行政院國家科學委員會專題研究計畫　成果報告

期貨市場競爭與市場互動：台灣與美國之分析

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計畫主持人：鍾惠民

計畫參與人員：李書宏

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行政院國家科學委員會補助專題研究計畫 成果報告

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（二）中、英文摘要及關鍵詞(keywords)

中文摘要

本研究從市場競爭觀點，分析台灣期貨市場在各發展階段中，台指指數期貨與其競爭者新加坡交易所摩根台指期貨交易量與價格之互動關係。為提供國際性比較，本研究同時分析美國 CME 的指數期貨與 ETF (exchange traded funds) 市場制度變革下之競爭關係。本研究在分析台灣期貨市場時從(1)市場絕對交易成本改變(期交稅調降)，(2)市場參與者提昇，與(3)市場相對交易成本改變(現貨市場嚴格放空制度等)因素造成期貨市場相對地具低成本性，使其市場成熟度改變，探討其對競爭者新加坡交易所交易量之替代與互補效應。同時亦運用美國的指數期貨與 ETF 日內交易資料分析各期貨市場與現貨 ETF 價格之互動關係之改變。

關鍵詞：市場競爭、指數期貨、交易成本假說

英文摘要

ABSTRACT

This research focuses on the increasing competition between exchanges for listing similar index futures. The trading volume dynamic of closely related index futures in Taiwan futures exchange and Singapore exchange are examined. We explore the impact on the trading dynamic of Taiwan index futures listed in Taiwan Futures Exchange (TAIFEX) and Singapore Exchange (SGX) for events that produce transaction costs changes. To provide international comparison, the research also examines the trading dynamic of US index futures and their corresponding ETFs. In particular, this research investigate the margin policy spillover effects on the trading dynamics of close substitute index futures markets in US. Our analysis also provides insights on the relative informational efficiency across emerging derivative markets at different stages of development. The price efficiency and price discovery between the important component stocks, TAIFEX index futures, and SGX Taiwan index futures are further explored.

***Key Words**:* Market competition; Index futures; Transaction costs hypothesis

(三)報告內容

1. 前言 (**Introduction)**

Motivated by the growing competition between international futures markets, this research aims to examine the impact of structure changes in (relative) transaction costs on the price and trading dynamic of closely related index futures traded in geographically separated markets.

A futures contract's success is likely to be affected by the existence of competing contracts. The index futures in Taiwan is an example of home county's index futures being first introduced by a foreign rival exchange. As noted by Cuny (1993), a first mover advantage exists since traders are attracted to the liquidity offered by the established market. Second contracts may not be able to divert trading volume from the existing market and hence fail to gain a critical market share, unless that markets are segmented and/or market structure and regulatory differences exist. If successful, a second contract may benefit the first mover if it creates additional trading possibilities by extending trading hours, or by creating arbitrage opportunities. However, it may also hurt the first mover, if its presence results in the loss of market share and liquidity by the former. Likewise, an exchange may succeed in offering correlated contracts if they correspond to agents' different hedging demand and sensitivity to transaction costs (Tashjihan, 1995).

Competition between futures market can be examined in many aspects. First, according to the trading costs hypothesis of Fleming, Ostdick, and Whaley (1996), market with lowest trading costs will react to new information more quickly. Thus, the market with lowest transaction costs will tend to lead its competing markets. Second, low transaction cost might be an important motivation for traders to migrate trades from exchanges to the lowest one. Hence, there might be some trading volume dynamic between closely related futures traded in geographically separated markets, as important transaction costs event take places.

2. 研究目的 **(The purpose of this research)**

This research aims to examine the increasing competition between exchanges for listing similar index futures. The trading volume dynamic of closely related index futures in Taiwan futures exchange and Singapore exchange are examined. We explore the impact on the trading dynamic during the various regulation changes on the Taiwan index futures contracts listed in Taiwan Futures Exchange (TAIFEX)

and Singapore Exchange (SGX). The research also explores relative price discovery of ETFs and index futures for the US.

