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ELECTRONIC TRADING IN HONG KONG AND ITS IMPACT ON MARKET FUNCTIONING

Key Points:

- *Electronic trading (ET) is rapidly gaining ground in financial markets, from organized exchanges to a wide variety of instruments in foreign exchange and fixed income markets, at both the wholesale inter-dealer markets as well as the retail markets. This global trend has also been observed in Hong Kong.*

- *The introduction of ET platforms has the potential to change the way the market functions. Such platforms increase the operational and informational efficiency of the market through reductions in transaction costs and improvement in market access and transparency. However, increased competition could reduce dealers' incentive to make markets and adversely affect market depth. The overall effect of ET on market liquidity is an unresolved issue.*

- *Our empirical study, based on intra-day transactable quote prices and trade data in the Hong Kong stock index futures market, finds evidence that ET helps to improve market liquidity by reducing bid-ask spreads, after controlling the effects of price volatility and trading volume. Furthermore, we find that bid-ask spreads widen under ET platform relative to floor-based trading system, when trading volume increases at time of market pressure. However, ET will under-perform floor-based system only under extreme market conditions.*

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I. INTRODUCTION

The use of electronic trading (ET) platforms expanded rapidly in recent years, from liquid and homogenous instruments on organized exchanges, such as stocks and futures to a wide variety of instruments in foreign exchange and fixed income markets, at both the wholesale inter-dealer markets as well as the retail markets. Leveraging on the advancement of technology and the proliferation of Internet, ET improves the functioning of the financial markets. It could increase operational efficiency in both centralized and fragmented markets, reduce transaction cost, improve market access, increase transparency, and facilitate cross-border 24-hour trading. However, ET could also pose challenges, especially during times of pressure. It could reduce dealer's margins, leading to fewer dealers and adversely affect the quality of dealer services in providing market liquidity. The reliance on electronic systems also raises concerns about operational risks due to system failures. As national borders become blurred in e-transactions, regulatory and supervisory authorities need to adapt to such changes.

This paper examines the recent emergence of ET platforms in Hong Kong, and discusses its likely impact on financial market functioning, drawing on recent studies by the BIS and others, and results from our empirical work. Based on intra-day transactable, firm quote prices and trade data in the Hong Kong stock index futures market, we find evidence that ET improves market liquidity by reducing bid-ask spreads, after controlling the effects of price volatility and trading volume. Furthermore, bid-ask spreads widen under ET when trading volume increases at time of market stress. As a result, this study shed some light on how market liquidity behaves under ET during normal times and under stress, which will help policy makers to further understand the information content of market indicators during the electronic age.

The rest of the paper focuses on two areas. Section II describes the characteristics of major trading platforms in Hong Kong in the over-the-counter (OTC) fixed income and foreign exchange markets, as well as in the stock market at the retail level. This will be discussed in a qualitative analytical framework. Section III focuses on the impact of ET on market functioning, and presents the empirical evidence on such impact in an organised exchange environment. Section IV concludes.

II. ELECTRONIC TRADING PLATFORMS IN HONG KONG

An ET system is a facility that provides some or all of the following functions—electronic order routing (the delivery of orders from users to the execution system), automated trade execution (the transformation of orders into trades), and electronic dissemination of pre-trade (bid offer quotes and depth) and post trade information (transaction price and volume data) (BIS, 2001).

ET systems differ from traditional systems, such as floor-based or telephone trading, in a number of ways. ET is location-neutral—users do not need to be at the same physical location, and allows continuous multilateral interaction (as telephone trading is bilateral). This facilitates cross border trading and cross-border co-operation of trading systems. Furthermore, ET has large room for economy of scale and reduction of operational costs, as it is cheap and easy to increase the trading capacity which tends to

encourage consolidation. Finally, ET allows straight-through-processing by easily integrating different parts of the trading process, starting from display of pre-trade information, to risk management.

Before discussing the impact of ET on market functioning, it is useful to review how markets are organised. Usually, trading is conducted in either exchange-based or over-the-counter (OTC) markets (Table 1). Centralised markets such as some of the stock and futures exchanges are order-driven with centralised order books. Market participants interact multilaterally and there is no negotiation within the system. In decentralised markets such as fixed income and derivatives markets, often referred to as OTC markets, markets are quote-driven and segmented into an inter-dealer and a dealer-to-customer market. Market participants interact bilaterally, and the price of large orders is negotiated.

Table 1. Key Features of Market Architectures

	Order book	*OTC market*
Access	No segmentation	Segmentation
Interaction	Multilateral	Bilateral
Price formation	Centralised, usually order-driven	Fragmented, quote driven
Dealers	Often present, but not necessary	Necessary for trade execution
Transparency	Potentially high	Limited
Anonymity	Usually anonymous	Not anonymous, but limited disclosure
Trading protocols	Standardised	Not standardised
Continuity	Continuous or periodic	Generally continuous

Source: BIS Report, 2001.

ET increases the operational efficiency in both centralised and fragmented markets. Automation of the trading process lowers order-processing costs, while the integration of the trading process makes straight-through-processing possible. It also reduces the search costs by automating the collection of pre-trade and post-trade information and increasing the amount and timeliness of information.

Fragmented markets become more centralised under ET through increased use of multi-dealer systems and moving towards order books. ET systems provide the technology to eliminate the intermediaries in segmented markets. Bilateral OTC relationship between dealers could be replaced by a centralised marketplace with better price discovery and transparency, while dealer to customer relationship could be moved from single-dealer to multiple-dealer systems. The speed of price information transmission from inter-dealer markets to customer markets will be improved.

