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Abstract

Along with the booming of internet, many enterprises have modified their business models accordingly, which then has influenced the trend and direction of many industries. In the securities market, investors could utilize internet to obtain order information more easily and completely. Especially, with the easy access of foreign securities information through internet, investments transactions are becoming globalized too. Traditional trading support no longer satisfies investors' requirements. That has contributed to the global rise of electronic communications networks (ECNs). These new trading platforms make the competition among exchanges more severe. With the gradual opening of Taiwan's financial market, the approaching of these new players becomes inevitable. We study the impact of ECN on the trading structure of Taiwan's securities market, based on the trading contents, trading methods, and trading support requirements. We first analyze the impact of ECN on the trading structure of United States securities market. Current trading structure of Taiwan's securities market is then analyzed for stocks, bonds, and futures separately. We also develop an experimental ECN with the negotiation mechanism. The system is then tested by several trading experts. Their answers to our survey are summarized as our conclusion.

1. Introduction

The trading functions of traditional securities exchanges are order matching, clearing, and settlement. Electronic Communications Networks (ECNs) accomplish order matching electronically, and provide an open platform for individual and institutional investors. Although most brokerages in Taiwan are already engaged in providing electronic order entry through internet, the current electronic trading services provided by Taiwan's securities exchanges are insufficient, which limited the whole effects of internet. For example, although investors could enter orders through internet anytime, matching for after-hours orders will be delayed to the official trading time next day. Furthermore, real-time price information is incomplete, and the trading cost for investors is still high.

Before joining WTO, Taiwan government had modified law so that Taiwan's stocks, bonds, and futures exchanges will no longer enjoy current monopoly by opening securities market to foreign competitors [5]. Since the setup of ECN is relatively easy and inexpensive, the first competition they would encounter would be from ECN. ECNs in the United States have created new forms of derivative portfolios and attracted individual investors. We would like to have a systematic study on the impact of ECN on the trading structure of Taiwan's securities market.

Because most institutional and individual investors in Taiwan do not have any experience of ECN, we implement an experimental ECN system to help them understand ECN's functions and characteristics. Besides normal trading operations like order inquiry, price inquiry, and matching, the system also provides risk management and negotiation mechanisms. We then interview several trading experts after they test the system. Their answers to our survey are then systematically analyzed to investigate the impact of ECN on the trading structure of Taiwan's securities market based on trading contents, trading methods, and trading support requirements. In trading contents, we will emphasize on the demographic change of trading investors and the migration of trading goods. In trading methods, will focus on the percentages of order entry and matching choices. In trading support requirements, we will focus on the demand of the trading support tools and of trading information. This analysis architecture is applied both to Taiwan's and U.S. securities markets.

2. Related Work

In this section, we introduce ECN. Its origin, functionalities, characteristics, and current status are discussed first. The impact of ECN on the trading structure of U.S. securities market is then analyzed.

ECN is defined as any electronic system that widely disseminates to third parties orders entered into it by an exchange market maker or over-the-counter market maker, and permits such orders to be executed in whole or in part [16]. It originally appeared as Alternative Trading System (ATS) by providing a proprietary communication channel and information display for private trading of institutional investors and broker-dealers. It added order matching functions like traditional exchanges, and provided real-time price information through internet. Although Meridien Research predicted ECN will be a short lived phenomenon under electronic automation of traditional exchanges[11],

with the low cost in establishing and maintaining ECN, trade share volumes through ECN in Nasdaq has already reached 33.1% in May, 2002 [12], rising from 25.8% in September, 2000 [13].

The functionalities of ECN could be classified as follows: (1) Real-time matching: Order matching is the most important function of ECN. Once orders are entered into ECN, the matching mechanism will immediately process them. (2) Anonymous trading: Current ECN matching does not reveal the identities of order holders. This improves the willingness of investors to participate in the market, and reduces the impact of individual orders on the market. (3) Real-time price information: In U.S. traditional exchanges, the trading process is unfair to most investors since they do not have the channel to obtain complete real-time price information. ECN attracts investors by providing real-time complete price information like "which identity number issued what orders at what time". (4) Order transfer: ECN match orders inside its own system first. For orders unable to match inside, it could search other connected ECNs for orders matched with the best price, and then transfer the orders to that ECN.

