Market Microstructure of FT-SE 100 Index Futures: An Intraday Empirical Analysis

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This article examines the market microstructure of the FT-SE Index futures market by analyzing the intraday patterns of bid-ask spreads and trading activity. The patterns are remarkably different from those of stock and options markets because of the futures market's open outcry system with frenzied scalpers/short-term marketmakers. Spreads are stable over the day, but decline sharply at the close and increase when U.S. macroeconomic news is distributed. Traders actively trade at the open with narrow spreads and large trade sizes. Volatility and volume have higher values at the open and close and when U.S. news is released. The overall results suggest that information asymmetry in the index futures market is insignificant, and traders find it easy to control inventory. The results are also broadly consistent with the Grossman and Miller (1988) model that describes liquidity as the price of transaction demand for immediacy. © 1999 John Wiley & Sons, Inc. Jrl Fut Mark 19: 31–58, 1999

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INTRODUCTION

Market microstructure analysis exploits the structure of specific trading mechanisms to model how price-setting rules develop in markets. Inventory control (Stoll, Amihud and Mendelson, 1980; Ho and Stoll, 1981, among others), adverse selection (e.g., Copeland and Galai 1983; Glosten and Milgrom, 1985, Kyle, 1985, Admati and Pfleiderer, 1988) and specialist market power (Brock and Kleidon, 1992) models have been studied extensively in the theoretical microstructure literature.[1] Many empirical papers have examined the microstructure of stock markets and options markets based on these models. Few papers have studied the microstructure of futures markets because neither of the major United States futures exchanges—Chicago Board of Trade (CBOT) and Chicago Mercantile Exchange (CME)—provide transaction volume and bid-ask quotes. Only transaction futures prices after a change in price are recorded.

This article investigates the market microstructure of the FT-SE 100 Index futures contracts traded on the London International Financial Futures and Options Exchange (LIFFE). It uses 1995 and 1996 transaction data of trades, quotes, and volume, which were recently distributed by the LIFFE. Market making and order flow mechanism in futures markets are different from other securities markets. Results of the paper may provide insights on the microstructure of an open outcry system and some important microstructure issues, such as the demand for immediacy. The prime interest of the current study is stock index futures, but the overall analysis is generally applicable to other liquid financial futures markets.[2]

The first difference between futures markets and other financial markets is that there are no designated marketmakers in the futures markets. All bids and offers are revealed to other traders in the trading pit by the process of open outcry, or through the continuous auction system of trading. Active futures markets rely on the presence of scalpers, or very short-term floor traders, who trade for their own accounts and act as "voluntary marketmakers" to provide liquidity to incoming market orders. Unlike the specialists in the New York Stock Exchange (NYSE) or the dealers in Nasdaq, scalpers have no obligation to bid or offer continually, or even to remain in any particular pit within their allowable trading sets.[3]

[1]A concise and intuitive review of the three models are provided by Chan, Chung, and Johnson (1995).

[2]However, the argument discussed below that information asymmetry is not important in futures markets may not be valid for some commodity futures markets that are influenced by few large informed traders. The strategic trading mechanism of these markets is modeled by Foster and Viswanathan (1994). Moreover, inventory costs in some illiquid futures markets may also be large.

[3]The trading behaviors of scalpers have been studied since the 1950s, e.g., Working (1954, 1967), Silber (1984), Brorsen (1991), and Kuserk and Locke (1993). See also Kolb (1997).

Second, inventory costs in futures trading are small and traders find it easy to control inventory. Manaster and Mann (1996) document that the median S&P 500 index futures trader can reduce inventory by half in one trade, while Hasbrouck and Sofianos (1993) and Madhavan and Smidt (1993) find that it takes a specialist a week to do so. Moreover, Silber (1984) reports that the average scalper holds positions open for a short period (a few minutes) and trades in small amounts (three contracts per trade) in the frenzied trading activity.

Third, index futures prices are not likely to be affected by private information. The models of Subrahmanyam (1991) and Gordon and Pennacchi (1993) show that a factor favoring trading in index futures markets is that the diversification of the portfolio of securities reduces the effects of private information. Furthermore, by the very nature of the open outcry system, informed traders, if any, are easily identified by other investors in the pits. Therefore, the adverse selection problem induced by information asymmetry will not be severe. It is worth noting that the absence of information asymmetry does not imply that trades in the futures market have no information content.[4]

Miller (1990) also points out that futures prices are influenced by market-wide information such as macroeconomic news. Miller's conjecture, however, cannot be easily tested in the U.S. index futures markets on a real-time basis because most macroeconomic news is reported at 8:30 AM New York time, one hour before the futures (and the stock and options) markets open.[5] By contrast, U.K. and U.S. macroeconomic news is announced during the trading hours of the LIFFE.

Given the characteristics of futures markets noted above, it is not surprising that neither the inventory control, adverse selection, nor specialist market power models can reasonably describe the microstructure of futures markets. Particularly, in the current study, the intraday patterns of bid-ask spread, volatility, volume, number of trades, and trade size of FT-SE futures are distinct from those of the NYSE, Nasdaq, London Stock Exchange (LSE), and Chicago Board Options Exchange (CBOE).

[4]Hasbrouck (1991) uses a vector autoregressive (VAR) model and impulse response function (IRF) analysis to examine the information content of trades. The IRF analysis allows a resolution between private information (the trade innovation) and public information (quote revision innovation). Hasbrouck (pp. 191–192) points out that market imperfections may lead to incorrect attribution of private and public information effects. Moreover, 7.8% of the trade prices in the current study are the same as the bid and ask quotes with zero spreads, resulting in indeterminate signs of trades (buy or sell). Therefore, the current paper does not use Hasbrouck's approach to investigate information asymmetry in FT-SE futures.

[5]Nevertheless, Chan (1992) provides some indirect evidence that the index futures market is able to update market-wide information faster than the cash market.

Brock and Kleidon (1992), McInish and Wood (1992), and Lee, Mucklow, and Ready (1993) have reported that the intraday bid-ask spreads of NYSE stocks follow a U-shaped pattern. This result is consistent with the specialist market power model: Specialists can exploit the public's inelastic demand to trade at the open and close by widening the spread. In contrast to this agency auction market, individual competitive dealers in Nasdaq, LSE, and CBOE find it difficult to exploit intraday changes in the elasticity of investors' desire to trade. Werner and Kleidon (1996), Kleidon and Werner (1995), and Chan, Chung, and Johnson (1995) show that the bid-ask spreads for LSE stocks and CBOE options, respectively, decline slowly throughout the trading day after a sharp decline at the first half hour. Chan, Christie, and Schultz (1995) (CCS) find that Nasdaq spreads remain relatively constant during the first hour of trading, then narrow steadily. One interesting observation reported both by Chan, Chung, and Johnson and CCS is that the spreads narrow significantly near the close.

In contrast to the results of previous work on stock and options markets, spreads of FT-SE 100 Index futures are quite constant over the floor trading hours, except near the open, close and when U.S. macroeconomic news is distributed. The spreads are widest during U.S. macroeconomic news distribution and narrowest during the opening and closing periods. Moreover, the open, close, and U.S. macroeconomic news periods give high values of volatility and volume.

These volatile and high-volume periods are profitable opportunities for traders and, accordingly, they trade heavily. They are willing to take positions at smaller spreads during the competitive opening and closing periods. Following the approach of Gerety and Mulherin (1992), the clustering of volume and number of trades around the open and close is evinced as a result of the desire of investors to exchange the risk of holding overnight in the absence of opportunity to trade. The closing spreads (volume and volatility) are further decreased (increased) because traders are unwilling to hold inventory and assume the risk of unfavorable news overnight. However, because U.S. macroeconomic news may alter futures prices immediately and significantly, traders will quote a higher ask or lower bid to avoid unwanted inventory.