ET is rapidly gaining ground in financial markets, from organized exchanges to a wide variety of instruments in foreign exchange and fixed income markets. This global trend has been observed in Hong Kong (Table 2). The migration of Hang Seng Index futures and options to the ET system in June 2000 made the Hong Kong Futures Exchange fully electronic (Box 1). ET systems have also been introduced in the inter-dealer and retail markets in bond and foreign exchange trading (Box 2 and 3).

Table 2. Major ET Platforms in Hong Kong

	Organised Exchanges	*OTC Markets*
Products traded	Stock and futures contracts	Fixed income and foreign exchanges
Major trading platforms	AMS/3 for stocks and HKATS for futures trading	ABP, BIA and BETS for bonds and Fxall, Reuters and EBS for foreign exchanges
Ownership	A listed company (went public in June 2000)	Shareholder-owned, mainly banks and information service providers
Date of introduction and implementation	Stocks: 1993 first introduced, fully electronic by Mar. 1997 Futures: 1995 first introduced, fully electronic by June 2000.	ABP: launched trading in Oct. 2000 BIA: July 2000 established, trading expected in 4th quarter 2001 BETS: established in Mar. 1999 in USA, started trading Hong Kong government bonds in Dec. 2000 by JPeX. Reuters: launched in 1992 EBS: launched in 1993 FXall: launched in May 2001
Price formation	Order-driven, with strict price and time priority	Quote-driven, multi-dealer trading platforms
Information dissemination	Timely and transparent, through Internet and information service providers	Timely and transparent, through Internet and/or private networks
Trading costs	Trading fee and tariff to the Exchange, brokerage fees to the brokers, and stamp duty.	ABP: Transaction fees and content subscription BIA: franchise and transaction fees Reuters, EBS: transaction fees BETS and FXall: no transaction fees

Sources: Hong Kong Exchanges and Clearing Limited, and various web-sites.

A list of Abbreviations:
AMS/3: the third generation of Automatic Order Matching and Execution System
HKATS: Hong Kong Futures Automated Trading System
ABP: AsiaBondPortal
BIA: BondsInAsia
BETS: Bloomberg Electronic Trading System
JpeX: J.P. Morgan eXpress
EBS: Electronic Brokering System

III. IMPACT OF ELECTRONIC TRADING ON MARKET FUNCTIONING

Through its impact on trading costs and market architecture, ET will have profound effect on market functioning and financial stability, in terms of market efficiency, liquidity, volatility, and resilience during times of stress (BIS, 2001). Reduced transaction costs and greater efficiency of ET facilitate trading, increase liquidity and reduce price volatility (Habermeier and Kirilenko, 2001). However, competition, in the form of lower costs and increased transparency by ET, reduces margins, leading to fewer dealers and reducing the amount of liquidity they provide. This also reduces the bargaining power of large market players to negotiate a better price for their positions. Multiple ET platforms emerged for trading stocks in the US leads to concerns about market fragmentation, in terms of the dispersal of trading (CRS report, 2000).

ET improves pricing information collection and transmission to market participants, which leads to better informational efficiency. As a result of improved transparency, market prices reflect better and faster available information about the fundamentals. However, the reduced number of dealers may reduce risk capital from the marketplace, and the provision of liquidity by dealers at times of stress. Information regarding the counter-party risk is more important during time of stress—the anonymous feature of many ET platforms may affect their performance during time of stress. As ET affects multiple factors that influence the informational and operating efficiency of the market, the impact of ET on market functioning and financial stability becomes an empirical question.

Since the operation of ET platforms in OTC markets (mainly in bond and foreign exchange trading) in Hong Kong has just started, and trading data are not readily available yet, we turn to the organised exchange for evidence on the impact of ET on market functioning. In this section, we study the bid-ask spreads, trading volumes and volatility of the HSI futures trading, before and after the transition to electronic systems on the Hong Kong Futures Exchange on June 5, 2000. The HSI futures contracts were introduced in May 1986. It is among the most heavily traded contracts in the world, with a daily trading volume of over 17,500 contracts at end-June 2001. Contracts for the spot month, the next two calendar months, and the next two quarterly months are available, with trading concentrated in the spot month contract till the day before it expires (on the business day prior to the last business day of the month).

In the literature, whether market liquidity is better in automated trading system or in the open-outcry markets in the organised exchanges remains a controversial issue (Table 3).[2] On the one hand, it is argued that automated trading systems are less liquid than open-outcry markets because automated systems cannot handle periods of intense trading as well as floor-traded systems. This is because automated systems have a higher degree of information asymmetry concerning the identity of the traders, and deprive liquidity providers such as locals and market-makers of some of their trading advantages. The delays in cancelling orders on the automated systems discourage the submission of limit orders as they are forced to offer free options with a duration longer than those on the floor-traded systems. This effect could be especially important during the period of

[2] For a detailed literature review on this topic, see Frino, McInish and Toner (1998), Tsang (1999) and Frino and Hill (2001).

intensive trading, a reflection of high information arrival. Automated systems can reduce human errors observed in the floor trading, but have experienced delays or system failure when faced with unusually large trading volume.

On the other hand, automated systems may enhance market liquidity because they are more cost effective than floor trading, which leads to higher volume traded. They also offer greater transparency of the order book on prices and volumes away from the best bid and ask, which can reduce information asymmetry and provide more information for market makers to manage their inventory exposure more effectively. This leads to a reduction in adverse selection costs and lower bid-ask spreads. Furthermore, trade and quote data are disseminated faster on an automated system, which encourages off-floor participants to provide liquidity.