The characteristics of ECN are as follows: (1) Fast trading: The order entering and matching in ECN could be completed without human participation, which improves the trading speed dramatically. According to McAndrews and Stefanadis [6], the average processing time for each order in an ECN in the United States was 2 to 3 seconds in 1999, compared to 22 seconds in the traditional exchanges. (2) Low cost: According to McAndrews and Stefanadis [10], in 2000, the personnel costs incurred from operators and dealers in NYSE and Nasdaq were about 55% and 25% respectively. Without much of the human participation, the operation cost of ECN is greatly reduced. Many ECNs have thus lowered the service charges to participating investors. (3) Long tradable time: Not only the order entry and matching are uninterrupted by weekends and holidays, but also are services improved by after-hours trading. Investors could make prompt trading decisions based on up-to-minute events. (4) Huge trade volume: The easy connection to the order entry system of brokers and other ECNs increases matching opportunities for orders. The low cost of ECNs also reduces the service charges imposed on the investors. The above two factors contribute to the increased ECN trade volume in Nasdaq. (5) Open structure: Traditional exchanges only allow their member brokers to connect to their system. The procedures of joining traditional exchanges and the establishment of their system take a long time. Non-member brokers need to enter orders to member brokers of a traditional exchange to trade their orders in that excahnge. ECNs provide a standard application program interface for brokers and investors to easily establish connection.

2.1 Current Status of ECN

Current ECNs have two trading modes: open and closed. After receiving an order, ECNs will try to match it with other orders inside immediately. If the matching does not succeed, in ECNs with open trading mode, they will try other connected exchanges or ECNs, while in ECNs with closed trading mode, they will not.

The most developed and sophisticated ECNs are in the United States for stocks listed in Nasdaq. There are three cross-border ECNs in Europe. Singaporean and Australian stock exchanges have formed an alliance to trade their listed stocks. Many Japan's and Taiwan's internet brokerages have worked together with U.S. ECNs for international market information. These could be perceived as a trend in the acceptance of the idea of ECN. The percentage of trade dollar volume through ECN in Nasdaq in May 2002 is 36.2%[12], increased from 32.2% in September 2000[13]. In 2001, besides stocks, four ECN's in the United States provide bonds trading, and two provide capabilities to trade European stocks. Jupiter predicted that the online trade dollar volume will reach 5.4 trillion U.S. dollars in 2005 [14]. ECN will enjoy the most significant increase in this trend.

2.2 The Impact of ECN on the Trading Structure of U.S. Securities Market

Before ECN, most trade volumes in traditional exchanges mostly came from human negotiations by market makers. After the establishment of ECN, the following changes in trading structure have been observed:

1. Trading contents:

   A. Growth of the percentage of individual investors: In the United States, the order information was unfair to individual investors in traditional exchanges. The service charges for them based on number of transactions were high for individual investors. Most individual investors needed to delegate professional dealers to handle their investments. In ECN, the information is fairly shared among individual and institutional dealers. ECN's service charges are relatively low compared to those of traditional exchanges. These contribute to the increased percentage of individual investors.

   B. Growth of new forms of derivatives: Derivatives were inconveniently traded through telephones before ECN, which made their trade volumes low. ECNs provide an easy to access environment both for information inquiry and for transaction completion for derivatives. It makes new forms of derivatives, like exchange of baskets of stocks, possible.

2. Trading methods:

Growth of the percentage of electronic trading: Traditional matching was through negotiation by market makers, which is inefficient and error prone. ECNs provide an easy to access electronic platform for order entering and matching. The percentage of trade share volumes through ECN in Nasdaq has increased from 25.8% in September 2000 [13] to 33.1% in May 2002 [12]. This statistics does not count orders matched inside each ECN or between ECNs. Therefore, the actual percentage of stock volume traded through ECN in Nasdaq is even higher.

3. Trading support requirements:

A. Increased demand for professional trading tools: Many new trading tools emerge after the appearance of ECN. For example, global market maker HullTrading [8] linked all exchanges and ECNs to provide a complete market linkage trading system. It helped the investors to search the best price in the market, and to enter orders in the appropriate ECNs or exchanges to obtain the best price margin.

B. The emergence of the requirement of consistent price information: ECNs caused the fragmentation of the securities market. The investors could enter their orders in both traditional exchanges and ECNs freely, which caused different prices for the same stock. The problem is especially severe when the market is hot.

3. Current Trading Structure of Taiwan's Securities Market

We will survey the current trading structure of Taiwan's stocks, bonds, and futures market separately in terms of trading contents and trading methods. Due to slow financial reform, the trading support requirement in Taiwan's securities market is mainly on the opening and linking of foreign and domestic markets. We will not survey this aspect in the following.

