IS IT TIME TO REDUCE THE MINIMUM TICK SIZES OF THE E-MINI FUTURES?

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TATYANA ZABOTINA

On the Chicago Mercantile Exchange (CME), so-called “E-mini” index futures contracts trade on the electronic GLOBEX trading system alongside the corresponding full-size contracts that trade on the open outcry floor. This paper finds that the current minimum tick sizes of the E-mini S&P 500 and E-mini Nasdaq-100 futures contracts act as binding constraints on the bid-ask spreads by not allowing the spreads to decline to competitive levels. We also find that, while exchange locals trade very actively on GLOBEX, they do not tend to act as liquidity suppliers. Taken together, our empirical results suggest that it is time for the CME to consider decreasing the minimum tick sizes of the S&P 500 and Nasdaq-100 E-mini futures contracts. A tick size reduction is likely to result in lower trading costs in the E-mini futures markets. © 2005 Wiley Periodicals, Inc. Jrl Fut Mark 25:79–104, 2005

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INTRODUCTION

Domowitz and Steil (1999), Domowitz (2002), and Conrad, Johnson, and Wahal (2003) have shown that automating trade execution leads to significant reductions in trading costs. Technological innovation and demand in the marketplace for efficient trade execution are fueling the momentum in financial markets away from open outcry towards electronic trading. The shift to automated execution has been particularly pronounced in futures markets. Although open outcry trading still accounts for a large proportion of the futures trading volume in the United States, both the Chicago Mercantile Exchange (CME) and the Chicago Board of Trade (CBOT) have gradually moved towards offering products traded on electronic platforms. In particular, the CME offers so-called “E-mini” futures contracts that trade on the electronic GLOBEX system. The E-mini S&P 500 index futures contracts were introduced in September 1997 and similar E-mini futures on the Nasdaq-100 index were introduced in June 1999. The E-mini contracts are sized at one-fifth of their full-size counterparts traded on the CME floor. Since E-mini trading is particularly affordable to traders with small margin accounts, the E-mini contracts quickly became popular among retail traders.

The primary contributions of this study are twofold. First, we show that the bid-ask spreads of the E-mini S&P 500 and E-mini Nasdaq-100 futures are constrained by the current minimum tick sizes. We maintain that the binding minimum tick sizes are likely to impede price competition on GLOBEX and may contribute to higher transaction costs in the E-mini futures compared to their floor-traded counterparts. Second, we use trade data with attached trader type identification codes to examine the extent to which exchange locals, clearing members and off-exchange traders demand and supply liquidity on GLOBEX.

The main focus of this study is to examine the impact of the current minimum price increments, called tick sizes, on trading costs in the E-mini markets. The minimum tick size of the E-mini S&P 500 index futures is 0.25 index points ($12.50), while for the regular S&P 500

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1The London International Financial Futures Exchange (Liffe), Marché a Terme International de France (MATIF), and the Sydney Futures Exchange (SFE) moved to electronic trading in the last five years.
2GLOBEX was introduced by the CME in 1992. Until 1997, it was used primarily as an off-hours trading system.
3According to former CME Chairman, Scott Gordon, “The largest growing, the fastest growing segment of our business comes from individual investors that are trading our E-mini products online. It’s by far and away the largest growth area.” Reported in Carlson (2000).
futures it is only 0.1 index points ($25). The minimum tick sizes of the regular and E-mini Nasdaq-100 futures contracts are equal at 0.5 index points ($50 and $10, respectively). We find that the bid-ask spreads of the E-mini contracts rarely exceed the minimum tick sizes, suggesting that the current tick sizes act as binding constraints on the spreads. The bid-ask spread represents the market maker’s compensation for providing liquidity. The costs of liquidity provision, and therefore the spreads, generally vary with market conditions. Assuming that traders rarely use below-cost pricing, our finding that the bid-ask spreads in the E-mini markets are constant at the level of one tick implies that the spreads are above the competitive levels. If the tick sizes are reduced, competition of limit order traders is likely to lead to narrower bid-ask spreads in the E-mini markets.

The current binding minimum tick sizes are likely to impede price competition on GLOBEX and lead to suboptimal executions for many limit order traders. When the bid-ask spread is equal to one tick, a limit order that improves the price effectively becomes a market order that hits the best bid or lifts the best offer and is executed immediately. To earn the spread, a trader may submit a limit order that matches the best price. That order is placed at the end of the queue in the limit order book. The trader is unable to increase the probability of execution by tightening the spread. Thus, instead of being presented with a continuum of possible choices, the E-mini traders are faced with a limited number of alternatives. Despite these negative aspects, the E-mini futures are successful products for a number of reasons. In particular, these contracts are affordable to retail traders and offer immediate and anonymous execution.

In further analysis, we examine supply and demand of liquidity in the E-mini markets. It is feasible that at the inception of the E-mini contracts the minimum tick sizes were established as sufficiently large in order to attract liquidity by creating arbitrage opportunities between the E-minis and the full-size contracts and to create an incentive for the CME locals to act as market makers on GLOBEX. Exchange locals play the role of informal market makers in open outcry futures markets by frequently buying at the bid and selling at the offer. When the E-mini contracts were introduced, GLOBEX terminals were installed on the

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4For the E-mini S&P futures the arbitrage between the pit and GLOBEX is likely to play a larger role because of the larger tick size of the E-mini contract.