Table 3. Comparison of Open Outcry and Automated Trading Systems

	Open Outcry Trading	*Electronic Trading*
Liquidity	Perceived to be inherently more liquid by some of the world's largest exchanges (CBOT, CME and NYSE)	Recent empirical studies found evidence that ET maybe better.
Immediacy	Orders are changed/cancelled faster, and price discovery maintained in market under stress.	Especially during market stress, order cancellation procedure may cause delays and discourage limit orders; system may slow down or fail.
Efficiency	Different prices may exist, orders may not fairly matched (front-running and curb-trading), with scope for human errors.	Transparent price discovery, reduce frauds and human errors
Cost	High fixed and operating costs	High development costs, low operating costs
Anonymity	Provide more information about counter-party	Adverse selection in block trades, limiting the growth of order size
Global Link	Segregated exchanges	24-hour, globally linked trading possible

Source: Adapted from Tsang (1999).

Empirical studies have been conducted to assess the effect of ET systems on market liquidity. Frino, McInish and Toner (1998) examined the trading of Bund futures on the floor-based open outcry London International Financial Futures Exchange (LIFFE) and the automated Deutsche Terminborse (DTB), which offered two different trading mechanisms operating at the same time for the same security. The paper investigated periods during which each exchange's share of total Bund trading was similar and found that bid-ask spreads (BAS) were wider on the LIFFE than the DTB, after controlling for trading activity and price volatility. It was also found that bid-ask spreads on the DTB were higher than LIFFE for a given level of volatility, after controlling for trading volumes. The results implies that ET systems are capable of providing higher

liquidity than open outcry, but the relative performance of ET systems deteriorates during periods of high price volatility. Hill (2000) examined intra-day trade and quote data for the nearest to maturity Share Price Index (SPI) futures contract traded on the Sydney Futures Exchange (SFE) for the period of September 30 to October 25, 1999, a total of 30 trading days around the beginning of ET of the contract on October 4, 1999. The study found that bid-ask spreads were significantly lower on the screen-traded system, compared to the previous open outcry markets. This implies that the screen-traded market structure facilitates higher levels of liquidity than the floor-traded market, highlighting the effect of automation on the efficiency of a futures market. Frino and Hill (2001) examined the transition of trading in stock index futures from open outcry to ET in the LIFFE, SFE and HKFE during 1999-2000. Quote and trade data 50 days prior to the introduction of ET and 50 days afterwards were examined. Similar results to the Frino, McInish and Toner (1998) study were found—ET reduced the bid-ask spreads across the three exchanges, but may increase spreads when price volatility is higher.

Table 4. Empirical Studies on the Effect of ET systems on Market Liquidity

	Frino, McInish and Toner (1998)	*Hill (2000)*	*Frino and Hill (2001)*	*Current study*
Market Studied	Bunds futures on LIFFE (open outcry) and DTB (automated)	SPI futures contract on SFE around the introduction of ET	Stock index futures on LIFFE, SFE, and HKFE around the transition to ET	HIS future contracts before and after the introduction of ET
Data	Intra-day trade and quote data during 14 Oct to 24 Nov. 1997—30 trading days, over 5-minute intervals	Intra-day trade and quote data during 30 Sept to 25 Oct 1999—30 trading days, over 15- minute intervals	Intra-day trade and quote data 50 days pre-ET and 50 days post-ET—100 trading days	Intra-day trade and quote data during July to Sept 1998, Jan to Apr 2000, and Feb to June 2001—232 trading days
Method	Descriptive statistics for mean and median bid-ask spreads (BAS) on DTB and LIFFE, and regression analysis.	Descriptive statistics for mean and median BAS, volume, and volatility.	Descriptive statistics for mean and median BAS, volume, and volatility, and regression analysis.	Descriptive statistics for mean and median BAS, volume, and volatility, and regression analysis.
Results	BAS are wider on the LIFFE than the DTB, after controlling for volume and price volatility. BAS on the DTB increase more rapidly as price volatility increases relative to the LIFFE.	BAS are found to be significantly lower on the ET system, compared to the previous open outcry system.	BAS are lower under the ET system across the three exchanges. However, BAS become wider in response to higher price volatility under ET, relative to floor trading.	BAS are significantly lower under ET, after controlling for volume and price volatility. BAS widen under ET, relative to floor trading, when trading volume is higher.

Sources: Papers by relevant authors.

Following the methodology used in the previous studies, we examined the intraday trade and quote data for the nearest to maturity HSI futures both before and after the introduction of ET on June 5, 2000.[3] The intra-day data is a record of the time and price of every trade and quote revision on the exchange, which are transactable. The use of the intra-day quote data avoids major shortcomings of the indicative quotes which are non-transactable prices, typically wider than the quoted spreads, and may be imprecise, especially during intensive trading as traders get too busy dealing to update their indications (Goodhart, Ito and Payne, 1995). The periods covered are from July 2—September 30, 1998, January 3—April 28, 2000, and February 1—June 29, 2001. Altogether, we have 136 observations before the introduction of ET, covering the period during the Asian Crisis, and 96 observations afterwards.

Bid-ask spreads (*BAS*) are used to measure market liquidity. Being a major part of trading costs, it is commonly used as an important indicator of the quality of the market functioning. Time-weighted, transactable bid-ask spreads are calculated in index points for each day t: $BAS_t = \sum_{i=1}^{n} BAS_i t_i \Big/ \sum_{i=1}^{n} t_i$, where t_i is the amount of time bid-ask spread i was alive on day t. Time-weighted percentage of bid-ask spreads are also calculated, with respect to the margin required to trade the futures contract.[4] Price volatility (*Volatility*) is calculated as the time-weighted standard deviation of the midpoint of the bid-ask quote P_i for each day t: $Volatility_t = \sqrt{\sum_{i=1}^{n} (P_i - \overline{P})^2 t_i \Big/ \sum_{i=1}^{n} t_i}$. The trading volume (*Volume*) is measured by the number of contracts traded (Charts 1-3).

