that impact the choice of a tick size in a dynamic and a dramatically changing environment. In my opinion, it is better for exchanges (rather than regulators) to choose the tick size in a competitive environment. The regulator's job should be to ensure a level playing field that fosters competition rather than choose the optimal tick size.

Instead of mandating a tick size, it would be better to facilitate easy entry and exit from the business of providing trading platforms and also fostering competition across exchanges in Europe by, for instance, allowing stocks to be traded across exchanges[11] as is the case with NYSE and Nasdaq. With easy entry and exit, different trading platforms can cater to different clienteles, viz., institutions versus individuals.

One concern is the political reality in Europe and the move to harmonize the tick size across exchanges. Also, as trading platforms such as BATS / Chi-X become increasingly active in Europe, there is a move to co-ordinate their tick sizes with those of the exchanges. This note has recommended that instead of harmonizing tick sizes, trading platforms should be allowed to compete by choosing their own tick sizes. However, if politically, the EU has decided on instituting a uniform tick size across the different markets, then it should be set as low as possible because with trading volumes and liquidity increasing dramatically due to high frequency trading, it is likely that high tick sizes may become binding. As has been the experience with the US markets, traders and markets will adapt to the regulations. The key is to promote a competitive environment.

[11] Kasch-Haroutounian and Theissen (2009) suggest that even though Xetra is a more efficient trading system than Euronext, the lack of competition across exchanges in Europe prevents investors from realizing these benefits.

References

Ball, Cliff and Tarun Chordia, 2001, True Spreads and Equilibrium Prices, Journal of Finance 56, 1801–1836.

Bourghelle, David and Fany Declerck, 2004, Journal of Banking & Finance 28, 373–398.

Chordia, Tarun, Richard Roll and Avanidhar Subrahmanyam, 2011, Recent Trends in Trading Activity and Market Quality, Journal of Financial Economics 101, 243–263.

Chordia, Tarun and Avanidhar Subrahmanyam, 1995, Market Making, The Tick Size and Payment-for-Order-Flow: Theory and Evidence, Journal of Business 68, 543 – 576.

Kasch-Haroutounian, Maria and Erik Theissen, 2009, Competition Between Exchanges: Euronext versus Xetra, European Financial Management 15, 181–207.

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