5The bid-ask spread of the regular S&P 500 contract was one tick when the contract started to trade. This binding minimum tick size was appropriate, since it probably helped to attract market makers to that market (e.g., Grossman & Miller, 1988).
CME floor on the perimeter of the trading pits, so that the exchange locals could observe the open outcry trading, while making the market in the electronic system. But do the exchange locals tend to act as market makers on GLOBEX? We find that locals trading E-mini contracts, who enjoy substantial privileges compared to off-exchange traders, are at least as likely to demand as supply liquidity. The locals appear to trade aggressively, relying on the access to the pit dynamics, while a substantial proportion of liquidity is supplied by limit orders of off-exchange traders.

Exchange locals still act as liquidity suppliers in a substantial proportion of E-mini trades. Assuming that the locals submit limit orders primarily to earn the bid-ask spread, a reduction of the E-mini tick sizes and a subsequent decline in spreads may have a negative effect on the supply of liquidity on GLOBEX. The dynamic equilibrium nature of this limit order market, however, is likely to ensure that any possible reduction in liquidity is temporary. For example, Biais, Hillion, and Spatt (1995) show that limit order traders actively compete and quickly provide liquidity when liquidity dries up. Therefore, if the tick sizes of the E-mini contracts are reduced and, consequently, the bid-ask spreads decline, the supply of liquidity on GLOBEX is unlikely to suffer.

A tick size that is too small is likely to increase negotiation costs. Furthermore, in open outcry markets a small tick size often leads to errors in trade processing. GLOBEX is an electronic limit order book market with five best bids and five best offers visible to all traders. Therefore, negotiation costs are not likely to be significant and trade-processing errors are not an issue of concern. A coarse price resolution, however, may preclude trading at mutually agreeable prices in some cases, and the potential gains from trade may be lost (see Brown, Laux, & Schachter, 1991). Furthermore, a large minimum price increment may impede price discovery given that movements of the unobservable equilibrium price are often smaller than the tick size.

Altering the characteristics of an already successful contract is not without risk, and exchanges are reluctant to make such changes. Nevertheless, our results suggest that the benefits of decreasing the minimum tick sizes of the E-mini contracts are likely to outweigh the possible costs discussed below. This paper is intended to initiate a discussion on the issue.

The remainder of the paper is organized as follows. The second section provides a literature review and some institutional detail. The third

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6 Theoretical papers discussing trading costs and supply of liquidity in limit order markets include Foucault (1999) and Foucault, Kadan, and Kandel (2003), among others.
7 Beaulieu, Ebrahim, and Morgan (2003) report empirical evidence supporting this notion.
section describes the data used in the paper and the descriptive statistics of our sample. The fourth section discusses the methodology and the empirical results. The last section provides a summary and conclusion.

LITERATURE REVIEW AND BACKGROUND

Literature on Tick Size Reductions

A number of theoretical papers including Seppi (1997), Anshuman and Kalay (1998), and Cordella and Foucault (1999) examine the issue of optimal tick size. Several papers also model the effects of changes in the minimum tick size on market liquidity. Ronen and Weaver (2001) show that if the tick size is reduced the bid-ask spread will decline even if the tick is not binding. A version of Glosten (1994) model with discrete prices, as in Sandas (2001), predicts that a reduction of minimum tick size in a limit order market leads to lower bid-ask spreads and lower depth at the best quotes, although cumulative depth is unaffected. Alternatively, Foucault et al. (2003) show that reducing the tick size may or may not lead to a reduction in the bid-ask spread in limit order markets, depending on the proportion of patient traders in the market.

Many markets reduced minimum tick sizes in recent years and there is a large empirical literature on the effects of tick size reductions on market liquidity. Nearly all of these studies report a decline in the bid-ask spreads. The bid-ask spread is a convenient measure of execution costs for relatively small orders. It is important, however, to also consider a potential impact of tick size changes on other liquidity characteristics including market depth. Focusing mainly on the bid-ask spreads and quoted depths at the inside quotes, a number of studies deliver a mixed verdict on the impact of tick size reductions on market liquidity. For example, Bacidore (1997), Porter and Weaver (1997), and Chakravarty, Harris, and Wood (2001), among others, show that both the bid-ask spread and quoted depth decline after a tick size reduction. However, Ahn, Cao, and Choe (1996) and Ronen and Weaver (2001) find that after a tick reduction from eighths to sixteenths on the AMEX, the bid-ask spreads declined, but the market depth did not decrease.

Studies that look beyond the depth at best bid and offer find that tick size reductions often result in lower trading costs even for trades that exceed the quoted depth at the inside quotes. MacKinnon and Nemiroff (1999) observe that the move by the Toronto Stock Exchange

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8Harris (1997a) provides a review of arguments and empirical evidence concerning decreasing the minimum tick size.
(TSE) to decimal pricing did not lead to an increase of the price impact of trading. Coupled with a decline in the bid-ask spreads, this finding implies that liquidity improved after decimalization at the TSE. In another recent paper, Bessembinder (2003) finds no evidence of systematic intraday price reversals on either NYSE or Nasdaq after decimalization. Such reversals of quote changes would be expected if decimalization had hurt liquidity supply.

Goldstein and Kavajecz (2000) show that depths in the NYSE limit order book declined throughout the book after the tick reduction from eighths to sixteenths. Bacidore, Battalio, and Jennings (2003), however, find that while displayed liquidity in the NYSE limit order book declined after decimalization, the execution quality for all order sizes did not deteriorate. They suggest that non-displayed liquidity available on the exchange floor accounts for this result. Bacidore et al. (2003) and Chan and Hwang (2001) point out that the results of Goldstein and Kavajecz (2000) are likely to be explained by specialists “stepping ahead of the book” more frequently after the tick size reduction. Chan and Hwang (2001) show that the market liquidity improved after a tick size reduction on the Hong Kong Stock Exchange, a pure limit order market.