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[3] We are grateful to Elton Cheng of the HKEX for providing the intraday HSI futures contract trade and quote data.

[4] The rationale for the calculation of percentage bid-ask spread in relation to the margin instead of the midpoint of the bid-ask quotes is that the price paid for the futures contracts is the margin, not the index levels.

Chart 1. Bid-Ask Spreads of HSI Futures Contracts

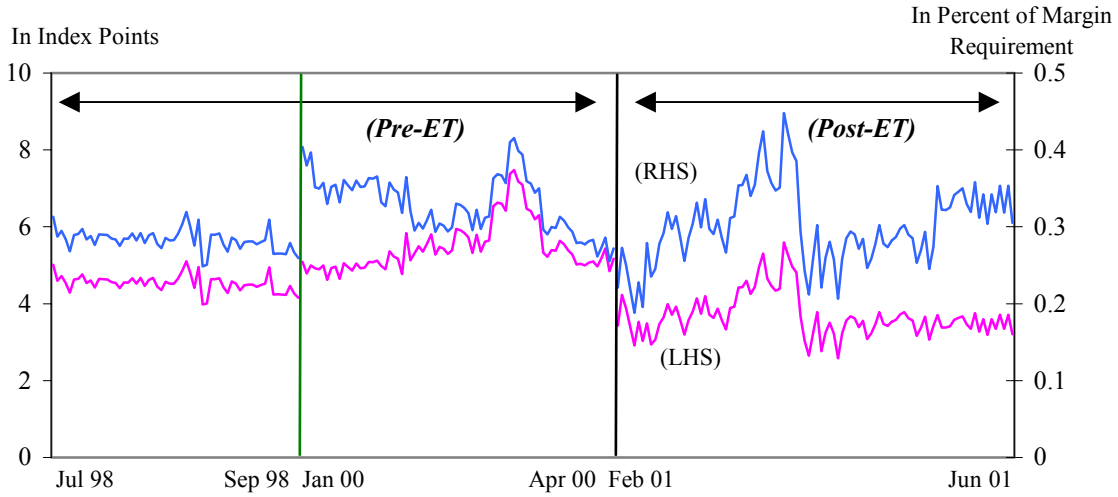


Chart 2. Price Volatility of HSI Futures Contracts

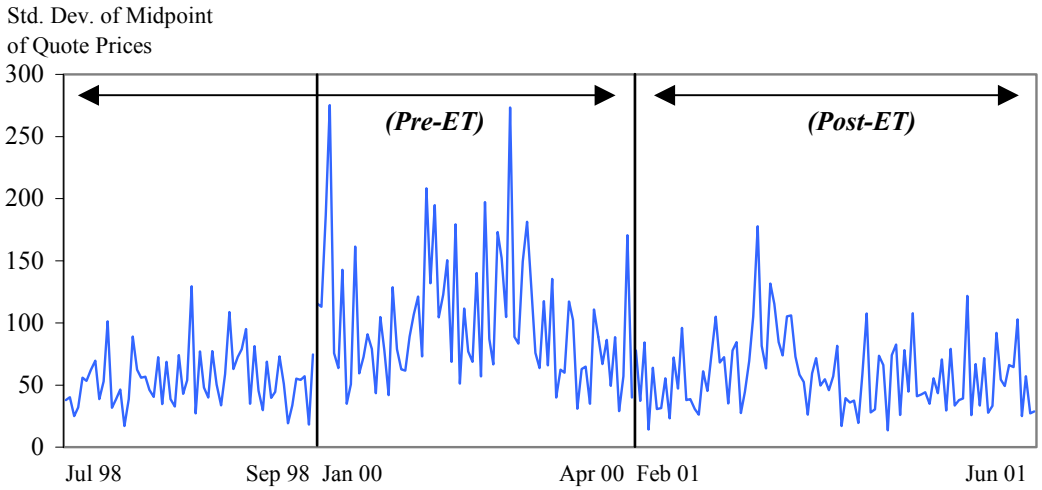
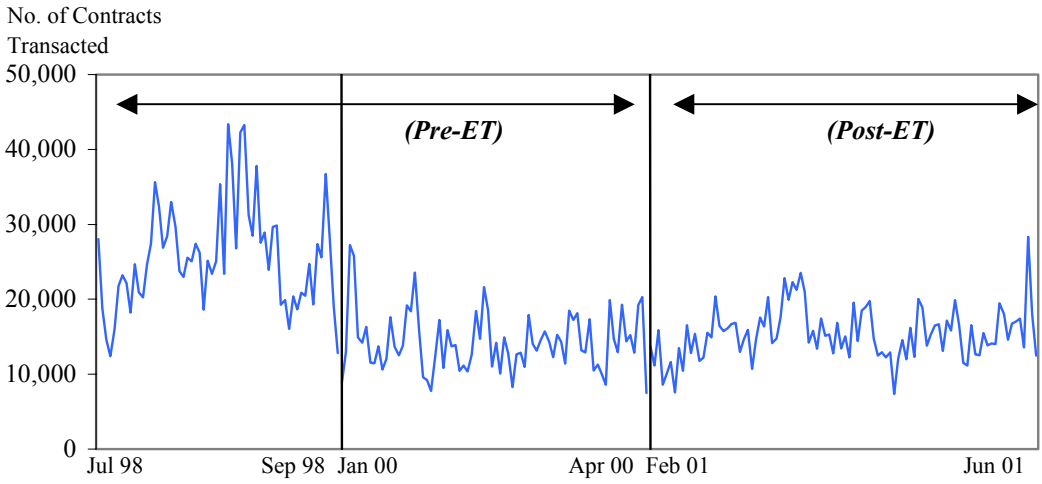


Chart 3. Volume of HSI Futures Contracts



Source: HKMA staff estimates.