Our analysis also provides insights on the relative informational efficiency across emerging derivative markets at different stages of development. We compare the price efficiency and price discovery among the important component stocks, TAIFEX index futures, and SGX Taiwan index futures.

3. 文獻探討(Literature Review) 與研究方法 (Research Methodology)

While there are numerous studies using price and volatility data for similar contracts across international financial markets, relative few use volume data. In particular, we examine the trading volume dynamic of closely related index futures traded in geographically separated markets. Daily data of trading volume for TAIFEX and SGX-DT used for the trading dynamic tests. Besides, the intra-day data from TAIFEX and SGX-DT are used to investigate their lead-lag relation. For the US market, the intraday tick-by tick data from 1996 to 2002 provide by Tickdata Inc. will be applied to investigate the margin policy spillover effects on the trading dynamics of close substitute index futures markets in US.

Trading volume dynamic of TAIFEX and SGX-DT

To explore the trading dynamic of Taiwan index futures between TAIFEX and SGX-DT, we first conduct unit-root test for the trading volume series. Ito and Lin (2001) examine the impact of changes in the margin requirements on the trading volume dynamic of Nikkei 225 futures traded in Osaka Securities Exchange (OSE) and SIMEX. They find that the loss of OSE's market shares from 1990 to1993 is partly due to the relative high transaction costs as a result of margin increased in OSE. Our approach is very similar to that of Chung (2002), which investigates the structure change in transaction costs and their impacts on trading dynamics of close substitute futures markets. The following model is examined for each contract.

$$V_{i,t} = \alpha_0 + \sum_{k=1}^{M} b_{k,i} M_{k,t} + \sum_{k=1}^{N} c_{k,i} W_{k,t} + d_{1,i} t + + \sum_{k=1}^{H} \lambda_{k,i} \Delta V_{i,t-k} + \delta_i V_{i,t-1} + u_t \ ,$$

where $V_{i,t}$ is the trading volume of the *i* market at time *t* and *i* = A, S, and C, standing for TAIFEX, SGX-DT and the cash market, respectively. $M_{k,t}$ is a dummy variable controlling for the monthly effect. $W_{k,t}$ is a dummy variable representing the day-of -week effects.

The null hypothesis for testing the unit root in the trading volume is $H_0 : \delta = 0$.

Empirical studies usually find that trading volume process does not have a unit root but instead tends to have a time trend (Ito and Lin 2001). Our preliminary study also confirms this result for TAIFEX and SGX-DT Taiwan index futures. Hence, the following equation is applied to examine the inter-market trading volume dynamic of TAIFEX and SGX-DT Taiwan index futures.

$$V_{i,t} = a_{0,i} + \sum_{m=1}^{2} a_{m,i} D_{m,t} + \sum_{k=1}^{P} b_{k,i} M_{k,t} + \sum_{k=1}^{Q} c_{k,i} W_{k,t} + d_{1,i} t + d_{2,i} H_t * (t - T_{Tax}) + u_{i,t} \quad (1)$$

where $V_{i,t}$ is the trading volume of the *i* market at time *t* and *i* = A, S, and C, standing for TAIFEX, SGX-DT and the cash market, respectively. $D_{m,t}$ is the dummy variable which controls the development stage effect in TAIFEX. $D_{1,t}$ is equal to 1 if a certain trading day is in the second period, i.e., May,1 2000 to July 31, 2001. H_t is the dummy variable which is equal to 1 if the trading day is after the tax rate reduction day and is 0 if else. T_{Tax} is the day number for the transaction tax reduction day. We then compare the trading volume dynamic for each of the three periods by using the following equation. All estimations are done by using the least square methods, and standard errors are adjusted for heteroskedasticity and autocorrelation. Equation (1) is analyzed for the three markets, namely TAIFEX, SGX-DT and the spot market. Taking the SGX-DT and TAIFEX as examples, their regression model can be written as:

$$V_{S,t} = a_{0,S} + \sum_{m=1}^{2} a_{m,S} D_{m,t} + \sum_{k=1}^{P} b_{k,S} M_{k,t} + \sum_{k=1}^{Q} c_{k,S} W_{k,t} + d_{1,S} t + d_{2,S} H_t * (t - T_{Tax}) + u_{S,t}$$