The overall results are consistent with the active position taken by floor traders, particularly scalpers, who supply the futures markets with liquidity as suggested by the Grossman and Miller (1988) model. The results also indicate that the patterns of bid-ask spreads and trading activity are substantially affected by the market making of an open outcry system and U.S. news.

LIQUIDITY, MARKET MAKING, AND BID-ASK SPREAD

Investors generally prefer to trade immediately. Grossman and Miller (GM) (1988) model the idea of liquidity as the price of immediacy in that investors wishing to trade now pay a cost relative to simply waiting to trade later. This idea has long been introduced by Demsetz (1968).

On Nasdaq and other competitive dealer markets, e.g., London Stock Exchange (LSE) and CBOE, immediacy is provided by dealers who quote bids and offers continuously. Of particular interest, CCS find that dealers can enter bid and ask quotes to attract trades on only one side of the spread and limit their exposure to trades that incur unwanted inventory. This ability of managing inventory through prices explains the sharp decline of spreads near the close. The bid-ask spreads of Nasdaq (CCS), LSE (Werner and Kleidon, 1996), and CBOE (Chan, Chung, and Johnson, 1995) also narrow over the day. This pattern is predicted by the Madhavan (1992) model, in which each trade diminishes the information asymmetry between competing dealers and informed traders. This model also infers that the intraday spreads of index futures, where private information is not important, should be stable.

Futures Markets and Trading Behavior of Scalpers

The high demand for immediacy in successful futures markets is closely related to the two basic functions of futures markets: price discovery and risk hedging (Grossman and Miller, 1986, and Stoll, 1992). The more volatile the futures price, the greater the risks of delaying trading and the higher the need for these two functions.

In the trading pits, where bids and offers are conveyed by voice and hand signals, every trader acts as an auctioneer. This open outcry allows full and open competition among traders confronting each other. In compliance with Exchange rules, floor brokers and traders may announce bids and offers only when their quotes are equal to or better than the existing market quotes for a specific contract. Thus, customers have the benefit of the highest (lowest) bid (offer) available, and the quoted spread is the same as the inside spread in dealer markets. A more precise meaning of bid-ask spread in futures markets is given in the following section.

Floor traders can be classified as scalpers, day traders, or position traders. Scalpers have the shortest horizon of holding positions (a few minutes), whereas position traders have the longest (longer than a day). Scalpers act as marketmakers or dealers and provide liquidity by continually quoting bids and offers against which market orders can be executed. They are informally identified by other traders by simply observing their trading behavior. Scalpers do not have an obligation to provide liquidity, to bid or ask, or even remain present in any particular pit. Most of the time they trade by feel and emotional factors rather than by fundamentals.[6] Silber (1984) and Kuserk and Locke (1993) document that a successful scalping strategy involves frequent trading in small trade sizes. Scalpers' income is derived from the bid-ask spread and their prediction of the intraday price movement. Manaster and Mann (1995) find that the latter source of income is more important than the former.

As discussed in the introduction, inventory risks and information asymmetry are negligible in financial futures markets. This is also the environment in Grossman and Miller's (1988) model, which describes the relationship between marketmaker profits and the amount of liquidity provided. (See O'Hara, 1995, ch. 10, for a lucid discussion of the model.) Grossman and Miller use a three-period model in which trade occurs in the first two periods and the asset liquidates in Period 3. What motivates trade is portfolio rebalancing induced by exogenous liquidity shocks. The asynchronization of desired trades creates the demand for immediacy in Period 1, with the imbalance reversed in Period 2. Thus the price change between Periods 1 and 2 can be considered the return, r, for providing liquidity to a speculator or marketmaker who is willing, for a price, to hold unbalanced inventory. The expected return, $E[r]$, is given by

$$\begin{aligned} E[r] = {} & \text{(speculator's inventory position)} \\ & \text{x (risk aversion coefficient) x (variance of } r\text{).} \end{aligned} \tag{1}$$

Because the return to speculators or scalpers increases with the return variance, periods with greater volatility will attract more speculators; but these speculators require a higher return to compensate them for the greater risk that new information may lead to losses on the inventory positions. Grossman and Miller (1990) argue that, in a competitive open-outcry market, this delay risk borne by any single marketmaker can be reduced by diversifying the risk across many marketmakers. In other words, the larger the number of traders in the pit, the lower the costs to each trader for assuming the temporary price risks. Moreover, the larger the inventory, the higher the expected return between periods to compensate the marketmaker for the risk. Note that the order imbalance sums

[6]Here's an example. If a scalper observes many brokers simultaneously hitting bids with incoming market orders, he may assume it will be difficult for him to sell the futures he would own if he were bidding. Thus, he might even liquidate his position at a loss by hitting lower bids himself.

to zero across periods; therefore, no *aggregate* inventory risk is associated with holding the asset across periods.

The above discussion suggests that volatility and volume should be inversely related to the bid-ask spread. Specifically, scalpers are eager to trade at the volatile (and profitable) opening and closing intervals, during which investors have greater transaction needs. Hence, scalpers are willing to post higher bids and lower asks to attract order flows, resulting in a narrower spread at the open and close than at other intervals.

At the open, particularly, scalpers may not worry about holding unwanted inventory because, as mentioned, there is no *aggregate* inventory risk. For the rest of the day, scalpers have plenty of time to dispose of the inventory obtained at the open. As argued by Manaster and Mann (1996), an average S&P 500 index futures trader can reduce inventory by half in only one trade. Therefore, at the open, the trade size (volume per trade), as well as the volume and number of trades, should be high. This is distinct from the results on Nasdaq stocks in CCS, who find that the trade size at the first five-minute interval is the lowest of the trading day, although the number of trades is the highest. The CCS results suggest that "price discovery on the [Nasdaq] appears to be accomplished, not through wide bid-ask spreads, but through a short period of rapid trading when dealers are initially reluctant to commit to large trades (p. 52)." Scalpers are willing to commit to large trades (and hold unbalanced inventory) but Nasdaq dealers are not because information asymmetry and inventory risk are not the concerns in futures markets, at least not at the open.

Near the close, scalpers and dealers in the Nasdaq have a similar attitude: to avoid holding overnight inventory. Scalpers, however, may take it more seriously because of their extremely short-term speculative trading behavior. Day traders are also eager to close out their positions before the market closes.[7] Thus, the spread of futures will decline sharply at the close.

Miller (1990) and Laux and Senchack (1992) point out that futures prices are influenced by macroeconomic news. The FT-SE 100 Index futures market should be volatile when U.K. and U.S. macroeconomic news is announced during the trading hours of LIFFE. Hence, a relevant question is whether scalpers would also trade actively during these (public) information intervals. They would, but the spreads may not be narrow. Although both the open and close and the intervals when macroeconomic news is reported are volatile, no substantial information is revealed during

[7]Position traders maintain their positions overnight; therefore, they should not affect the intraday patterns of spreads and trading activity significantly.

the open/close intervals. Volatility at the open/close is fundamentally derived from liquidity trading. The accumulation of overnight information will also result in higher volatility at the open (Amihud and Mendelson, 1991). By contrast, volatility at the U.K. and U.S. information intervals is induced by information reported exactly at these moments. The inventory risks are higher during information intervals than at the open/close, and scalpers may post wide spreads when U.S. and U.K. news is announced.

In sum, the bid-ask spread of FT-SE 100 Index futures should be narrow at the open and close, wide when the U.K. and U.S. macroeconomic news is distributed, and fairly constant for the rest of the day.

MARKET STRUCTURE OF LIFFE AND DATA

LIFFE is the second largest futures market on a world-wide basis, next to the Chicago Board of Trade (CBOT).[8] Its market structure, open outcry trading, is almost the same as that of the floor trading on the CBOT and CME. On these two major U.S. futures markets, trade prices are entered by the pit reporters, who stand adjacent to the trading pit, with a time stamp only after a price change has been observed. The U.S. futures markets do not publicly provide bids/offers and transaction volume in real time as do most equity markets. The lack of these transactions data impedes empirical research on microstructure of futures markets.[9] In contrast, on the LIFFE, all bids/offers, transaction prices and volumes are recorded and made public immediately through the Order Transit System and Trade Registration System on a real-time basis.