Preliminary statistical analysis is conducted by comparing the average of bid-ask spreads before and after the introduction of ET on the HSI futures contracts, using parametric t-test for the mean and non-parametric Wilcoxon z-test for the median. This is followed by a more formal regression analysis, incorporating the main determinants of bid-ask spreads—trading activities and price volatility. Finally we test the whether the changes in futures trading volume and price volatility are owing to changes in the underlying cash markets or the introduction of the ET system. The results are presented in Tables 5—7.

Table 5 shows that average bid-ask spreads measured in index points are significantly lower after the introduction of the ET—by over 1 index point, compared to the floor trading. Though average bid-ask spreads measured as a percentage of the margin requirements are also lower, the differences are not significant. Determinants of the bid-ask spreads—price volatility and trading volume are also significantly lower during the post-ET period—which raise the question whether the lowering of bid-ask spreads is owing to the introduction of ET or to changes in their determinants.

Table 5. Liquidity, Volatility and Volume of HSI Futures Contracts, Pre- and Post- Electronic Trading

	Bid-Ask Spreads (Index Points)			Bid-Ask Spreads (Percentage)[1.]			Time-Weighted Volatility			Trading Volume		
	Pre-ET	Post-ET	*t/z*	Pre-ET	Post-ET	*t/z*	Pre-ET	Post-ET	*t/z*	Pre-ET	Post-ET	*t/z*
Mean	5.05	3.68	16.16 *	0.31	0.30	1.34	80.40	58.75	3.90 *	19,335	15,406	4.56 *
Median	4.94	3.58	11.58 *	0.30	0.30	1.12	67.63	55.30	3.50 *	18,195	15,201	3.28 *
Std. Dev.	0.68	0.56		0.04	0.05		48.28	29.66		7,919	3,478	
n	136	96		136	96		136	96		136	96	

Source: HKMA staff estimates.

* Significant at the 1 percent level.

1. Bid-ask spreads expressed as a percentage of the margin required for the futures contract.

To assess the impact of ET on bid-ask spreads, the following model is specified to control for differences in the determinants of bid-ask spreads before and after the introduction of ET:

$$BAS_t = \alpha + \beta_1 ET + \beta_2 Volatility + \beta_3 \sqrt{Volume} + ET \times (\beta_4 \sqrt{Volume} + \beta_5 Volatility) + \varepsilon_t$$

The impact of ET is represented by a dummy variable (*ET*) that is 0 for pre-ET observations, and unity otherwise. The square root of trading volume is for reducing the effect of outliers, consistent with McInish and Wood (1992). The interactive term between ET and trading volume is included to capture the incremental effect of ET on bid-ask spreads of trading volume, after controlling for changes in price volatility and trading volume. A similar interactive term between ET and volatility is also included.

There are two major findings in Table 6: first, ET reduces bid-ask spreads (measured in index points as well as in percent of margin requirements), after controlling for the effect of price volatility and trading volume. Second, the coefficient on the interactive term between ET and trading volume is positive, indicating that higher trading volume will increase bid-ask spreads under ET, other things being equal. Chart 4

illustrates the relationship between bid-ask spreads with trading volume, pre- and post-ET, controlling for the effect of price volatility. During the pre-ET period, higher trading volume tends to lower bid-ask spreads, consistent with the common belief. In the post-ET period, higher trading volume actually raises the bid-ask spreads. However, the combined effect of the introduction of ET (which lowers the bid-ask spreads) and the interaction of ET and higher trading volume (which raises the bid-ask spreads) is to lower the bid-ask spreads during the sample period, which includes high trading volume observed during the Asian Crisis (over 40,000 contracts traded daily on a few dates, compared to an average of around 17,500 contracts daily in normal times). This implies that only under extraordinary trading volumes, ET will lead to higher bid-ask spreads, compared to the floor-based system.

All coefficients are highly significant, except the one on the interactive variable between ET and volatility. To address potential problems with serial correlation, Newey-West adjusted t-statistics are used to assess the significance of the estimated coefficients. Regressions with lagged independent variables yield similar results, indicating that our estimates are not affected by the possible endogeneity of the right-hand side variables, as current bid-ask spreads are unlikely to affect the past trading volume and volatility.

Table 6: Effects of Electronic Trading on Bid-Ask Spreads of HSI Futures Contracts