(1A)

$$V_{A,t} = a_{0,A} + \sum_{m=1}^{2} a_{m,A} D_{m,t} + \sum_{k=1}^{P} b_{k,A} M_{k,t} + \sum_{k=1}^{Q} c_{k,A} W_{k,t} + d_{1,A}\, t + d_{2,A}\, H_t * (t - T_{Tax}) + u_{A,t} \quad (1B)$$

If $a_{1,S}$ is negative then it would support the substitution effect that a reduction in the transaction costs due the tax rate reduction decrease the trading volume of SGX. A positive $a_{1,A}$ would indicate that the own market effect of decrease in tax rate is positive. Furthermore, the coefficient of $d_{2,A}$ and $d_{2,S}$ provide long-run impact of the tax rate reduction. The residual terms of the trading volume are obtained from the above equation and are used to test the spillover effects from one market to the other two related markets.

$$u_{i,t} = \sum_{k=1}^{n} \alpha_{k,i} u_{c,t-k} + \sum_{k=1}^{n} \beta_{k,t} u_{A,t-k} + \sum_{k=1}^{n} \gamma_{k,t} u_{s,t-k} + \varepsilon_{i,t} \quad (2)$$

where $\varepsilon_{i,t}$ is the random error term.

Elasticity of TAIFEX trading volumes with respect to transaction costs

The reduction of transaction tax rate of TAIFEX on May 1, 2000 provides a good

opportunity to examine elasticity of trading volumes with respect to transaction costs. Wang, Yau, and Baptiste (1997) examine the relations between trading volume and transaction costs in seven financial, agricultural, and metal futures. Because there is no transaction tax in U.S. futures markets and the major variable component of transaction costs is the bid-ask spread, the elasticity of trading volume is estimated with respect to the bid-ask spread. Their results show that there is a positive relationship between trading volume and intraday price volatility and the elasticity of financial futures are relatively high comparing to that of agricultural futures. For, example, the elasticities of trading volume with respect to transaction costs for S&P 500 index futures and Deutsche mark futures are –2.03 and –2.07, suggesting that the trading volume of S&P 500 decrease 2.03% in response to a 1% increase in transaction costs.

An alternative approach to understand the market impact of changes in transaction cost on the trading volume of futures contract is to examine the market in isolation by estimating the following equation.

$$V_t = \theta_0 + \theta_1 IV_t + \theta_2 OI_{t-1} + \theta_3 TC_t + \delta D_t + \varepsilon_t, \qquad (3)$$

where V_t is the log-trading volume of the index futures at daily t, D_t is a dummy variable that characterizes the strict short sale restriction period, IV_t is the intraday volatility of the futures contract at day t, OI_{t-1} is the open interest at day t-1, and TC_t is the sum of the transaction costs components (percentage) at time *t*.

Relative market efficiency and liquidity

Structure changes in transaction costs would also likely to impact the pricing efficiency in the cost of carry model. We perform efficiency test of the index futures by comparing the forecast errors of cost of carry model at various stages. The t test and nonparametric Wilconson Rank-Sum test is conducted to examined the variation of pricing errors of cost of carry model for the three stages. We also compute the ratio of futures volume to open interest. The ratio is used as an approximate measure of liquidity. A high ratio, indicating that that trading is high compared to the number of outstanding contracts, would imply that agents could enter and liquidate their positions with relative ease.

Relative price discovery at various stages

There exists a wealth of literature that analyzes the theoretical relationship between futures contracts and their underlying spot indices. Most studies report a lead-lag relationship up to 30 minutes from futures prices to the spot price. Examples include Stoll and Whaley (1990) on S&P 500 and Major Market Index; Chan (1992)

and Koutmos and Tucker (1996) on the S&P 500; Abhyankar (1995) on the FTSE 100; and Booth, So, and Tse (1999) on the German Equity index derivative. One reason for this lead-lag effect is the fact that futures markets tend to have less restrictive regulation and lower transaction costs.