It is important to understand that no formal quoted bid-ask spread exists in futures markets as in dealer markets. Instead of quoting *pairs* of bids and offers with quantities available at these quotes (depth), scalpers or brokers/traders usually only cry out the price (bid or ask) and quantity they want to buy/hit or sell/lift. Examining the two-minute period (10:16:00–10:17:59 on 22 February 1995) shown in Table I will illustrate this more clearly. The first four columns list the raw data with the fourth column showing the trading code (T = Trade, B = Bid, A = Ask/Offer) of each transaction. The bid and offer are not necessarily quoted simul-

[8]The Chicago Mercantile Exchange (CME), for years the second largest futures market, has fallen to the third recently behind the LIFFE. See "New, Less-Regulated Futures Markets For Large Traders Sought by 2 Exchanges," *Wall Street Journal,* April 21, 1997.

[9]Particularly, many papers have estimated the implied effective spread (or transaction costs) from the available time series of transaction prices using the models of Roll (1984) and Smith and Whaley (1994) and their modifications. Locke and Venkatesh (1997), however, show that this approach is inappropriate.

TABLE I

A Sample of Transaction Data

Raw Data				*Bid-Ask Spread*				
Time	*Price*	*Volume*	*Code*	*Time*	*Bid*	*Ask*	*Absolute Spread in Prices*	*Ticks*
101601	3023.0	1	T	101604	3023.0	3024.0	1.0	2.0
101604	3023.0	0	B	101635	3022.0	3023.0	1.0	2.0
101604	3024.0	0	A	101639	3022.0	3023.0	1.0	2.0
101628	3023.0	25	T	101648	3022.0	3023.0	1.0	2.0
101635	3022.0	0	B	101650	3022.0	3022.0	0.0	0.0
101635	3023.0	0	A	101658	3022.0	3023.0	1.0	2.0
101637	3022.0	1	T	101707	3023.0	3023.0	0.0	0.0
101639	3022.0	0	B	101712	3023.0	3024.0	1.0	2.0
101639	3023.0	0	A	101729	3022.0	3024.0	2.0	4.0
101645	3023.0	50	T	101739	3022.0	3024.0	2.0	4.0
101648	3023.0	0	A	101743	3022.0	3023.0	1.0	2.0
101650	3022.0	0	B	101750	3022.0	3023.0	1.0	2.0
101656	3022.0	1	T	101752	3022.0	3024.0	2.0	4.0
101658	3022.0	0	B					
101658	3023.0	0	A					
101702	3023.0	4	T					
101707	3023.0	0	B					
101709	3023.0	1	T					
101712	3024.0	0	A					
101721	3023.0	7	T					
101729	3022.0	0	B					
101739	3024.0	0	A					
101743	3023.0	0	A					
101748	3022.0	1	T					
101750	3022.0	0	B					
101752	3024.0	0	A					

A sample data of two minutes (10:16:00–10:17:59) on 22 February 1995 is used to describe how the bid-ask spread is formed. The first four columns list the raw data with the fourth column showing the trading code (T = Trade, B = Bid, A = Ask/Offer) of each transaction. The bid and offer are not necessarily quoted simultaneously; even so, they may not be quoted by the same trader. The last two columns present the absolute spread constructed in prices and ticks. One tick is the minimum price movement, 0.5.

taneously; e.g., in the last two rows, the bid is recorded at 10:17:50, and the ask at 10:17:52. Even when the bid and ask are quoted at the same second, such as the first pair of bid and ask at 10:16:04, they are not necessarily auctioned by the same trader. The bids and offers are paired by being considered as two series with observations at different times. The last two columns present the absolute quoted spread in prices and ticks, respectively.

The FT-SE Index is constructed from 100 of the largest U.K. companies traded on the LSE, which trades from 8:00 to 16:30. The floor trading hours of FT-SE Index futures on LIFFE are 8:35 to 16:10. The minimum price movement (tick size) is 0.5 (£12.50). The open outcry floor trading is supplemented by the computerized after-hours Automated Pit Trading (APT) system. The trading volume by this one-hour APT (16:32 to 17:30) is about 5.4% of the floor trading. The current study focuses on the market structure of the open-outcry floor trading and, unless specified, "close (open)" means "close (open) of the floor trading." Nevertheless, APT data are also used for comparison with the floor trading results.

The time and sales data used in this study contain every bid, ask, and trade price and volume, stamped to the second, and have been error-filtered by LIFFE. The most liquid nearest contracts of FT-SE Index (with an average daily floor volume of 6,860 contracts by 1,084 trades) for the two entire years of 1995 and 1996 are used. Each of the 499 trading days is partitioned into 91 five-minute intervals for the floor trading, e.g., the first interval is 8:35:00 to 8:39:59 London time, and 12 five-minute intervals for APT.[10] The APT-first interval has only three minutes, from 16:32:00 to 16:34:59. Unless specified, London time is used.

The Appendix lists U.K. and U.S. macroeconomic news announced in the fourth quarter of 1995. It illustrates that most U.K. news and U.S. news is announced at 9:30 London time and 8:30 New York time, respectively. 8:30 New York time corresponds to 13:30 London times. For brevity, the 9:30–9:34 and 13:30–13:34 intervals are, respectively, called the U.K. and U.S. news intervals.

Distributions of Spreads and Volume

Figure 1 illustrates the distribution of absolute quoted spreads in ticks. One tick is 0.5 in prices. Most of the spreads for both floor trading and APT are two ticks, followed by four ticks. Specifically, 62.8% (40.9%) of the absolute spreads of floor trading (APT) are two ticks; 24.8% (28.9%) are four ticks.[11] The figure also shows that the APT spreads are greater than the floor trading spreads. An absolute spread of two ticks corresponds to a proportional spread of 0.03%, much less than that of stock and option markets, suggesting high liquidity of futures markets.

In Figure 2, the histogram of volume (or trade size) shows that on the floor, 41% of the trades are transacted with three contracts and 29.6%

[10]Seven trading days (20 September 1995; 24, 27, 29 December 1995; 24, 27, 31 December 1996) were deleted because the afternoon transaction data are not available.

[11]A small percentage (0.86%) of spreads are negative and are excluded. An anonymous referee suggests that if the data set also includes the bids/offers that are immediately hit and will therefore only be recorded as T and not as B or A, negative spreads will be obtained at times. The author has tried to confirm this with the LIFFE but to no avail.

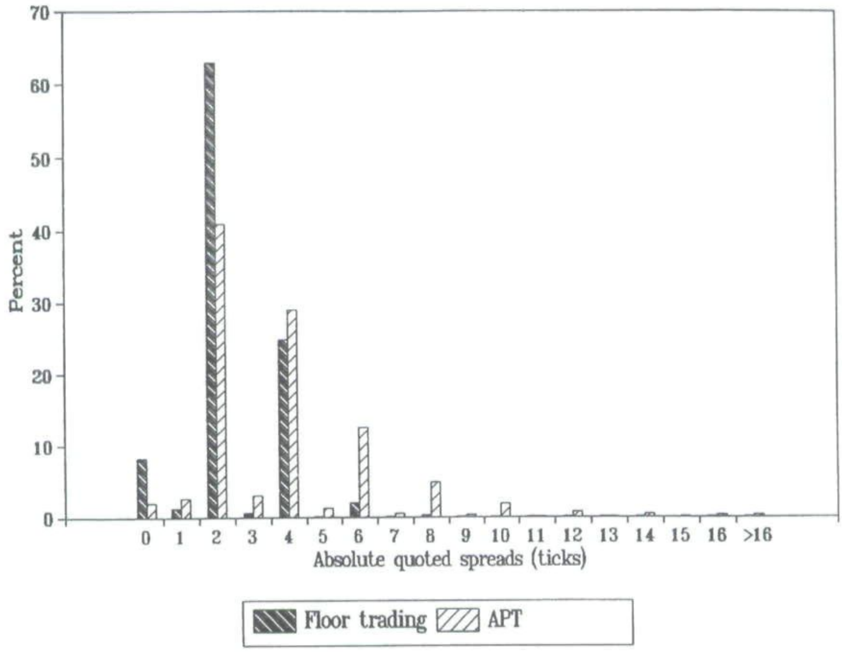

FIGURE 1

The distribution of absolute quoted spreads. The distributions are computed using all absolute spreads of FT-SE Index futures for the two entire years of 1995 and 1996. The horizontal axis shows the spreads in ticks. One tick (or 0.5 in prices) is the minimum price movement. The vertical axis represents the percentage of all spreads that are equal to the specified ticks.