A number of studies examine the impact of tick size reductions on execution costs of institutional traders. Jones and Lipson (2001) show that realized execution costs of institutional traders increased after the NYSE tick size reduction from eighths to sixteenths. Alternatively, the results of Chakravarty, Panchapagesan, and Wood (2002) suggest that decimalization did not increase execution costs for institutions trading NYSE stocks.

**Competitive Considerations**

The CME currently has an exclusive license to trade S&P 500 index futures contracts. This exclusive license, along with a first-mover advantage, allows the CME to enjoy a competitive advantage in its high volume index futures markets by precluding competition for order flow from other market centers.9,10 One example of how the CME has used its competitive advantage is its decision to halve the denomination and double the tick size of the regular S&P 500 futures contracts in November 1997,

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9Holder, Tomas, and Webb (1999) show that being first to list a futures contract is the most important determinant of the competitive outcome when several exchanges offer equivalent futures contracts.

10Although no other exchanges list equivalent index futures contracts, the CBOT’s DJIA index futures contract represents a source of indirect competition for the CME.
soon after the E-mini S&P 500 futures were introduced. Bollen, Smith, and Whaley (2003) find that this measure increased the welfare of the exchange members, while increasing the trading costs of the CME’s customers.

Eurex, the Swiss-German electronic derivatives market, has announced plans to launch a U.S. exchange offering a full range of financial derivatives based on U.S. underlying assets. This new exchange may become a source of competition for the CME in the future if it lists similar futures contracts. Existing research shows that competition between market centers leads to lower trading costs. For example, Mayhew (2002), Anand and Weaver (2002), and De Fontnouvelle, Fishe, and Harris (2003) find that competition among options exchanges reduces bid-ask spreads. Similarly, Boehmer and Boehmer (2003) and Tse and Erenburg (2003) show that the bid-ask spreads of exchange-traded funds (ETFs) declined significantly after entrance of the NYSE into the ETF market.

Even without competing markets, the side-by-side approach used by the CME gives its customers a choice between the floor and GLOBEX. But do the current characteristics of the CME’s futures contracts allow for unimpeded competition between the floor and GLOBEX? Given that five E-minis have to be traded to replicate one regular contract, many institutional traders currently prefer to trade the regular futures to save on brokerage commissions and fees, which are charged on a per contract basis. Lowering the tick sizes of the E-mini contracts is likely to lead to lower bid-ask spreads, rendering these contracts more attractive to institutional traders.

DATA AND DESCRIPTIVE STATISTICS

Data

This study employs computerized trade reconstruction (CTR) data and time and sales data for the regular S&P 500 and Nasdaq-100 futures. We also use trade data for the E-mini S&P 500 and the E-mini Nasdaq-100 futures. These data are obtained from the Commodity Futures Trading Commission (CFTC). The CTR data and E-mini trade data

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11In its 1999 Annual Report, the CME stated that the exchange provides the customers with the best of both open outcry and electronic platforms and leaves it to the customers to choose between the two systems. According to Savage (2002), CME’s Chairman Emeritus Leo Melamed also emphasizes that the choice between the open outcry and electronic systems must be made by the marketplace itself.
contain the contract ticker symbol, trade date, trade time to the nearest second, the contract month, buy/sell code, number of contracts traded, trade price, customer type indicator (CTI), CTI of the opposite side of the trade, session indicator (pit or GLOBEX) and in timestamp (when the order is received on the trading floor or entered into GLOBEX). CTI is designated from 1 to 4 as follows: CTI1 are trades executed for a floor trader’s personal account (local trade), CTI2 are trades executed for a clearing firm’s account, CTI3 are trades executed for a personal account of another floor trader, and CTI4 are trades executed for an account of an outside customer.\footnote{Daigler and Wiley (1998) provide a detailed discussion of the four CTI categories.}

Our sample period extends over the 248 trading days from January 2, 2002 to December 31, 2002. Days with more than one hour of data missing, such as shortened pre-holiday days, are removed from the sample. For every trading day, only the most actively traded contract in each market is considered.\footnote{Trading activity shifts from the futures contract approaching expiration to the next available contract during the second week of the expiring contract’s month when the exchange redesignates the lead contract.}

Summary Statistics

Table I reports summary statistics for regular and E-mini futures. Trades in the E-mini contracts occur much more frequently than trades in the regular futures. For example, trading frequency of the E-mini Nasdaq-100

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P 500</th>
<th></th>
<th>Nasdaq-100</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular</td>
<td>E-mini</td>
<td>Regular</td>
<td>E-mini</td>
</tr>
<tr>
<td>Mean number of trades per day</td>
<td>15,454</td>
<td>113,930</td>
<td>3,874</td>
<td>64,579</td>
</tr>
<tr>
<td>Mean number of trades per minute</td>
<td>38.2</td>
<td>281.3</td>
<td>9.6</td>
<td>159.5</td>
</tr>
<tr>
<td>Mean trading volume (contracts)</td>
<td>74,488</td>
<td>449,071</td>
<td>15,748</td>
<td>212,266</td>
</tr>
<tr>
<td>Mean trading volume ($ billion)\footnote{Based on closing prices.}</td>
<td>18.40</td>
<td>21.47</td>
<td>1.86</td>
<td>4.87</td>
</tr>
<tr>
<td>Mean trade size (contracts)</td>
<td>4.82</td>
<td>3.94</td>
<td>4.07</td>
<td>3.29</td>
</tr>
<tr>
<td>Mean trade size ($ '000)\footnote{Based on closing prices.}</td>
<td>1,190.3</td>
<td>188.5</td>
<td>480.8</td>
<td>75.4</td>
</tr>
<tr>
<td>Mean open interest (contracts)</td>
<td>572,728</td>
<td>252,577</td>
<td>64,240</td>
<td>128,777</td>
</tr>
<tr>
<td>Mean open interest ($ billion)\footnote{Based on closing prices.}</td>
<td>141.59</td>
<td>11.99</td>
<td>7.32</td>
<td>2.95</td>
</tr>
<tr>
<td>Mean $ volume market share</td>
<td>45.3%</td>
<td>54.7%</td>
<td>27.1%</td>
<td>72.9%</td>
</tr>
</tbody>
</table>