3.1 The Trading Structure of Taiwan's Stocks Market

1. Trading contents:

The percentage of individual investors in Taiwan is relatively high. For example, the percentage of individual investors was 87% in February 2001 [17]. According to Taiwan Stock Exchange Corporation (TSEC), the number of individual investors involving internet issuing is about 317,000 in August 1999 [3], and the number has increased to 2.16 million in March 2002 [2], about 10% of Taiwan's population. It is easy to see that the acceptance of internet among Taiwanese investors is very high. In terms of trading

goods, due to the relative closeness of financial laws, the number of derivatives regarding stocks and other securities is low.

2. Trading methods:

Current trading methods could be classified as follows:

i.   On spot orders: investors could enter delegation orders in person in the brokers' counters.
ii. Telephone orders: Investors could call the brokers to relay their order information, which will be filled in to the delegation orders by the operators.
iii. Internet orders: Investors could fill in order information in their broker's web sites.
iv. Programmed telephone orders: Investors could call a special telephone number to issue orders by answering programmed instructions.
v.   Mobile orders: This is similar to internet orders, except the media is now through WAP or GPRS of cellular phones.

Note that after the orders are entered, order matching is then performed in TSEC electronically in the official working hours. Chang [1] argued that TSEC is already like a big ECN in terms of order matching. However, with the definition in Section 2, we do not treat TSEC as an ECN. Currently, most order entries are through telephone. According to TSEC, the percentage of electronic order entering was 8.66% in the first quarter of 2002 [2], rising from 7.29% in October 2000 [9].

3.2 The Trading Structure of Taiwan's Bonds Market

1. Trading contents:

Current trading unit for bonds in Taiwan is NT 50 million dollars. Since the minimal trading value is huge, most investors are institutional dealers. The trading goods include government bonds, corporation bonds, monetary bonds, and cross-country monetary bonds. Trading modes are classified into outright purchases (OP) and repurchase and reverse repurchase (Repo, Reverse Repo). In OP, the ownership of traded bonds is transmitted to the purchaser on the date of the transaction. In Repo, the seller agrees to purchase back the bonds in a fixed date with an agreed interest rate. In Reverse Repo, the buyer agrees to sell the bonds back to the seller in a fixed date with an agreed interest rate.

2. Trading methods:

Most bonds in Taiwan are traded over the counter in brokers' offices through individual negotiations. This makes the whole trading process and pricing information neither transparent nor real-time. The trading is either through telephone conversation or through the bond trading system

operated by GreTai Securities Market (GTSM, formerly Over-the-Counter Securities Exchange). However, the bond trading system in GTSM is mainly for batch trading among professional bond dealers, and it is not open to investment companies and individual investors. Although this system could generate matching information during trading sessions, it does not proactively notify the dealers their trading results. With slow response and insufficient functionalities, the system does not receive good market reaction.

3.3 The Trading Structure of Taiwan's Futures Market

1. Trading contents:

Taiwan only opens index-based futures markets. Taiwan's domestic futures market started trading in July 1998, with the product Taiwan weighted stock index futures. Taiwan electronic and banking & insurance sector stock indexes were listed in July 1999. Taiwan stock index options was then listed in December 2001. The percentage of individual investors in Taiwan's futures in terms of trade volumes in lots is about 95.92% for the first half year of 2002 [15]. Initial margins in Taiwan's futures market are much higher than those in the United States. In addition, since there is a 7% fluctuation bound in Taiwan's stock market, the daily gain or loss in Taiwan's futures is also limited.

2. Trading methods:

Taiwan's futures are already traded electronically. However, information of foreign futures, like commodities or SIMEX MSCI Taiwan Stock Index Futures, is hard to obtain, and trading channels for them are inconvenient.

4. The Design and Implementation of an Experimental ECN

4.1 System Requirement

Besides the aforementioned ECN functionalities of real-time price information, immediate matching, order transfer, and standard API, we believe a negotiation mechanism with an ICQ-like interface with log capability is very important. The log could provide negotiation history, evidence when there is an argument, and confirmation after the negotiation is complete.