with seven contracts. Silber (1984) also finds that scalpers on the New York Futures Exchanges frequently trade at three contracts per trade. In contrast, most of the APT trades are transacted with one contract, 46.7%, and two contracts, 16.5%, and the percentages decrease almost monotonically with the number of contracts. This also indicates that the trade size of APT is smaller than that of floor trading.

INTRADAY BEHAVIOR OF SPREAD, VOLATILITY, AND VOLUME

The time-weighted proportional bid-ask spread S_i at interval i introduced by McInish and Wood (1992) and used by, among many others, Chan, Chung, and Johnson (1995), and Battalio (1997), is employed.

$$S_t = \frac{\sum_{(t:t \in \text{ interval } i)} \tau_t s_t}{\sum_{(t:t \in \text{ interval } i)} \tau_t}, \tag{2}$$

where $s_t = (Ask_t - Bid_t)/[(Ask_t + \text{Bid}_t)/2] \times 100$ is the proportional

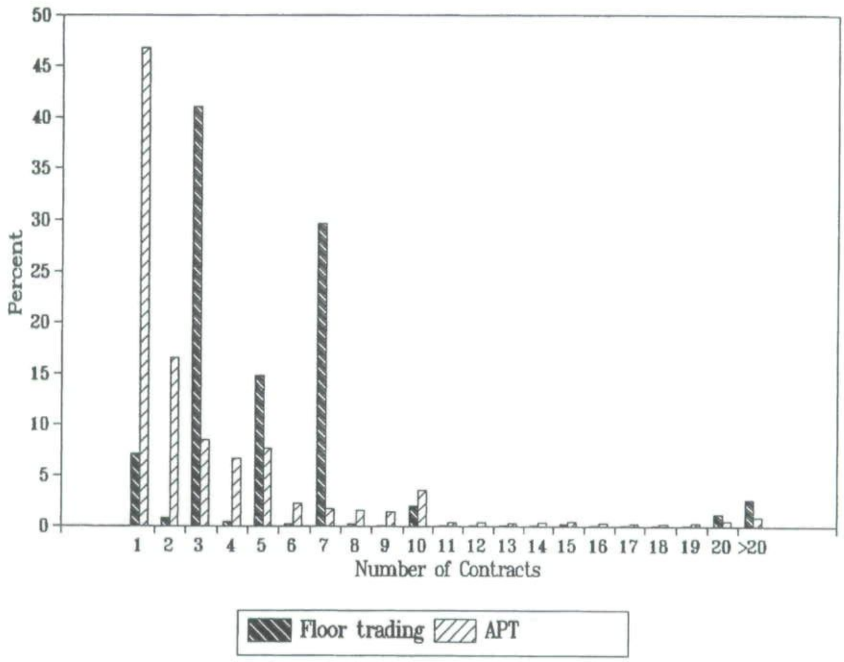

FIGURE 2
The distribution of volume. Volume is measured by the number of contracts. The vertical axis represents the percentage of volume that is equal to the specified number of contracts. The data used are FT-SE Index futures for the two entire years of 1995 and 1996.

spread at time t and τ_t is the length of time (in seconds) the quote is active. Volatility is measured by Parkinson's (1980) extreme-value estimator; i.e., difference between the (log) high and low trade prices, or range, and absolute mid-quote change. Results are virtually the same if volatility is estimated by Garman and Klass (1980).

The intraday patterns of the time-weighted proportional spreads are illustrated in Figure 3. Consider floor trading first. The spread over the day is more stable than those of the NYSE, Nasdaq, LSE stocks, and CBOE options. The figure also shows that the spread is the highest (0.0364%) for the interval of 13:30 to 13:34. Thus, the spread is widened by U.S. macroeconomic news, but not by U.K. news. The spreads also show a sharp decline for the last 10 minutes, with the lowest spread (0.0301%) occurring at the last interval. The opening spread is the second lowest (0.0309%); then the spreads, on balance, stay at a stable level for the rest of the morning.

The sharp decline in spreads immediately before the close is consistent with the short-term speculative behavior of scalpers and day traders.

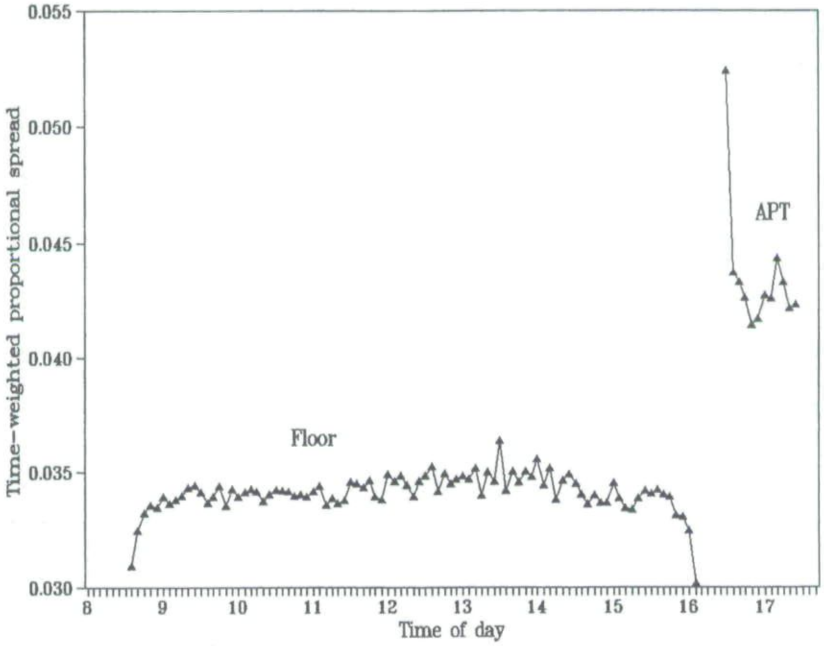

FIGURE 3

Intraday patterns of time-weighted proportional spread. The horizontal axis shows the time of day. Each trading day is partitioned into 91 five-minute intervals for the floor trading from 8:35 to 16:10, and 12 intervals for the APT from 16:32 to 17:30. The vertical axis represents the average time-weighted proportional spreads at each interval. The data used are the spreads of FT-SE index futures for the entire two years of 1995 and 1996.

Although they have one more hour on the APT, which opens one hour after the floor trading is closed, scalpers may not be interested in this screen trading environment. They lose the information advantage they have while being present on the floor and observing the incoming order flow (Brown and Zhang, 1997). Or simply put, scalpers find it difficult to sense the feel of the trading among other market participants by looking at the screens on the APT.[12] As shown in Figure 3, spreads on the APT are higher than those on the floor. Also, unlike the floor, the APT-opening interval has the highest spread during the APT hour.

The intraday patterns of the range (high-low) and absolute mid-quote change volatilities illustrated in Figure 4 are different from that of the spreads; volatility shows great variation during the day. Consider the floor

[12]Because screen trading systems are unlikely to attract the services of large numbers of competing market makers who provide liquidity, the floor trading pits are expected to be more liquid than the screen trading systems. Nonetheless, Miller (1990) highlights the competitive impact of overseas screen trading on the U.S. exchanges.