Note. All statistics are for regular trading hours.
futures exceeds that of the regular Nasdaq-100 futures by a factor of about sixteen. The open interest in the E-mini futures is substantially smaller than the daily trading volume. At the same time, for the regular futures the open interest far exceeds the daily trading volume. This suggests that many hedgers still prefer to trade the full-size contracts to save on brokerage commissions and exchange fees, which are charged on a per contract basis. Alternatively, the hedge horizon may tend to be longer for traders using full-size contracts.

Both E-mini S&P 500 and E-mini Nasdaq-100 futures contracts appear to have been successful products. Table I shows that the E-minis have a large dollar volume market share ranging from 54.7% for E-mini S&P 500 to 72.9% for E-mini Nasdaq-100 futures. Trading volumes of both E-mini contracts have been growing steadily since the introduction of these contracts.

### Distribution of Trading Volume by CTI Type

Our paper considers liquidity supply and demand on GLOBEX. It is therefore important for our analysis to examine the distribution of trading volume among different trader types. Table II reports the proportions of daily volume for various counterparty combinations in regular and E-mini futures. Consistent with prior literature (e.g., Manaster & Mann, 1996; Ferguson & Mann, 2001), trades between exchange locals and off-exchange customers account for the largest proportion of trades and volume among all four considered contracts.

<table>
<thead>
<tr>
<th></th>
<th>Local (CTI1) with</th>
<th>Customer (CTI4) with</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CTI1</td>
<td>CTI2</td>
</tr>
<tr>
<td>S&amp;P 500 futures</td>
<td>14.6%</td>
<td>3.2%</td>
</tr>
<tr>
<td>E-mini S&amp;P 500</td>
<td>25.3%</td>
<td>18.3%</td>
</tr>
<tr>
<td>Nasdaq-100</td>
<td>16.2%</td>
<td>6.4%</td>
</tr>
<tr>
<td>E-mini Nasdaq-100</td>
<td>17.8%</td>
<td>18.4%</td>
</tr>
</tbody>
</table>

**Note.** The CTI categories include local traders (CTI1), clearing members (CTI2), other floor traders (CTI3), and off-exchange customers (CTI4). "Other" refers to trades between clearing members, trades between other floor traders and trades between clearing members and other floor traders. The percentages trading volume are calculated for each day and then averaged across days. All statistics are for regular trading hours.
Massimb and Phelps (1994) and Locke and Sarkar (2001) suggest that exchange locals are likely to abandon automated futures markets. In contrast, Table II shows that the locals participate in a large proportion of trades in the E-mini markets. The locals trade very actively by using GLOBEX terminals located on the perimeter of the trading pits on the CME floor. Kurov and Lasser (2004) suggest that the access of locals trading E-mini contracts to the open outcry floor ensures that they have an informational advantage over the off-exchange traders and are able to trade profitably on GLOBEX.

Interestingly, clearing members account for a larger proportion of the total trading in the E-minis than in regular futures. For example, clearing members participate in about 30% of trading volume in the E-mini S&P 500 futures compared to only about 6% of trading volume in the regular S&P 500 futures. The access of clearing members to the trading floor may create an incentive for them to trade on GLOBEX, leading to their high trading activity in the E-mini markets.

EMPIRICAL TESTS AND RESULTS

Estimated Bid-Ask Spreads of Regular and E-mini Futures

To analyze the trading costs in the regular and E-mini markets, we begin by calculating customer execution spreads. This direct measure of transaction costs in futures markets is suggested by Locke and Venkatesh (1997) and used by Ferguson and Mann (2001), among others. The execution spread is calculated as mean customer buy price minus mean customer sell price for a five-minute interval, with prices weighted by trade size. The mean execution spread reported in Table III is close to zero for both E-mini futures. Furthermore, the execution spreads in trades with locals are even smaller, suggesting that locals trading E-mini contracts tend to use market orders to quickly take desirable positions and pay the bid-ask spread at least as often as they earn it. In contrast, for the regular futures the customer execution spread in trades with locals is greater than the all-trade spread, suggesting that the role of locals on the trading floor is closer to traditional market making than on GLOBEX.

The execution spreads are calculated by aggregating across all customer orders, including limit and market orders. Traders using market orders demand liquidity and pay the bid-ask spread, while traders using limit orders supply liquidity and tend to earn the spread. Therefore, the execution spread results discussed above suggest that off-exchange traders in the E-mini markets are about equally likely to use market and
TABLE III
Execution Costs in Regular and E-mini S&P 500 and Nasdaq-100 Futures
for January 2, 2002 to December 31, 2002

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P 500</th>
<th>Nasdaq-100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular</td>
<td>E-mini</td>
</tr>
<tr>
<td>Mean all-trade execution spread(^a)</td>
<td>0.0107%</td>
<td>0.0014%</td>
</tr>
<tr>
<td>Mean against-local execution spread(^a)</td>
<td>0.0136%</td>
<td>-0.0001%</td>
</tr>
<tr>
<td>Mean estimated bid-ask spread (index points)</td>
<td>0.226</td>
<td>0.256</td>
</tr>
<tr>
<td>Mean estimated bid-ask spread (percent)(^a)</td>
<td>0.023%</td>
<td>0.027%</td>
</tr>
<tr>
<td>Number of observations(^b)</td>
<td>314,338</td>
<td>4,414,178</td>
</tr>
</tbody>
</table>