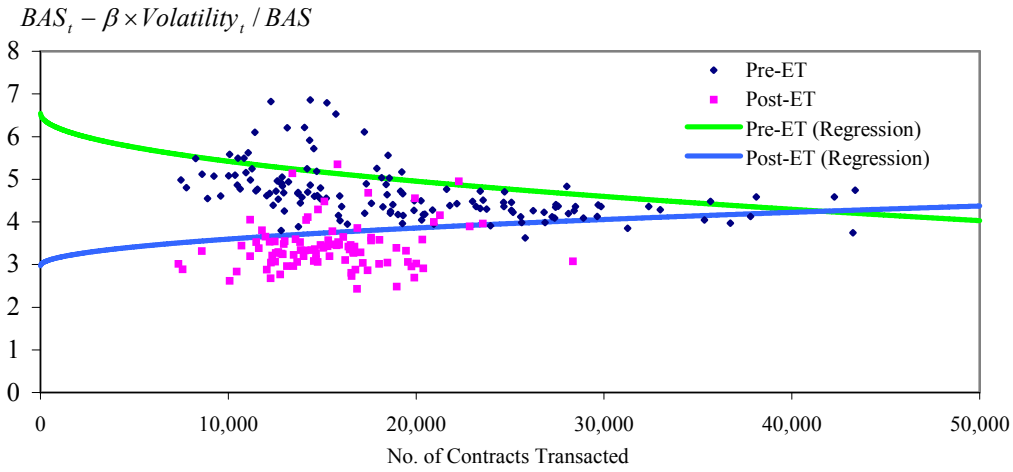
	Coefficient	Newey-West Adjusted *t*-statistics	Coefficient	Newey-West Adjusted *t*-statistics
			(Lagged Independent Variables)	
Bid-Ask Spreads (in Index Points)				
Constant	6.21	18.89 *	6.22	20.68 *
Electronic Trading	-3.59	-4.81 *	-3.69	-6.65 *
Sqrt(Volume)/1000	-11.25	-5.25 *	-11.86	-6.00 *
Volatility/1000	4.74	3.37 *	5.62	3.59 *
ET*Sqrt(Volume)/1000	17.70	2.69 *	18.41	3.86 *
ET*Volatility/1000	-0.20	-0.08	0.23	0.09
Adj. R2		0.66		0.69
F-statistics		89.66		103.48
n		232		231
Bid-Ask Spreads (in percent of margin requirements)				
Constant	0.36	18.47 *	0.37	20.11 *
Electronic Trading	-0.20	-2.81 *	-0.23	-4.43 *
Sqrt(Volume)/1000	-0.50	-4.17 *	-0.60	-5.09 *
Volatility/1000	0.26	3.41 *	0.26	3.33 *
ET*Sqrt(Volume)/1000	1.58	2.50 **	1.75	3.98 *
ET*Volatility/1000	-0.04	-0.18	0.03	0.15
Adj. R2		0.19		0.25
F-statistics		12.04		16.62
n		232		231

* Significant at the 1 percent level.

** Significant at the 5 percent level.

Source: HKMA staff estimates.

Chart 4. Relationship Between Bid-Ask Spreads And Trading Volume



Source: HKMA staff estimates.
Notes: The volatility is held at the sample average for the regression.

We further examine whether declines in price volatility and trading volume observed after the introduction of ET system are owing to changes in the fundamental market conditions or the change in trading system. Following the methodology used in Frino and Hill (2001), we compare the price volatility and trading volume of the HSI futures contract with those of the HSI, as the transition to the ET system only happened in the futures exchange, with no effect on the cash market. Given the availability of comparable data on the cash and futures HSI markets, price volatility is measured by the high-low volatility metric and the trading volume of HSI is measured by an estimated contract turnover, derived from the value turnover data.[5]

Table 7 shows that price volatility of both the HSI cash index and the futures contracts declined significantly after the introduction of the ET in the futures exchange. However, the difference in price volatility between HSI index and futures contracts does not change significantly during the floor and ET periods. This result shows that the changes in the price volatility in the HSI futures market is similar to the changes in the cash HSI market, implying that the introduction of ET system in the futures market is not likely to affect price volatility. Similar results were found for trading volume in both the HSI cash and futures markets (in log), which declined significantly after the introduction of the ET, with no significant changes in the difference of volumes between HSI cash index and futures contracts across the pre- and post-ET periods. In sum, declines in price volatility and trading volume in HSI futures contracts observed after the introduction of ET system are owing to changes in the fundamental market conditions, not the change in trading system.

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[5] Volatility is defined as $(\ln H - \ln L)^2 / (4n \ln 2)$, where H and L are the daily high and low prices, respectively. Contract turnover is defined as value turnover/(50*HSI closing index points), as each index point is valued at HK$50 for HSI futures contracts.

Table 7: Volatility And Volume in the HSI Cash and Futures Contracts, Pre- and Post- Electronic Trading

	Changes in Volatility (x 10^6)			Changes in Trading Volume (in log x 10^2)		
	Stock Index	Future	Stock - Futures	Stock Index	Future	Stock - Futures
Mean	0.43	0.47	-0.04	6.60	7.54	-0.94
Median	0.26	0.28	-0.03	6.08	7.81	-0.79
t	5.62 *	4.89 *	0.86	3.31 *	3.85 *	0.48
z	8.15 *	6.71 *	1.64	2.78 *	3.28 *	0.38
n	232	232	232	232	232	232

* Significant at the 1 percent level.

Source: HKMA staff estimates.

Our results are similar to what has been found by other studies. However, this study covers a longer period of time, and includes observations during the Asian Crisis, during which intensive trading activities were present. While previous studies found that the performance of ET systems deteriorates during high price volatility, our results shows that intensive trading (measured by volume) might pose challenge to the functioning of ET systems, but only under extreme market conditions that ET will under-perform floor-based trading. These results could be potentially mutually consistent as a period of market pressure could be characterised by either price volatility or intensive trading, or both. Possible explanations for the deterioration of performance of the ET system during market pressure could be that when the market is under pressure, information intensity is high. During a period of intensive information arrival, the information contained in the electronic order book on prices and volumes away from the best bid and ask is of little value, while the delays in cancelling orders on an automated system may discourage the submission of limit orders. In addition, the higher degree of anonymity of the trading parties may lead to greater concerns about counter-party risks under ET during market pressure.

IV. CONCLUSIONS

ET is a global trend in the international financial markets. Early evidence based on the relative performance of exchange-based ET systems and floor trading has shown that the impact of ET on market functioning is likely to be positive. In particular, it is likely to improve transparency and liquidity of the markets. The performance of ET systems deteriorates during times of market pressure with high price volatility or large trading volumes, however only during extreme market conditions will ET under-perform the floor-based trading.

Further study will be needed to test the robustness of our results, by examining data over a longer period, or taking into consideration of inter-day volatility, in addition to intra-day volatility. We also need to deepen our understanding of the effect of ET systems on market functioning, not only in the organised exchanges, but also in OTC markets when data become available. Further study on the performance of the ET system under market pressure and underlying factors will also be useful.