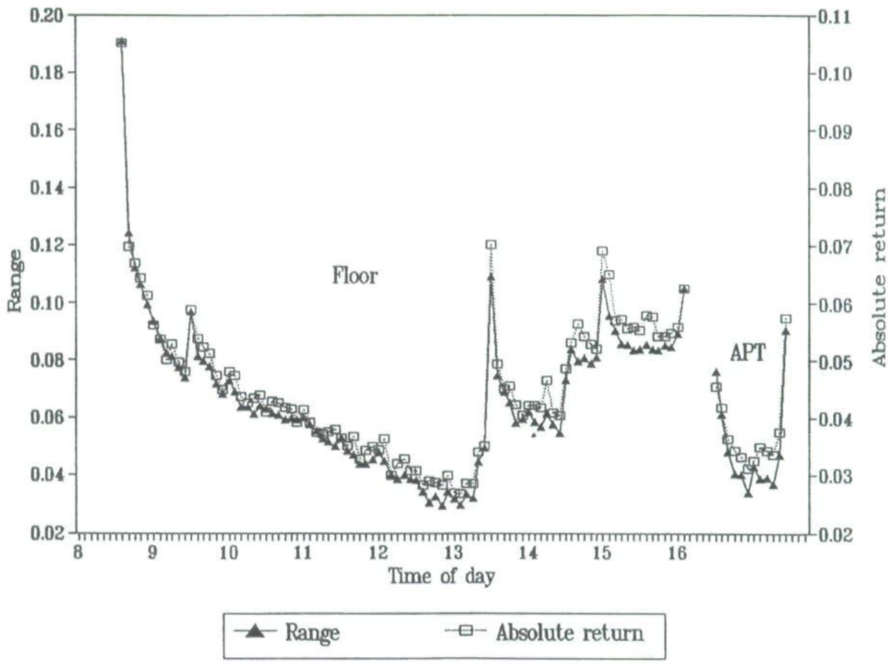

FIGURE 4

Intraday patterns of volatility. Volatility is calculated by Parkinson's (1980) extreme-value estimator; i.e., difference between the (log) high and low trade prices, or range, and absolute mid-quote change. Each trading day is partitioned into 91 five-minute intervals for the floor trading from 8:35 to 16:10, and 12 intervals for the APT from 16:32 to 17:30. The vertical axis represents the average volatility (both range and absolute return) at each interval. The data used are FT-SE index futures for the two entire years of 1995 and 1996.

trading hours. Volatility is the highest at the open and declines rapidly until immediately before the U.S. news interval; a spike of volatility is observed at this interval. A milder spike also occurs at the U.K. news interval. After dropping for 30 minutes from the U.S. news interval, volatility starts increasing moderately at 14:30 (the NYSE open) and rises toward the end of the floor trading. The last result suggests that U.S. order flow conveys information to the U.K. index futures markets, although the impact is not distinct.[13] Not surprisingly, the APT volatility follows a separate U-shaped curve as other financial markets, because no macroeconomic news is distributed during this hour.

While studies such as Wood, McInish, and Ord (1985) and Werner and Kleidon (1996) have reported U-shaped intraday volatility patterns, the spike at the U.S. news interval contrasts sharply with the LSE and

[13]Werner and Kleidon (1996) and Kofman and Martens (1997), among others, discuss the information flow between the London and New York stock exchanges.

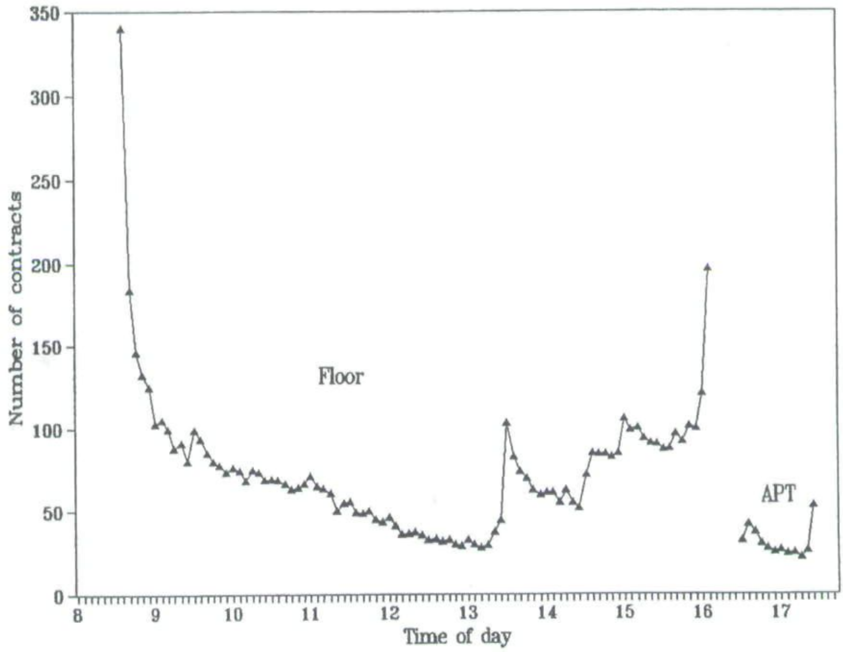

FIGURE 5

Intraday patterns of volume. Volume is calculated by the number of contracts. Each trading day is partitioned into 91 five-minute intervals for the floor trading from 8:35 to 16:10, and 12 intervals for the APT from 16:32 to 17:30. The vertical axis represents the average volume at each interval. The data used are FT-SE index futures for the two entire years of 1995 and 1996.

many other financial markets. Using 15-minute intervals for the year of 1991, Werner and Kleidon (1996) find that the volatility of LSE stocks is the lowest during the lunch period of 13:00 to 14:00; no spike is observed.[14]

The intraday pattern of volume demonstrated in Figure 5 is similar to that of volatility: A U-shaped curve with a spike at the U.S. news interval. But the U.K. news and U.S. stock markets open intervals are not noticeable. Index futures prices, therefore, are shown to be driven by macroeconomic news, assuming that volatility/volume is a proxy for information flow.[15] The greater impact U.S. news has on the volatility and spreads of FT-SE futures than U.K. news parallels the results of Becker,

[14]The spike at 13:30 is still observed when 15-minute intervals are used. Thus the dissimilarity between the results given by the FT-SE index cash and futures is not incurred by the differing intervals adopted.

[15]A recent example showing the influence of U.S. macroeconomic news on FT-SE Index futures is given by the announcement of the U.S. employment report on 22 February 1997. The futures price rose by 31 index points after the U.S. jobs report allayed investors' fears of increased inflationary pressure.

Finnerty, and Kopecky (1995) and Tse (1998). Becker, Finnerty, and Kopecky find that U.S. macroeconomic information has a significant influence on British interest rates, but not vice versa. Tse shows that the London Euromark futures prices are affected by U.S. news but not by U.K. news. Like the APT volatility, the APT pattern in volume is U-shaped (after prorating the three-minute APT-opening interval to five minutes).

It is worth noting that, whereas spreads, volatility, and volume surge at the U.S. news interval, they drop immediately at the next interval. A closer examination by sampling 1-minute intervals indicates that the spike occurs at the minute of 13:30:00–13:30:59. These findings suggest rapid reaction of futures prices to macroeconomic news. Ederington and Lee (1995) find that the U.S. interest rate and foreign exchange futures markets (which open before the index futures markets) completely respond to macroeconomic reports within 40 seconds of the news release.