Panel B: 7:15–8:15 a.m. (CST)

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P 500</th>
<th>Nasdaq-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean estimated bid-ask spread (index points)</td>
<td>0.222</td>
<td>0.289</td>
</tr>
<tr>
<td>Mean estimated bid-ask spread (percent)(^a)</td>
<td>0.023%</td>
<td>0.031%</td>
</tr>
<tr>
<td>Number of observations(^b)</td>
<td>33,016</td>
<td>66,389</td>
</tr>
</tbody>
</table>

Note. Execution spread is calculated as mean customer buy price minus mean customer sell price for a 5-minute interval, with prices weighted by trade size. Bold text indicates that the execution spread is statistically significant at the 1% level.

The bid-ask spread is estimated using the CFTC estimator, which is calculated as the average absolute value of price reversals. To minimize influence of large price changes, which are unlikely to be related to bid-ask bounce, price changes are eliminated from calculation of estimated bid-ask spread if they are equal to or exceed in absolute value:

- 5 index points for regular and E-mini S&P 500 futures;
- 20 index points for regular Nasdaq-100 futures during the regular trading hours;
- 10 index points for regular Nasdaq-100 futures during the preopening period;
- 10 index points for E-mini Nasdaq-100 futures.

Removing large price changes does not affect the results qualitatively. The results showing the impact of omitting large price changes on the estimated spreads are available upon request.

\(^a\)Percent of contract value.
\(^b\)Number of observations used to calculate the bid-ask spreads.

limit orders. Given that the bid-ask spread is the cost of immediacy, the effective spread for liquidity-demanding orders is a more informative measure of trading costs than the aggregate execution spread.\(^{14}\)

Our data do not contain bid-ask quotes.\(^{15}\) Therefore, we estimate effective spreads for liquidity-demanding orders using the estimator suggested by Wang et al. (1994) and Wang, Yau, and Baptiste (1997).\(^{16}\) This estimator, which is used by the CFTC, is calculated as the average opposite

\(^{14}\)For example, Demsetz (1968) notes that the bid-ask spread represents the cost of trading without delay. Similarly, Grossman and Miller (1988) argue that the cost of trading immediately rather than waiting to trade is the essence of market liquidity. Most studies of bid-ask spreads in equity markets estimate effective spreads for market orders.

\(^{15}\)Time and sales data for regular futures include bid-ask quotes when the quote price differs from the price of the previous trade. However, these bid-ask quotes are not recorded systematically and we remove them from the analysis.

\(^{16}\)We repeated calculation of the bid-ask spreads using the spread estimator suggested by Bhattacharya (1983). The results (not reported but available upon request) were similar. According to ap Gwilym and Thomas (2002), correlations of the Bhattacharya (1983) estimator with effective and realized spreads are in excess of 0.75.
direction absolute price change. Price changes in the same direction as the preceding price changes are discarded to reduce the impact of changes in the underlying futures price unrelated to the bid-ask bounce.

The estimated bid-ask spreads are reported in Table III. The average daily estimated bid-ask spread of the E-mini S&P 500 futures is 0.256 index points, suggesting that the spread rarely exceeds one tick. Somewhat surprisingly, the bid-ask spread of this E-mini contract is higher than that of the regular S&P 500 futures. As mentioned above, previous research that compares open outcry and electronic markets shows that the trading costs in electronic markets tend to be lower. On the other hand, the average bid-ask spread of the regular Nasdaq-100 futures exceeds that of the corresponding E-mini contracts by a factor of two. The bid-ask spread expressed as a percentage of contract value is about 0.027% for the E-mini S&P 500 contract and about 0.045% for the E-mini Nasdaq-100 contract. These percentage spreads are similar in magnitude to the bid-ask spreads of the most liquid ETFs reported by Boehmer and Boehmer (2003).

In order to examine the effects of the binding minimum tick sizes of the E-mini futures, we estimate bid-ask spreads of both regular and both E-mini futures contacts for the periods since the introduction of the E-mini contracts. The estimated bid-ask spreads are presented in Figure 1. It is instructive to compare the average daily spread graphs for the regular and E-mini S&P 500 futures. The graph for the regular S&P 500 futures shows a large variation in the bid-ask spread depending on changing market conditions between October 1997 and December 2002. In contrast, the similar graph for the E-mini S&P 500 futures exhibits much less temporal variation. This finding suggests that the larger minimum tick size of the E-mini S&P 500 contract became a binding constraint on the spread soon after the contract started trading. As this E-mini market matured, periods with bid-ask spread exceeding the minimum tick size of 0.25 index points became increasingly rare.

The graphs of intraday variation in the estimated bid-ask spread for the year 2002 presented in panels A and B of Figure 1 tell a similar story. Consistent with prior research (e.g., Wang et al., 1994), the graph for the regular S&P 500 futures shows substantial intraday variation in spreads. At the same time, the similar graph for the E-mini S&P 500 futures is nearly flat.

Figure 1 also reports the average estimated bid-ask spreads for the regular and E-mini Nasdaq-100 futures. The temporal variation in the estimated spreads for both contracts was substantial until about May 2001. After May 2001 the bid-ask spread of the regular Nasdaq-100 futures has been close to one index point, which corresponds to two ticks. The bid-ask
Panel A. Regular S&P 500 futures

Estimates average bid-ask spread for October 1, 1997 to December 31, 2002

Intraday variation of the estimated bid-ask spread for January 2, 2002 to December 31, 2002

Panel B. E-mini S&P 500 futures

Estimated average bid-ask spread for October 1, 1997 to December 31, 2002

Intraday variation of the estimated bid-ask spread for January 2, 2002 to December 31, 2002

FIGURE 1

Estimated CFTC bid-ask spreads.