4.2 System Architecture

Fig. 1 demonstrates the system architecture for our proposed ECN. The investors in the left of the dash line represent the client side of the system to enter orders through internet. The main modules are as follows:
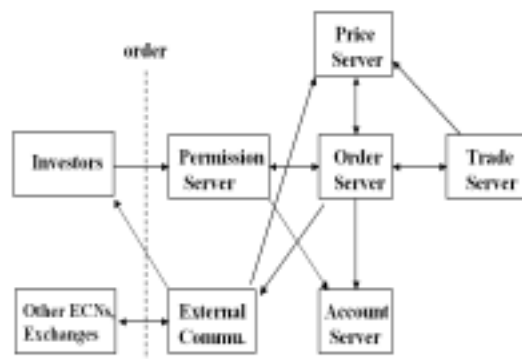

Fig. 1: System Architecture of Our ECN

1. Permission server: It is responsible for registration, security and authentication control. Negotiation and usage logs are recorded here.

2. Order server: It is responsible for coordinating all order related operations. It will dispatch orders to corresponding modules based on their status. Other modules will report their processing results to it too. It will also proactively transmit order information through External Communication to interested investors and brokers in other ECNs. Chen [4] provided details about its operation.

3. Trade server: It is responsible for order matching. After it receives the order information from order server, it will try to match the order immediately. The result will then be sent back to order server.

4. Price server: It stores the price information from trade server, order information from order server, and the external price information from other ECNs. External orders will be sent to order server for matching.

5. Account server: It is responsible for storing account related information, like current balance and detailed securities holdings, so that the user could inquire their financial data to perform risk management.

6. External communication: It is to handle communication with end users and other ECNs or exchanges. External orders will be sent to price server to store related information before matching. Orders unable to be matched in the system will be sent to other ECNs or exchanges through this module. For system extensibility, the format for the communication is FIX 4.2 [7], the format for standard financial transactions.

4.3 System Application

Brokers could handle the received order information based on their own needs. To verify the usability of our system, we also implement a testing client system for brokers to query information and enter orders. For example, a user could query price information for a bond by simply typing in the bond's number.

In addition to normal functionalities of ECN, we also provide the following extra functions:

1. Control of dealer's handling amount: We provide this mechanism for the broker to control the maximal daily handling amount for their dealers. It will prevent the broker from huge loss caused by adventurous dealers.

2. Negotiation: The negotiation mechanism could allow the investors to negotiate with several dealers simultaneous to obtain the best price.

5. The Impact of ECN on the trading structure of Taiwan's Securities Market

In this section, we first explain the background of the inevitability of the approaching of ECN. Questions for several trading specialists are then presented. Their answers to these questions are then summarized according to the analysis structure in Section 2.

There are two main reasons why the approaching of ECN is inevitable:

1. The trend of cross-country trading: Currently when an Taiwanese investor plans to participate in foreign securities market, the usual channel is through purchasing mutual funds for foreign securities. If he wants to handle the investment in person, then he needs to enter orders in various foreign exchanges, which is very inconvenient. The capability of order transfer in ECN is an off-the-shelf solution to alleviate this issue. Most corporations also are willing to have their stocks or bonds traded cross-border to collect capital. Global cross-country exchanges have been booming recently. Euronext comprises stock exchanges of New York, Paris, Amsterdam, and Brussels. Nasdaq, London, and Frankfurt stock exchanges are already linked. Singapore and Australian stock exchanges have formed an alliance. The easy connection of ECNs also makes their entrance into other countries easy.

2. The openness of financial market after WTO: Before joining WTO, Taiwan government has removed the monopoly protection to domestic exchanges. Foreign exchanges, ECNs, investment banks, etc., are entering into Taiwan's financial market with their professional knowledge and huge capital. For example, Taiwanese web sites, like Cnyes [6], have already linked with U.S. ECNs to provide real-time stock information. It is inevitable that Taiwan's financial market will link with global markets. Taiwanese brokers have started the process of merge and acquisition since 1999 to react to the emerging global competition.

We demonstrated our experimental ECN system to several trading specialists and asked them to test it. We then interviewed them with questions based on the analysis structure we mentioned in Section 2. Table 1 demonstrates the questions we proposed:

Table 1: Questions to Taiwan's Trading Specialists

Interview questions	Reasons for asking
What will be the advantage of ECN in Taiwan's current securities trading environment?	Since the securities trading environments are quite different in Taiwan and the United States when ECN is booming, some advantages of ECN in the United States may not hold in Taiwan.
What kind of ECNs will prosper in Taiwan?	Since order matching in Taiwan is already completed electronically, and order entry through internet has been booming in Taiwan, we believe the ECNs that will proper in Taiwan will be different from those in the United States.
What will be the impact of ECN on the trading structure of Taiwan's securities market?	This is our research thesis.
What will be the influence of the negotiation mechanism on the trading methods?	We would like to investigate the effect of our ECN's ICQ-like negotiation mechanism on the trading methods of Taiwan's securities market.
What will be the impediments of ECN in Taiwan? Are there other missing functionalities?	We would like to understand the problems ECN will face in Taiwan.