The lead-lag relationships among spot index, SGX futures and TAIFEX futures is examined for the three periods. In addition to the value weighted index of TAIEX, we also employ the large component stocks as an alternative to the spot index. Chiang and Fong (2001) found that market maturity is important factor for the price discovery function of Hongkong derivative markets. Previous studies find price discovery predominantly originates in the local market (Garbade and Silber, 1979, Tse 1999). TAIFEX has the benefit of home market advantage. However, it is not clear whether price dissemination will originate.

Since the futures prices are found in almost every study to be an I(1) nonstationary process. We apply the Johansen (1989) cointegration test approach to examine the long run relationship and determining the number of long-run common trends. We expect that like many of the previous studies, there will be one. We then investigate the lead-lag relationship by the following Vector Autoregressive (VAR) model based on intraday data.

$$R_t = \alpha_0 + \sum_{k=1}^{P} \alpha_k R_{t-k} + \varepsilon_t \qquad (4)$$

$R_t = [R_t^T \quad R_t^S \quad R_t^C \quad R_t^L]'$ is a 4×1 vector of return series of futures and cash index at day *t*. While R_t^T is the log price difference (return) of the TAIFEX Taiwan index futures at time *t*, R_t^S, R_t^C and R_t^L are the returns of SGX Taiwan index futures, TAIEX value weighted index, and the portfolio of large component stocks, respectively. α_k, for *k*=0,1..P, is a 4×4 matrix.

Alternatively, the Hasbrouck (1995) approach, that measures the price discovery process in a more definitive manner, is applied. The above models will be examined for the following three periods: (I) July, 1998 to April 2000; (II) May 2000 to June 2001; and (III) July 2001 to May 2002.

4. Relative price discovery of US index instruments

This research is further extended to examine the impact of decimalization on the relative changes in the trading costs, the information trading, and the speed of information transmissions between Exchange Traded Funds (ETFs) and their corresponding index futures. The quotes of ETFs have been decimalized on January 29, 2001, while the quotes of index futures were not. We examine whether the decrease in the minimum tick size of ETFs enhances its role in the price discovery

process. We find that, for ETFs, the trading activity increases, but the market depth drops significantly after decimalization. The spreads for ETFs and index futures generally decrease. The adverse selection component of ETFs decreases, while that of index futures increases. Furthermore, we find that ETFs start to lead index futures and have a higher information share after decimalization. Overall, the efficiency of the ETFs prices seems to improve significantly after decimalization.

5. 結果與討論 (Results and Discussion)

This study sets out to investigate the impact on market quality stemming from the reduction in transaction tax during the early stages of development of the Taiwan Futures Exchange (TAIFEX). Alongside an examination of the various impacts on market liquidity, volatility and government tax revenues arising from the transaction tax reduction, we also test the relative pricing efficiency of the 'cost of carry' model in both the pre- and post-tax reduction periods. Furthermore, in order to provide an insight into the growing competition between closely related index futures, we also examine the spillover effects of the transaction tax reduction on the trading volume of its foreign competitor, the Singapore Exchange (SGX). Our results indicate that the reduction in the tax rate has improved both the liquidity of the index futures, the relative price discovery of TAIFEX and government tax revenues. We also find that the transaction tax reduction has led to an increase in the long-run growth of the trading volume in the TAIFEX, whilst reducing the trading volume growth rate of its foreign competitor. Our results therefore support the hypothesis that a reduction in transaction costs increases the competitiveness of the futures exchange.

At least three related paper were derived from this research. Below is the partial list:

Huimin Chung, Mei-Ying Liu and Soushan Wu, Transaction Costs and Trading Activity in the Index Futures Market: the Case of the Transaction Tax Reduction in Taiwan, Paper presented at 2003 FMA-Europe, Finland. Under review.

Huimin Chung and Shu-mei Chuang, The Introduction of Mini-sized Index Futures and their Impact on the Underlying Assets: The Case of U.S. Index Futures, Forthcoming in *International Journal of Financial Service and Management* 2003.

Huimin Chung, and Shu-mei Chuang, Market Changes and the Price Leadership of Index Futures: An Analysis of the three TAIFEX Index Futures. (in Chinese)