Note: The bid-ask spread is estimated using the CFTC estimator, which is calculated as the average absolute value of price reversals. Chicago time shown.
Intraday variation of the estimated bid-ask spread for January 2, 2002 to December 31, 2002

Panel C. Regular Nasdaq-100 futures
Estimated average bid-ask spread for July 1, 1999 to December 31, 2002

Panel D. E-mini Nasdaq-100 futures
Estimated average bid-ask spread for July 1, 1999 to December 31, 2002

FIGURE 1 (Continued)
Tick Sizes of the E-Mini Futures

spread of the E-mini contract, on the other hand, has settled at the level of 0.5 index points, i.e., one tick. The market makers in the floor-traded contract appear to have been reluctant to reduce spreads below two ticks, while the spread in the E-mini contract is apparently bounded by the minimum tick size. The graph of intraday variation in bid-ask spreads shows that for the floor-traded contract the average spreads are highest in the first 15 minutes of trading. At the same time, the bid-ask spread of the E-mini Nasdaq-100 futures is essentially flat intraday.

We also examined intraday variations in volume and volatility for each of the four futures contracts under consideration. Consistent with prior research, our results show that volume and volatility in both regular and both E-mini futures contracts follow a U-shaped pattern.\(^{17}\) There are sound theoretical and empirical reasons to believe that spreads in limit order markets are affected by volatility. Models of Handa and Schwartz (1996) and Handa, Schwartz, and Tiwari (2003) suggest that the bid-ask spreads in limit order markets decrease with transitory volatility and dispersion of traders’ valuations and increase with fundamental volatility. Ahn, Bae, and Chan (2001) find that transitory volatility is associated with lower spreads in the Hong Kong Stock Exchange, since transitory volatility encourages limit order traders to submit orders more actively. The finding that the E-mini spreads do not seem to be affected by changes in price volatility suggests that the current levels of bid-ask spreads, which are very close to one tick for both E-mini contracts, represent sufficient compensation to liquidity providers even under the most adverse market conditions. If the minimum tick sizes in these two contacts are reduced, the bid-ask spreads are likely to decline.

In their analysis of the regular S&P 500 futures, Huang and Stoll (1998) show that as trading volume increases the price increment chosen by the market tends to decline. The binding minimum tick sizes of the E-mini contracts, however, do not allow the traders to use smaller price increments despite a large increase in the trading volume over the last few years.

Estimated Bid-Ask Spreads of the Regular and E-mini Futures During the Preopening Period

The minimum tick size of the E-mini S&P 500 futures exceeds the tick size of the full-size S&P 500 contracts by a factor of 2.5. In order to further examine the impact of the large minimum tick size of the E-mini

\(^{17}\)These results are not reported to conserve space but are available upon request.
contract we look at the bid-ask spreads during the one-hour period of 7:15–8:15 am (CST) before the start of the regular pit trading hours. During the regular trading hours, the full-size contracts are traded in the open outcry pits. On the other hand, before 8:15 am (CST) both S&P 500 and Nasdaq-100 regular contracts trade on GLOBEX. This allows us to examine how the larger tick size of the E-mini S&P 500 futures affects the bid-ask spreads, while controlling for the trading mechanism. Trading on GLOBEX is already fairly active during the one-hour preopening period. For example, the average number of trades per minute during this period is about 11 for the regular S&P 500 futures and about 27 for their E-mini counterparts.

Panel B in Table III reports the results. The average estimated bid-ask spread of E-mini S&P 500 futures is about 0.29 index points, exceeding the spread of the corresponding regular contract by about 30%. At the same time, the bid-ask spread of the E-mini Nasdaq-100 futures is substantially lower than that of the regular contract. This finding appears to support the conclusion that the bid-ask spread of the E-mini S&P 500 contract is constrained by its relatively large minimum tick size.

Price Clustering and Potential Impact of a Tick Size Reduction on Front-Running and Quote Matching

In addition to estimating the bid-ask spread, we examine clustering of trade prices in both regular and both E-mini contract markets. The results reported in Figure 2 show that trades in the E-mini futures occur with roughly equal frequency on all possible ticks (four ticks for the E-mini S&P 500 and two ticks for the E-mini Nasdaq-100 futures). This evidence is consistent with the earlier finding that the bid and ask prices are separated by one tick. At the same time, trades in both regular contracts appear to be clustered on certain ticks. This clustering is especially prominent in the regular Nasdaq-100 futures with about 98% of trades occurring at full index points.

Market microstructure theory warns that a small minimum tick size may hurt liquidity because it makes front-running of limit orders and quote-matching more profitable and easily implemented. Seppi (1997) suggests that if traders with superior information or market access are

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18 Price clustering on GLOBEX is currently not pronounced, but it is possible that if the E-mini tick sizes are reduced the price clustering will increase. Such price clustering may limit the effect of tick size reduction on the bid-ask spreads on GLOBEX.
FIGURE 2
Percent of trade prices at each tick increment for regular and E-mini S&P 500 and Nasdaq-100 futures for January 2, 2002 to December 31, 2002.
able to “step ahead” of the limit orders of other traders, those limit orders are more likely to receive execution when the price moves away from them. Quote-matchers try to identify informed orders in the limit order book and take liquidity from such orders by slightly improving the limit price. If the price moves against the quote matchers, they are often able to liquidate the position by trading with the limit order they attempt to front-run. Harris (1997b) argues that quote-matchers are parasitic traders because they take liquidity from large patient traders, forcing the large traders to hide their orders. Quote-matching behavior is likely to occur in markets that strictly enforce time precedence. This strategy may be difficult to implement, however, because it is hard to identify informed orders, especially if trading is anonymous. Harris (1996) shows that informed traders tend to split their orders into multiple parts and quickly get in and out of the market in an effort to conceal their information and make quote-matching unprofitable.