On Nasdaq, CCS show that dealers are reluctant to commit to large trades immediately when the market is open. Rather, dealers make frequent small trades to avoid holding unbalanced inventory. In futures markets, scalpers consider the inventory control risks at the open trivial because they can close out their position easily during the rest of the day. In addition, the volatile opening interval is potentially profitable to them. Therefore, scalpers trade frequently with *large* trade size at the open, a finding different from CCS. This is illustrated in Figure 6: Both the number of trades and trade size at the open are higher than those during any other interval. Moreover, the intraday pattern of the number of trades resembles the U-shaped pattern (with a spike at the U.S. news interval) of volatility and volume. As expected, the trade size of APT is smaller than that of floor trading, and the APT number of trades follows a U-shaped curve.

Statistical Testing

The statistical inference of the intraday pattern of floor trading is examined by the following equation based on Foster and Viswanathan (1993).

$$X_t = a_0 + \sum_{j=1}^{10} a_j D_j + e_t, \tag{3}$$

where X_t is the variable (time-weighted proportional spread, range volatility, or volume) being examined, and D_j's are dummy variables defined as follows:

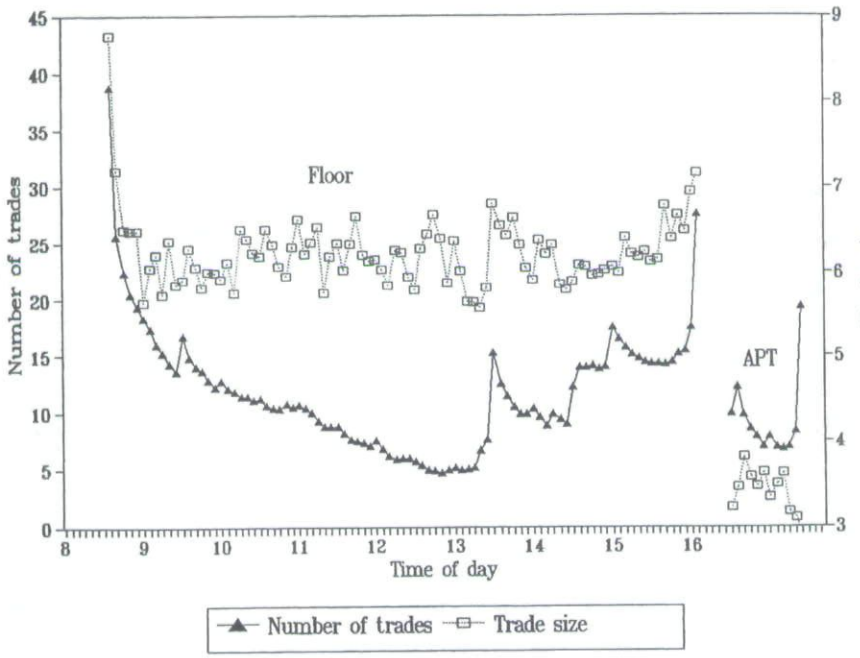

FIGURE 6

Intraday patterns of number of trades and trade size. Each trading day is partitioned into 91 five-minute interval for the floor trading from 8:35 to 16:10, and 12 intervals for the APT from 16:32 to 17:30. The vertical axis represents the average number of trades and trade size at each interval. The data used are FT-SE index futures for the two entire years of 1995 and 1996.

$$
\begin{aligned}
D_1 &= 1 \text{ if } 8{:}35{:}00 \leq t \leq 8{:}39{:}59, \text{ 0 otherwise;}\\
D_2 &= 1 \text{ if } 8{:}40{:}00 \leq t \leq 8{:}44{:}59, \text{ 0 otherwise;}\\
D_3 &= 1 \text{ if } 9{:}30{:}00 \leq t \leq 9{:}34{:}59, \text{ 0 otherwise;}\\
D_4 &= 1 \text{ if } 9{:}35{:}00 \leq t \leq 9{:}39{:}59, \text{ 0 otherwise;}\\
D_5 &= 1 \text{ if } 13{:}30{:}00 \leq t \leq 13{:}34{:}59, \text{ 0 otherwise;}\\
D_6 &= 1 \text{ if } 13{:}35{:}00 \leq t \leq 13{:}39{:}59, \text{ 0 otherwise;}\\
D_7 &= 1 \text{ if } 14{:}30{:}00 \leq t \leq 14{:}34{:}59, \text{ 0 otherwise;}\\
D_8 &= 1 \text{ if } 14{:}35{:}00 \leq t \leq 14{:}39{:}59, \text{ 0 otherwise;}\\
D_9 &= 1 \text{ if } 16{:}00{:}00 \leq t \leq 16{:}04{:}59, \text{ 0 otherwise;}\\
D_{10} &= 1 \text{ if } 16{:}05{:}00 \leq t \leq 16{:}09{:}59, \text{ 0 otherwise.}
\end{aligned}
$$

Foster and Viswanathan, CCS, and Chan, Chung, and Johnson (1995) focus on the differences between the opening and closing periods and the midday period. In Eq. 3, the statistical significance of each circumstance over the floor trading day is tested by the corresponding dummy variables. That is, in a time sequence, D_1 and D_2 account for the 10-minute period of LIFFE open, D_3 and D_4 the U.K. macroeconomic news, D_5 and D_6 the U.S. macroeconomic news, D_7 and D_8 the U.S. stock markets open (NYSE and Nasdaq, 9:30 New York time), D_9 and D_{10} the LIFFE close. D_7 and D_8 are added because Werner and Kleidon (1996) report that NYSE order flow conveys information into LSE stock prices.

Regression 3 is estimated with Newey-West (1987, 1993) heteroskedasticity- and autocorrelation-consistent (HAC) covariance matrix. Adding a dummy variable in Eq. 3 and the regressions in the following section to account for Mondays and days-after-holidays do not change the results qualitatively. To allow for contemporaneous correlations between spreads, volatility, and volume, the paper also uses the seemingly unrelated regression (SUR) models with autoregressive terms selected by the Akaike information criterion (AIC).

Panel A of Table II presents the Newey-West HAC estimates of the intraday variations in spread, volatility, and volume. Since the sample size (45,409) is large, a more conservative significance level, 1%, is used. (Connolly, 1989, among many others, emphasizes that the significance level should be adjusted downward with sample size.) The results match the intraday patterns plotted.

The two dummy variables for the first two intervals (D_1 and D_2) of spread are significantly negative, suggesting spreads are narrow at the open. D_1 and D_2 in the volatility and volume equations are significantly positive; i.e., traders trade actively at the open. The two dummy variables (D_9 and D_{10}) for the last two intervals of spread, volatility, and volume are significantly negative, positive, and positive, respectively. The dummy variables for the U.K. news intervals (D_3 and D_4) of spreads are insignificant, whereas the dummy variable for the U.S. news interval (D_5, but not D_6) is significantly positive. The U.S. news interval also gives significantly positive volatility and volume. The dummy variables for the U.S. stock markets open (D_7 and D_8) are not significant in the spread equation. As shown in Panel B of Table II, the SUR results are similar to the Newey-West HAC estimates.

INVENTORY RISK TRANSFERRING AT THE OPEN AND CLOSE

Brock and Kleidon (1992) assert that much of the trading at the beginning and end of the trading day stems from the inability to trade when the market is closed. Gerety and Mulherin (1992) extend the insights of

TABLE II

Estimates of Variations in Spread, Volatility, and Volume

$$X_t = a_0 + \sum_{j=1}^{10} a_j D_j + e_t,$$

where X_t is the variable (spread, volatility, or volume) being examined, and D_j's are dummy variables.