Box 1. ET Systems in Organised Exchanges in Hong Kong

Hong Kong has one of the most active stock and futures markets in the Asia Pacific region. The stock market is the third largest in terms of market capitalisation after Japan and the mainland China, and the Hang Seng Index futures contract is among the most heavily traded contracts in the world, with a daily trading volume of over 17,500 contracts at end-June 2001.

Securities are traded through a computerised Automatic Order Matching and Execution System (AMS) on the Stock Exchange of Hong Kong. The AMS system was first introduced in 1993, and all listed stocks were traded under the system by March 1997. AMS is an order-driven system that accepts limit, enhanced limit and special limit orders. Trading is conducted through terminals in trading halls or through the off-floor trading devices at Exchange participants' offices. Orders are executed in strict price and time priority. Order and trade information is disseminated to the market and investors through the Teletext system, market data feed, and the Exchange's website and other information systems. The third generation of the AMS (AMS/3) is a trading system developed by the Stock Exchange of Hong Kong and was launched in October 2000. The Order Routing System under the AMS/3 enables investors to place trading requests electronically over the Internet and other access channels (such as mobile phones).

The Hong Kong Futures Exchange (HKFE) has become a fully electronic marketplace since June 2000. It introduced ET in 1995, using the Automated Trading System (ATS). Rolling Forex—a currency futures product—was the first product traded on ATS. HIBOR futures was migrated to ATS in September 1997, leaving HSI futures and options contracts the only two products traded on the floor. The ATS was upgraded to a new electronic screen-based trading system—Hong Kong Futures Automated Trading System (HKATS) in April 1999 to prepare for the migration of HSI futures and options contracts to HKATS, which was completed in June 2000. Under the HKATS, the HKFE operates the central marketplace and subscribing Exchange participants can directly access the market through computer terminals in their offices. The HKATS automatically match order in the system based on a price/time priority mechanism. The execution of orders can be made immediately. HKATS allows brokers to provide straight-through processing and real-time Internet trading.

With rapid technological advances and growing demand for more efficient trading environment, most brokerage houses and banks in Hong Kong offer online stock trading to retail investors. While Boom Securities, a Hong Kong-based stockbroker, was the first company to offer online trading in Hong Kong-listed companies in 1998, an increasing number of brokers and banks have been providing online stock trading facilities to clients over the past couple of years. These e-brokers, such as Tai Fook Securities, Prudential Brokerage, KGI Securities, 2cube Securities, HSBC Broking Sevices, Citibank, Wing Hang Bank, and Citic Ka Wah Bank, provide clients a wide range of services, including real-time quotes, market analysis, trade execution, and monitoring of account portfolios from a single point of access. While most e-brokers offer online trading facilities in Hong Kong listed securities, some also

offer trading in US securities as well as securities from other overseas markets such as Singapore, Taiwan, Thailand and Korea. With the implementation of the Order Routing System (ORS) to the Automated Order Matching and Execution System (AMS/3) by the Hong Kong Exchanges and Clearing Ltd. (HKEx) in February 2001, investors are able to place orders through Internet to brokers for approval and submission to the market. In this regard, given that the broker systems are connected to the ORS, securities orders can be passed electronically and directly from brokers to the Stock Exchange, thereby eliminating human intervention. This helps to shorten the time for trade execution and to reduce costs. While online stock trading provides convenient and efficient services to investors, the commission charges of some of these e-brokers are even lower than that of traditional full-service brokers. For instance, the commission charges of some e-brokers are 0.15% or below on transaction amount, much lower than the average 0.25% of traditional full-service brokers. Study has shown that lower transaction costs have positive effects on price discovery, volatility and liquidity, leading to improvement in the informational efficiency of markets (Habermeier and Kirilenko, 2001).

Box 2. Major ET platforms in the Fixed Income Market in Hong Kong

The main electronic bond trading platforms that cover Hong Kong dollar debt instruments include AsiaBondPortal, BondsInAsia, and Bloomberg. These portals provide ET platforms for institutions to complete fixed-income deals and offer other services such as market research and information.

2. AsianBondPortal

AsianBondPortal (ABP), a Hong Kong-based multi-dealer on-line trading system for Asian debt instruments, was officially launched in October 2000. ABP is an alliance between ABN Amro, Bank of America, Commonwealth Bank of Australia, Credit Suisse First Boston, Daiwa Securities SMBC, Deutsche Bank, GIC (Government of Singapore Investment Corporation) Special Investments, Income Partners Group, J.P. Morgan, and UBS Warburg. ABP currently includes G3 currency denominated bonds (Asian bonds denominated in US dollars, euro or yen) as well as Singapore and Hong Kong-dollar bonds, and plans to trade Australian domestic and Kangaroo bonds (Australian dollar bonds issued by foreign companies), ringgitt, baht, and rupiah domestic currency bonds in the future.

ABP mainly offers two types of accounts – trading accounts for institutional investors and subscription accounts for groups and individuals who want to access to market analysis and information on the portal. ABP's income is mainly derived from the transaction fees from brokers/dealers for each trade and content subscriptions of the portal. As a multi-dealer system, ABP enables institutional investors to trade with various brokers/dealers through a single site, provided that they have sufficient credit lines. Institutional investors can execute trades on firm prices or solicit bids and offers from brokers/dealers and negotiate prices on-line. The ABP provides a platform for secondary bond trading during Japan and Hong Kong time zones and plans to support 24- hour trading across Asia, London and New York trading times in the future.