The price clustering results reported in Figure 2 suggest that quote-matching does not seem to be a frequently used strategy in the regular S&P 500 and Nasdaq-100 futures markets despite the fact that open outcry markets preserve time precedence by allowing traders to quote only when they improve the standing quote. In the regular S&P 500 futures, most of the trades occur at full index points and 0.5 index points. At the same time, trades at 0.9, 0.1, 0.4, and 0.6 index points are much less common than those farther away from the 0.0 and 0.5. This evidence suggests that quote-matchers do not step in front of other traders who prefer to price their trades at 0.0 and 0.5 index points.

As mentioned above, trades in the regular Nasdaq-100 futures at 0.5 index points occur very infrequently. We also examined the distribution of trades for the regular Nasdaq-100 futures during the first half of the year 2000, before their tick size was increased from 0.05 to 0.5 index points. With about 99.4% of trades occurring at full index point and about 0.5% of trades at 0.5 index points, trades at other tick increments were extremely infrequent. Furthermore, trades at 0.05 and 0.95 index points were not more frequent than trades at some other increments.19 These price clustering results support the conclusion that quote-matching is not frequently employed by floor traders.

The results of Kurov and Lasser (2004) suggest that exchange locals trading E-mini contracts may be able to use order flow information from the trading floor to time their trades on GLOBEX, potentially undercutting limit orders of other traders to speed up execution.

19These results are not reported for brevity but are available from the authors upon request.
Quote-matching may also occur on GLOBEX because it is an electronic market with an open limit order book. Therefore, it is possible that a reduction of tick sizes of the E-mini contracts will lead to increased use of front-running and quote-matching strategies. However, the results discussed in the next section show that the locals tend to trade with market orders. Given that their informational advantage comes from observing the pit dynamics, and is therefore short lived, the locals are likely to continue using market orders regardless whether the minimum tick sizes are reduced.

Supply and Demand of Liquidity on GLOBEX and Potential Impact of a Tick Size Reduction on Liquidity Supply

One possible benefit of high bid-ask spreads dictated by a binding minimum tick size is that they represent compensation to liquidity providers. According to the traditional view of liquidity provision in open outcry futures markets supported by Silber (1984) and Kuserk and Locke (1993), exchange locals play the role of informal market makers. Chang and Locke (1996) show that clearing members also play an important role in liquidity provision by absorbing a substantial proportion of the customer order imbalances. Grossman and Miller (1988) observe that, in futures markets, the profit a market maker earns from a quick turnaround often equals the minimum tick size. As a result, if the minimum tick size is too low, floor traders may be unable to recoup fixed costs. Grossman and Miller conclude that the minimum tick rule is important because it supports a minimum level of profit to market makers and guarantees provision of liquidity.

Tick size reductions often result in decline of the bid-ask spreads, thus reducing the incentive for market makers to provide liquidity. However, Wood (2000) argues that smaller tick sizes encourage pseudo-dealers, or “naturals,” to provide liquidity by allowing them to compete for execution. As opposed to dealers, pseudo-dealers trade, for example, to rebalance their portfolios. Pseudo-dealers have lower liquidity provision costs than dealers because any given pseudo-dealer does not have to be present in the market during the whole trading day. Furthermore, in a market dominated by pseudo-dealers the same traders at various times supply and provide liquidity. Wood (2000) suggests that the ability of pseudo-dealers to trade directly without intermediation leads to lower trading costs. In support of this view, CFTC (2002) notes that once sustainable market liquidity is established, it often becomes unnecessary to maintain a market maker structure.
Liquidity on GLOBEX is supplied by limit order providers and consumed by impatient traders using market orders. If the E-mini tick sizes are reduced and the bid-ask spreads decline, the limit order traders may not be able to receive sufficient compensation for liquidity provision. Liquidity in the E-mini markets may decline as a result. If most of the limit orders are submitted by CME locals, the locals may need to maintain relatively high bid-ask spreads to recover their fixed investments. In this section, we consider whether the exchange locals tend to act as market makers on GLOBEX.

To find out whether liquidity on GLOBEX is supplied primarily by exchange locals, we need to classify trades by type of initiator. Since the E-mini trade data do not include bid-ask quotes, we use the tick rule to identify trades initiated by different types of traders.\textsuperscript{20} For example, a trade is classified as buyer-initiated if it occurs on an up-tick. If in a buyer-initiated trade the buyer is a local, then the trade is classified as a local-initiated buy trade. If a trade occurs on a zero-tick, i.e., if its price is equal to the price of its preceding trade, we classify it using the GLOBEX order submission times. The submission times are reported for both sides of each trade. Therefore, the trader whose order was submitted last initiated the trade.\textsuperscript{21} The initiating trader in each trade is classified as a liquidity demander and the other counterparty as a liquidity supplier. Similar to Frino and Jarnecic (2000), once the trades are classified we calculate proportions of trades and volume in which the different trader types act as liquidity demanders and as liquidity suppliers.