	Time-Weighted Proportional Spread		*Range Volatility*		*Volume*	
Panel A: Newey-West (1987) Heteroskedasticity- and Autocorrelation-Consistent Covariance Matrix						
Constant	0.0340	(370.6)	0.063	(108.7)	69.17	(77.28)
D_1	−0.0033	(−11.24)	0.127	(38.18)	271.6	(38.78)
D_2	−0.0018	(−6.17)	0.061	(25.36)	115.3	(17.44)
D_3	−0.86e-4	(−0.24)	0.034	(11.50)	30.12	(6.90)
D_4	−0.58e-3	(−1.94)	0.018	(7.67)	29.17	(5.46)
D_5	0.0022	(3.41)	0.046	(8.22)	34.81	(5.37)
D_6	0.12e-3	(0.25)	0.012	(4.14)	13.58	(2.60)
D_7	0.38e-3	(0.95)	0.010	(4.59)	2.89	(0.88)
D_8	−0.20e-3	(−0.55)	0.021	(8.60)	16.31	(4.49)
D_9	−0.0018	(−6.42)	0.026	(11.70)	54.82	(10.81)
D_{10}	−0.0041	(−16.49)	0.042	(17.97)	134.9	(22.02)
Panel B: SUR with Autoregressive Terms (26 Lags for Spreads, 19 for Range, 16 for Volume)						
Constant	0.0070	(21.80)	0.013	(26.96)	18.94	(26.48)
D_1	−0.0025	(−6.39)	0.108	(54.01)	229.6	(59.06)
D_2	−0.82e-3	(−2.06)	0.020	(9.59)	32.82	(8.18)
D_3	0.27e-3	(0.67)	0.020	(9.64)	9.72	(2.42)
D_4	−0.26e-3	(−0.66)	0.42e-3	(0.20)	5.85	(1.46)
D_5	0.0019	(4.70)	0.066	(32.94)	59.75	(15.49)
D_6	−0.55e-3	(−1.40)	0.016	(8.19)	24.25	(6.27)
D_7	−0.22e-3	(−0.55)	0.017	(8.42)	14.46	(3.74)
D_8	−0.76e-3	(−1.91)	0.23	(11.48)	23.82	(6.17)
D_9	−0.0016	(−4.00)	0.012	(6.14)	38.50	(9.99)
D_{10}	−0.0037	(−9.39)	0.027	(13.23)	113.4	(29.43)

The statistical inference of the intraday pattern results is examined by the equation above based on Foster and Viswanathan (1993). The statistical significance of each circumstance over the day is tested by the corresponding dummy variables. That is, in time sequence, D_1 and D_2 account for the 10-minute period of LIFFE open, D_3 and D_4 the U.K. macroeconomic news, D_5 and D_6 the U.S. macroeconomic news, D_7 and D_8 the NYSE open, D_9 and D_{10} the LIFFE close.

Panel A presents the results using the Newey-West (1987) heteroskedasticity- and autocorrelation-consistent (HAC) covariance matrix. To allow for contemporaneous correlations between spreads, volatility, and volume, Panel B uses the seemingly unrelated regression (SUR) model with autoregressive terms selected by the AIC. t-statistics are reported in parentheses.

Brock and Kleidon by arguing that investors are transferring the risk of holding a position while the market is closed. According to this argument, volume at the close should be directly related to the volatility expected to occur overnight. The same expected volatility that induces trading volume at the close will also be related to the volume at the open due to recontracting between scalpers (and day traders) and other investors. Thus, opening volume should be directly related to the expected overnight volatility. Moreover, the higher unexpected overnight volatility, the higher the investors' demand for rebalancing portfolios at the open, and, consequently, the higher the volume at the open. Owing to scalpers' active trading at the open and close, the Gerety and Mulherin (1992) predictions should be significantly revealed in the futures markets.

The paper closely follows the three-step approach of Gerety and Mulherin (1992). The first two steps derived from Schwert (1990) extract the overnight expected and unexpected volatilities. The first step is to estimate and iterate the following regressions:

$$r_i = a_0 + \sum_{j=1}^{10} a_j D_j + \sum_{k=1}^{p} b_k r_{t-k} + \varepsilon_i \tag{4a}$$

$$|\varepsilon_i| = c_0 + \sum_{j=1}^{10} c_j D_j + \sum_{k=1}^{p} d_k |\varepsilon_{i-k}| + \eta_i, \tag{4b}$$

where r_i is the interval (log) futures price change during the floor trading, including the overnight price change. The lag length p Equation (4a) is set equal to 4, and the lag lengths in Eqs. (4b) and (5) below are 19, as chosen by the AIC. Virtually identical results are given for $p = 10$ and 20. In the second step, the normalized absolute residuals, $\sigma_i = (\pi/2)^{1/2} |\varepsilon_i|$, from Eq. (4a) are used:

$$\sigma_i = f_0 + \sum_{j=1}^{10} f_j D_j + \sum_{k=1}^{p} g_k \sigma_{i-k} + u_i, \tag{5}$$

where σ_t is also the estimate of the standard deviation at interval i. The predicted values from Regression 5 are the expected volatility, $\sigma_{e,\,t}$, and the residuals are the unexpected volatility $\sigma_{u,t}$.

Step 3 examines the relationships between (i) the closing volume, $VOL_{c,n}$, on day n and the overnight expected volatility, $\sigma_{e,n}$, and overnight unexpected volatility, $\sigma_{u,n}$, and (ii) the opening volume, $VOL_{o,n+1}$, on day $n + 1$ and overnight expected and unexpected volatilities.

$$VOL_{c,n} = \alpha_0 + \alpha_1 \sigma_{e,n} + \alpha_2 \sigma_{u,n} + \alpha_3 r_n + \alpha_4 |r_n| + \zeta_n \tag{6}$$

$$VOL_{o,n+1} = \beta_0 + \beta_1 \sigma_{e,n} + \beta_2 \sigma_{u,n} + \beta_3 r_{n+1} + \beta_4 |r_{n+1}| + \xi_{n+1},$$

The futures price changes (and absolute changes) at the close and open intervals, r_n and r_{n+1}, respectively, are also included. To avoid the problem of block trade, the number of trades, *NTRADE*, is also used as dependent variable of Eq. 6. The coefficients of α_1, β_1, and β_2 should be significantly positive, while α_2 should be insignificantly different from zero.

Panel A of Table III shows that trading volume and the number of trades at the closing interval are directly related to expected overnight volatility/information. In Panel B, volume and the number of trades at the open are directly related to the expected and unexpected volatility from the previous overnight period. Hence, all the results of Table III are consistent with Gerety and Mulherin's (1992) argument.

Because both $\sigma_{e,n}$ and $\sigma_{u,n}$, in Eq. (6) are estimated from Eqs. (4) and (5), the results may suffer from measurement errors or errors-in-variables. The Hausman (1978) specification error test using the method of instrumental variables (Wald's grouping and Durbin's ranking procedures) reported in the last two rows of each panel provide no evidence of mis-specification induced by these errors. (See econometric textbooks, e.g., Fomby, Hill, and Johnson, 1984, and Greene, 1997, for detailed description for this approach.

CONCLUSIONS

Although extensive research has been conducted on the market microstructure of stock and options markets, few researchers have studied the stock index futures markets because of the lack of transaction bid-ask quotes and volume. This article investigates the microstructure of the LIFFE FT-SE 100 Index futures contracts by examining intraday patterns in spreads and trading activity for 1995 and 1996. Results of the current paper may provide a better understanding of the microstructure of an open outcry system (a freely competitive environment) and the transaction demand for immediacy.

Market making and order flow mechanisms in index futures markets differ from other securities markets through an absence of designated marketmakers and negligible private information and agency market power. Moreover, futures traders bear low inventory risk, except at the close and when U.S. news is announced, and they find it easy to control inventory. As a result, the intraday patterns of spreads and trading activity of futures markets are different from those of stock and options markets. Spreads of FT-SE futures are stable over the day, but decline sharply near the close and increase abruptly at the U.S. macroeconomic news interval. Traders also actively trade at the open with narrow spreads and large trade size. In particular, over a given trading day, scalpers are eager to trade at the volatile and profitable opening and closing intervals, when investors have a great desire to rebalance their portfolios. Hence, scalpers are will-

TABLE III

Relationship between Open and Close Volume/Number of Trades and Overnight Expected and Unexpected Volatilities

$$VOL_{c,n} = \alpha_0 + \alpha_1\sigma_{e,n} + \alpha_2\sigma_{u,n} + \alpha_3 r_n + \alpha_4|r_n| + \zeta_n$$

$$VOL_{o,n+1} = \beta_0 + \beta_1\sigma_{e,n} + \beta_2\sigma_{u,n} + \beta_3 r_{n+1} + \beta_4|r_{n+1}| + \xi_{n+1},$$

where $VOL_{c,n}$ is the closing volume on day n, $VOL_{o,n+1}$ is the open volume on day $n+1$, $\sigma_{e,n}$ is the overnight expected volatility, and $\sigma_{u,n}$ is the overnight unexpected volatility.