It is expected that the ABP will enhance price discovery and transparency. More competitive prices might lead to tighter margins for brokers/dealers. The automation of the collection of pre-trade information (executable bids and offers) and post-trade information (trade details) leads to greater transparency and more timeliness of information flows. The accessibility of quotes from several brokers/dealers at the same time contributes to lower search costs. However, complete straight-through-processing is not possible with the current system, as clearing and settlement of trades remain the same as if the deals are done over the telephone. There is no anonymity in the trading process, as each counterparty in a transaction will know with whom they are dealing.

2. BondsInAsia

BondsInAsia (BIA), a joint venture of BNP Paribas, Citigroup, Credit Suisse First Boston, Deutsche Bank, HSBC, and BRIDGE eMarkets, was established in July 2000. BondsInAsia creates multi-dealer trading platform for each Asian market,

allowing local investors to trade Asian domestic and international fixed income securities, including government and corporate bonds. The platforms will provide real-time firm and indicative prices, yield, deal analytics, research and news, and will be linked to offer trading in local and international Asian markets to both domestic and global market participants. BIA's multi-market model encompasses both dealer-to-client and dealer-to-dealer trading. Users can access the BIA system through the Internet and other private networks; view and negotiate prices; and execute trades on-line. They can choose to view a country hub or a central page showing all the markets.

BIA follows a franchise business model. While BIA provides infrastructure, security, and operational services for the trading platform, local dealers participate in ownership and governance of the franchise in their market. The sources of BIA's income include the franchise fees from dealers who act as market makers, and the transaction fees for each trade. Originally being scheduled to go live in the first quarter of 2001, BIA has, however, delayed its launch towards the 4th quarter of 2001.

By providing a single point of access to multi-dealer pricing, execution, and trade-related information about Asian domestic and international fixed-income securities, BIA should help enhance price discovery and transparency of Asian bond markets. Liquidity of Asian fixed-income securities would increase if the improved market access can attract more participants, including dealers and investors. BIA supports straight-through-processing, which should help reduce transaction cost and minimize transaction errors. Unlike ABP that primarily focuses on the Asian international bond markets, BIA is expected to help internationalize the Asian local debt markets.

3. Bloomberg

Bloomberg announced in October 2000 that its ET platform, Bloomberg Electronic Trading System (BETS), started to offer trading in Asian fixed income securities. The BETS was first launched in the US in March 1999 and was subsequently introduced in Europe. In addition to US and Europe government, agency and corporate bonds, BETS currently offers Asian government bonds of the Philippines, Hong Kong, Japan, and Singapore. The on-line trading of Hong Kong and Singapore government bonds is currently offered by the J.P. Morgan eXpress (JPeX) that runs on BETS. JPeX focuses on sovereign bonds while ABP offers emerging market corporate bonds. BETS is available to Bloomberg Professional service subscribers to view real time two-way prices from multiple dealers on a single screen and to execute transactions on-line with straight-through-processing capabilities. As a leverage network of current terminals, trading via BETS incurs no transaction fees, and participating dealers' revenue is mainly derived from bid-ask spreads.

With a worldwide customer base of corporations, issuers, financial intermediaries, and institutional investors, BETS allows extensive market access to the platform. BETS also supports straight-through-processing. BETS helps to enhance price discovery as clients can view and trade on real time bid/offer prices provided by multi-dealers. BETS captures other trade-related information such as real-time positions, profit and loss results, and historical performance review.

Box 3. Major ET platforms in the foreign exchange Market in Hong Kong

Among the different FX ET platforms, including Atriax, Currenex, FX Connect, and STN Treasury, FXall is the only one that have a presence in Hong Kong and is approved as a money broker by the HKMA.[6] Other ET systems that are approved by the HKMA as money brokers include Reuters and EBS, which only serve the inter-bank trading community. Other institutional customers such as corporate treasurers and hedge funds cannot access these systems.

Reuters Dealing 2000-2 was launched in 1992, the first international computerized matching service for foreign exchange trading. The Electronic Brokering System (EBS) was established in September 1993, by a dozen leading banks in foreign exchange and Quotron, an electronic information screen competitor with Reuters. Before the introduction of these ET systems, banks have to rely on voice brokers or direct telephone dealing to execute trades, which are characterized by slow price formation and opaque market information.

FXall, a multi-bank ET platform for foreign exchange, including FX spots, forwards, swaps and options, was launched in May 2001 and established an office in Hong Kong in September 2001. Owned by 15 banks – Bank of America, Bank of New York, Bank of Tokyo-Mitsubishi, BNP Paribas, Credit Agricole Indosuez, Credit Suisse First Boston, Dresdner Kleinwort Benson, Goldman Sachs, HSBC, JP Morgan Chase, Morgan Stanley Dean Witter, Royal bank of Canada, Royal Bank of Scotland, UBS Warburg, and Westpac Banking Corporation, FXall offers institutional clients foreign currency trade execution, access to research, straight-through-processing, and 24-hour access to a multi-lingual support centre.

FXall can be accessed via Internet or private networks. With 50 global banks acting as liquidity providers, clients can trade on FXall and request executable quotes from several liquidity providers at once, provided that they have trading relationships with the specified liquidity providers. In addition, both clients and others can access to indicative foreign exchange quotes, which are blended rates of the liquidity providers' quotes. Clients can also chat with liquidity providers online. Income of FXall is mainly derived from the price makers, as there is no fee for transactions and access to research for clients and others. FXall is the only fully automated multi-bank ET platform for foreign exchange in Hong Kong, with straight-through-processing capability. Price discovery and transparency should be enhanced as both clients and others are able to view indicative quotes aggregated from liquidity providers, though only clients are allowed to view real-time executable quotes from several individual liquidity providers at once.

[6] A money broker refers to a person who acts as an intermediary between independent counterparties, one of which is an authorized institution, in foreign exchange and money market transactions. In Hong Kong, money brokers are required to be approved by the Monetary Authority under the Banking Ordinance.

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