The results are presented in Table IV. In the E-mini S&P 500 futures locals act as liquidity suppliers in 44.8\% of all trades and 48.5\% of all trading volume. They act as liquidity demanders in 42.7\% of trades and 51.6\% of volume, suggesting that local-initiated trades tend to be relatively large. Thus, in the E-mini S&P 500 futures the exchange locals are about equally likely to supply as to demand liquidity. In the E-mini Nasdaq-100 futures locals demand liquidity in 42.9\% of trades and 47.6\% of volume, while they supply liquidity in only 36.6\% of trades and 37.2\% of volume. Therefore, on a net basis the locals are liquidity demanders in the E-mini Nasdaq-100 market. The small customer execution spreads reported in Table IV lend further support to the conclusion that the exchange locals tend to trade aggressively to exploit their

\textsuperscript{20}Aitken and Frino (1996) and Finucane (2000) show that the tick rule performs well when zero-tick trades are removed.

\textsuperscript{21}The proportion of non-zero tick trades classified identically by the tick rule and order submission times exceeded 98\%. This suggests that the submission times can be used to classify trades accurately for non-zero tick trades.
TABLE IV
Liquidity Supply and Demand in S&P 500 and Nasdaq-100 E-mini Futures for January 2, 2002 to December 31, 2002

<table>
<thead>
<tr>
<th>Panel A. E-mini S&amp;P 500 futures</th>
<th>Panel B. E-mini Nasdaq-100 futures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquidity demand</strong></td>
<td><strong>Liquidity supply</strong></td>
</tr>
<tr>
<td>CTI1</td>
<td>CTI2</td>
</tr>
<tr>
<td>Trades</td>
<td>42.7%</td>
</tr>
<tr>
<td>Volume</td>
<td>51.6%</td>
</tr>
<tr>
<td>Trades</td>
<td>42.9%</td>
</tr>
<tr>
<td>Volume</td>
<td>47.6%</td>
</tr>
</tbody>
</table>

**Note.** The CTI categories include local traders (CTI1), clearing members (CTI2), other floor traders (CTI3), and off-exchange customers (CTI4).

A trader demands liquidity in a particular trade if the trader initiates the trade. Non-zero tick trades are classified by type of initiator using the tick rule. Zero-tick trades are classified by using the reported GLOBEX order submission times. Nonclassifiable trades (i.e., trades that occurred on a zero tick and have equal reported submission times) are excluded from calculation. These trades account for about 8.8% and 10.5% of the total number of trades for the E-mini S&P 500 and E-mini Nasdaq-100 futures, respectively. All statistics are for regular trading hours.

An informational advantage derived from their access to the open outcry order flow.\(^{22}\)

Consistent with Chang and Locke (1996), clearing members appear more likely to supply than demand liquidity. For example, in the E-mini S&P 500 futures they demand liquidity in 16.1% of the total volume and supply liquidity in 19.8% of the total volume. Clearing members participate in about 30% of trading volume, but (based on CFTC’s Commitments of Traders Data)\(^{23}\) they account for more than half of the total open interest in the E-mini contracts. If clearing members were acting primarily as market makers on GLOBEX by using scalping tactics to earn the spread, one would expect an opposite result, i.e., a relatively high trading volume along with a relatively low open interest. Therefore, it is likely that a substantial proportion of clearing member trades is undertaken for hedging purposes, with limit rather than market orders used to reduce transaction costs. This conclusion is consistent with Daigler and Wiley (1998), who suggest that the clearing members are primarily hedgers.

\(^{22}\)The E-mini futures were originally created for retail customers. While our results show that exchange locals do not tend to act as market makers in the E-mini markets, it is possible that locals make markets to retail customers. We thank a referee for pointing this out. Unfortunately, our dataset does not allow us to test this hypothesis.

\(^{23}\)The Commitments of Traders data are available at http://www.cftc.gov/.
Our findings imply that exchange locals do not tend to act as market makers in the E-mini futures markets, while they continue to enjoy substantial privileges including lower GLOBEX and clearing fees and exclusive access to important trading information on the open outcry floor. CFTC (2002) suggests that granting market access privileges to market makers in perpetuity may often lead to a situation where the public costs of such privileges eventually outweigh the public benefits afforded by the market makers. The E-mini futures markets seem to be an example of such a disconnect between public costs and public benefits of privileges granted to market makers.

**SUMMARY AND CONCLUSION**

The CME employs a “side-by-side” trading model in which so-called “E-mini” versions of several floor-traded index futures contracts trade on the electronic GLOBEX trading system. This paper examines the impact of the minimum tick sizes on the bid-ask spreads in the E-mini S&P 500 and E-mini Nasdaq-100 futures markets. We find that the tick sizes of the E-mini contracts act as binding constraints on the bid-ask spreads by not allowing the spreads to decline to competitive levels. Given the resulting relatively high trading costs on GLOBEX, many institutional traders are likely to prefer to trade the full-size index futures contracts traded on the CME floor.

We also find that the exchange locals trading E-mini contracts, who continue to enjoy substantial privileges compared to off-exchange customers, are at least as likely to demand as supply liquidity. This finding contradicts the prevailing notion that locals play the role of market makers in futures markets. Furthermore, this result supports the notion that electronic limit order markets are likely to develop adequate liquidity without the presence of designated market makers.

In its 1997 letter to the CME regarding several changes to contract specifications proposed by the CME, which included increasing the minimum tick size of the forthcoming E-mini S&P 500 futures contract from 0.1 to 0.25 index points, the CFTC suggested that the CME “should monitor the trading in the E-mini contracts to determine if the minimum tick is too large, and adjust the minimum tick if warranted.”

Our empirical results suggest that the time has come for the CME to consider reducing the minimum tick sizes of the E-mini S&P 500 and E-mini Nasdaq-100 contracts. Such a measure is likely to result in a reduction of trading costs in the two major U.S. index futures markets.

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