Since the interview should be conducted to people with some background knowledge of ECN, it is difficult to find proper trading specialists for the interview. We only interviewed three specialists before December 2001. The following is the conclusion of our interview:

1. The impact of ECN on trading contents of Taiwan's securities market

a. Increased percentage of institutional investors: The percentage of individual investors in Taiwan is already very high. With the introduction of many new financial goods to Taiwan, ECNs will increase the flexibility of investment combinations of securities, and also increase the difficulty of investment management. Thus, individual investors will seek the help of trading specialists, which will increase the percentage of institutional investors in Taiwan's securities markets. On the other hand, in the United States, before ECN, since individual investors had difficulties in obtaining complete trading information, and the service charges were high, the percentage of individual investors was relatively low. ECN changed the above trading environment in the United States, and increased the percentage of individual investors.

b. Emergence of diversified securities goods: Taiwan's current tradable securities goods are limited. Besides easy combination of securities goods, ECN is suitable for cross-country trading. That will make the securities goods more diversified. Part of the investment capital will be moved to these new financial goods. Thus the percentage of stock investment in total investment will then be reduced. On the other hand, because the financial goods in the United States have been relatively complete before ECN, ECN has little impact on the percentage of securities goods, and it just increased the flow of current financial goods.

2. The impact of ECN on trading methods of Taiwan's securities market

a. Trading volume will be shifted to ECN: Although order matching in Taiwan is already completed electronically, it is performed in a black box. With the advantages of ECN, investors will be attracted to complete their orders in ECN, especially for after-hours market. On the other hand, in the United States, the reduce of percentage of trade volumes through non-ECNs in Nasdaq has been mainly due to the speed up of ECN compared to slow human negotiations by market makers.

3. The impact of ECN on trading support requirements of Taiwan's securities market

a. The growth of the demand of supporting investment tools: With the expected booming of new diversified investment goods, the demand for investment tools to analyze and to support trading of these diversified goods will also increase.

b. The emergence of the requirement of transparent trading information: Current price information in Taiwan is not transparent in real-time for both institutional and individual investors. With the provision of complete ordering information in ECN, investors in the traditional exchanges will ask for the same support. On the other hand, in the United States, since individual investors did not have sufficient order information of orders from market makers, the demand of transparent trading information has been existent before ECN.

c. The emergence of the demand of negotiation mechanisms: Although order matching in Taiwan is completed electronically, the human negotiation process still exists in bond trading and after-hours market. They currently are completed mostly through telephone conversations. The demand for the negotiation mechanism will increase. On the other hand, the trading market in the United States before ECN had been mainly by human negotiation. The demand to add negotiation mechanisms in ECN was not so obvious in the beginning.

6. Conclusion

With the gradually opened Taiwanese financial market, most people have noticed the booming trend of internet brokerages. This trend has been extended to the traditional exchanges in other countries, and ECNs have already occupied noticeable market share already. However, the trend seems not noticed by most investors in Taiwan. We surveyed and accumulated related data about ECN in the United States. We designed and implemented an experimental ECN with the negotiation mechanism. The system was tested by Taiwan's trading specialists. Their interview answers were then summarized for the impact of ECN on the trading structure of Taiwan's securities market based on an analysis structure of trading contents, trading methods, and trading support requirements. The conclusion of our interview is as follows:

1. Securities goods will be more diversified.
2. The percentage of trade volumes from institutional investors will increase.
3. Part of the trade volumes will be shifted to ECN.
4. The demand for supporting investment tools will increase.
5. The requirement of transparent price information will arise.
6. The requirement of negotiation mechanisms will arise.

Future research topics include:

1. Investigation of required modification of regulating laws: Since the regulation about

securities trading is different for each country, it has become an obstacle in establishing a global trading market. Most financial reforms will need to adjust the current law in each country. A consistent and systematic investigation is needed to compare the differences in each country.

2. The enforcement of security: Since the trading dollar amounts are normally huge, it will become an obvious target for security intruders when order information is communicated electronically. Therefore, a proper design and implementation of network security mechanisms is very important.

3. The impact of ECN on the trading structure of securities market in other countries: It has been difficult for us to find related academic works about this research. We hope our research will be helpful for later investigation for other countries.

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