Panel A: Closing Volume and Closing Number of Trades

	$VOL_{c,n}$		$NTRADE_{c,n}$	
α_0	−451.0	(−2.53)	−18.1	mode.(−2.02)
α_1	2178.2	(3.63)	148.4	(4.88)
α_2	8.16	(0.25)	1.07	(1.04)
α_3	119.7	(1.57)	−0.54	(−0.11)
α_4	−193.7	(−1.41)	7.61	(0.82)

Haussman specification test of errors-in-variables

	Statistic, $\chi^2(5)$	*P*-value	Statistic, $\chi^2(5)$	*P*-value
Wald	6.61	0.25	1.72	0.88
Durbin	7.86	0.16	0.68	0.98

Panel B: Opening Volume and Opening Number of Trades

	$VOL_{o,n+1}$		$NTRADE_{o,n+1}$	
β_0	−161.2	(−1.09)	3.34	(0.33)
β_1	1594.4	(3.28)	109.7	(3.35)
β_2	167.7	(4.72)	8.55	(4.06)
β_3	−154.4	(−2.37)	−1.20	(−0.34)
β_4	151.2	(1.71)	18.75	(3.26)

Haussman Specification Test of Errors-in-Variables[a]

	Statistic, $\chi^2(5)$	*P*-value	Statistic, $\chi^2(5)$	*P*-value
Wald	5.33	0.37	3.04	0.69
Durbin	2.89	0.72	1.11	0.95

This table reports the results of the Gerety and Mulherin (1992) model, which argues that investors are transferring the risk of holding a position while the market is closed. According to this argument, volume at the close ($VOL_{c,n}$) and open ($VOL_{o,n+1}$) should be directly related to the volatility expected to occur overnight ($\sigma_{e,n}$), and volume at the open increases with unexpected overnight volatility ($\sigma_{u,n}$). Therefore, the coefficients of α_1, β_1, and β_2 should be significantly positive, while α_2 should be insignificantly different from zero. To avoid the problem of block trade, the number of trades, *NTRADE*, is also used as the dependent variable. The *t*-statistics are reported in parentheses.

Since both $\sigma_{e,n}$ and $\sigma_{u,n}$ are estimated from previous equations, the results may be suffer from measurement errors or errors-in-variables. The Hausman specification error test using the method of instrumental variables (Wald's grouping and Durbin's ranking procedures) reported in the last two rows of each panel provide no evidence of misspecification induced by these errors.

ing to post narrow spreads to attract order flows at the open and close. Near the close, the spreads are further tightened by the tendency of scalpers and day traders to avoid holding overnight inventory. This article also shows that investors are transferring the risk of holding a position while the market is closed, as argued by Gerety and Mulherin (1992).

FT-SE Index futures prices are significantly driven by U.S. macroeconomic news. Although all traders in the pits have the same access to public information, they may differ in their interpretation of the information or may have different ability to process information. Because U.S. macroeconomic news may change the futures prices significantly, scalpers quote a wide spread to avoid unwanted inventory.[16]

In sum, the intraday patterns in bid-ask spreads and trading activity of index futures markets are affected by the open outcry system and U.S. news. The overall results are also broadly consistent with the Grossman and Miller (1988) model that describes liquidity as the price of transaction demand for immediacy.

Appendix

U.K. and U.S. Macroeconomic News in the Fourth Quarter of 1995

U.K. News Announcements

Date	*Time*	*Event*
951002	730	Purchasing Manager Index
951002	930	Provisional MO
951003	930	Consumer Credit
951003	930	Final M4
951006	930	Industrial Production
951006	930	Manufacturing Production
951009	930	Producer Prices
951012	930	Retail Prices
951017	930	PSBR
951018	930	Retail Sales
951018	930	Unemployment
951018	930	Underlying average earnings
951018	930	Unit labor costs
951019	930	Provisional M4
951019	930	Provisional M4 lending
951019	930	B. Soc New Commitments
951020	930	Non EU Trade
951023	930	GDP
951024	1130	CBI Industrial Trends Survey
951106	930	Industrial Production
951106	930	Manufacturing Production
951110	1230	CBI Distributive Trades

[16]As suggested by an anonymous referee, some traders may trade very fast on news announcements, like the SOES bandits on Nasdaq, causing spreads to widen for information reasons. See Battalio, Hatch, and Jennings (1997) and Harris and Schultz (1997) for detailed analysis of SOES trading.

Appendix Continued

U.K. and U.S. Macroeconomic News in the Fourth Quarter of 1995

U.K. News Announcements Date	Time	Event
951120	930	B. Soc New Commitments
951120	930	GDP Expenditure
951120	930	M4 (Provisional)
951120	930	M4 Lending (Provisional)
951121	930	Non-EU Trade
951124	1130	CBI Monthly Trends Survey
951204	930	M0
951204	930	Official reserves
951205	930	Housing Starts
951206	930	Industrial Production
951206	930	Manufacturing
951206	930	yoy
951206	n.a.	Gilt Auction
951207	1230	CBI Distributive Trades Survey
951218	930	PSBR
951220	930	Non-EU Trade
951221	930	Balance of Payments
951221	930	GDP
951222	930	Stock & Capital Expenditure
U.S. News Announcements		
951002	830	Personal Income
951002	1000	NAPM Survey
951002	1000	Construction Spending
951004	830	Leading Indicators
951004	1000	Factory Inventories
951006	830	Employment
951006	n.a.	Installment Credit
951012	830	Producer price Index
951013	830	Retail Sales
951013	830	Consumer Price Index
951016	1000	Business Inventories
951017	915	Industrial Production
951018	830	International Trade
951019	830	Housing Starts
951023	n.a.	Federal Budget
951025	845	Existing Home Sales
951026	830	Durable Goods Orders
951027	830	Gross Domestic Product
951030	830	Personal Income
951031	830	Employment Cost Index
951031	1000	New Home Sales
951031	1000	Consumer Confidence
951101	830	Leading Indicators
951101	1000	NAPM Survey
951101	1000	Construction Spending
951103	830	Employment
951107	1000	Productivity and Costs
951107	1500	Installment Credit
951109	830	Producer price Index
951114	830	Retail Sales
951115	n.a.	FOMC Meeting
951115	830	Consumer Price Index
951115	915	Industrial Production

Appendix Continued

U.K. and U.S. Macroeconomic News in the Fourth Quarter of 1995

U.S. News Announcements

Date	*Time*	*Event*
951115	1000	Business Inventories
951117	830	Housing Starts
951121	830	International Trade
951122	1400	Federal Budget
951124	830	Unemployment Claims
951127	845	Existing Home Sales
951128	830	Housing Starts
951128	1000	Consumer Confidence
951130	830	Durable Goods Orders
951201	1000	NAPM Survey
951206	1000	Construction Spending
951207	1000	Factory Inventories
951207	1500	Consumer Credit
951208	830	Employment
951208	1000	New Home Sales
951208	n.a.	GDP Revisions
951212	830	Producer price Index
951213	830	Retail Sales
951214	830	Consumer Price Index
951214	915	Industrial Production
951214	1000	Business Inventories
951219	830	Gross Domestic Product
951219	830	Housing Starts
951219	n.a.	FOMC Meeting
951220	830	International Trade
951221	830	Personal Income
951221	n.a.	Federal Budget

Source: *LIFEE Newsletter.*
Source: *Business Week.*

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