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An Empirical Study of the Impact of Stock Index Futures on the Spot Stock Price Volatility of the Nikkei 225 Index and S&P 500 Index*

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ABSTRACT

Since both SIMEX listed MSCI Taiwan Index Futures and CME listed DJGI Taiwan Futures on January 9, 1997 respectively, there has been a wide spread argument concerning the impact of stock index futures trading on the SIMEX and the CME on the volatility of cash stock prices in Taiwan. The Taiwan Futures Exchange (TFE) has been in operation since July 21, 1998. The present researchers have been motivated to investigate whether the Nikkei 225's listings on the SIMEX and S&P 500's listing on the CME affect the volatility of spot stock price in the OSE and the NYSE respectively. The empirical results indicate that during any of the time periods studied, the S&P 500 stock index futures did not affect the volatility of the spot stock market. However, the Nikkei 225 stock index futures traded on the SIMEX significautly affected the spot stock market volatility on the OSE.

Key words: *The S&P500 stock index futures, CME, the Nikkei 225 stock index futures, SIMEX, Taiwan stock index futures.*

I. Introduction

The security market in Taiwan, the Republic of China, has rapidly developed during the past decade. In addition to improving the market structure and system, the R.O.C. government has dedicated itself to the establishment of an Asian Pacific Financial Center. To achieve this goal, the Taiwan Futures Exchange has been in operation since July 21, 1998.

Since both Singapore International Monetary Exchange (SIMEX) and Chicago Merchantile Exchange (CME) listed Morgan Stanley Capital International (MSCI) Taiwan Stock Index Futures and Dow Jones Growth International (DJGI) Taiwan Stock Index Futures on January 9, 1997, respectively, there has been a widespread argument concerning the impact of stock index futures trading on the SIMEX and the CME on the volatility of spot stock prices in Taiwan. Table 1 summarizes the major content of CME's DJGI Taiwan stock Index Futures and SIMEX's MSCI Taiwan stock Index Futures. Government officials and National Security Association members in Taiwan argue that the stock index futures listed on the SIMEX and the CME before they are listed on the Taiwan Futures Exchange will affect local spot stock price volatility. They have used the example of the Nikkei 225, which was listed by the SIMEX on Sept. 3, 1986, while the Nikkei 225 was listed by the Osaka Securities Exchange (OSE) on Sept. 3, 1988. Table 2 lists the major content of CME's S&P 500 Stock Index Futures, SIMEX's Nikkei 225 Stock Index and OSE's Nikkei 225 Stock Index. The stock index futures trading on the SIMEX is assumed to affect the volatility of the spot stock market on the OSE. Hence, the present researchers have been motivated to investigate whether the Nikkei 225's listing on the SIMEX two years before its listing on the OSE significantly affected the volatility of spot stock prices in Japan. For comparison purposes, S&P 500 stock index futures have been included in this research to

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determine whether the S&P 500 stock index futures traded in the CME affect the volatility of spot stock price in the NYSE.

Therefore, the objectives of this study are as follows: (1) to investigate whether stock index futures trading affects spot stock price volatility. (2) to test when the macro-economic factors are controlled, whether stock index futures trading affects the volatility of spot stock prices. (3) to determine whether the inclusion of stock index futures trading will change the structural relationships among the macro-economic factors affecting the spot stock prices.

II. Literature Review

There have been many articles espousing different opinions on the impact of stock index futures trading on the spot stock market volatility during the past decade. For example, Damodaran (1990), Lee & Ohk (1992), Wong (1993), Huang (1994) and Antonios & Holmes (1995) argue that stock index futures trade increases the speculative and arbitrage activities of markets. Consequently, these speculative and arbitrage activities enlarge the instability of the market and enhance the spot stock price volatility. Antonios & Holmes (1998) extend the traditional analysis of examining whether futures trading has increased stock market volatility by considering the issue of volatility, asymmetries, and market dynamics. They find that although the onset of futures trading has had limited impact on the level of stock market volatility over a 3-year period, it has had a major effect on the dynamics of the stock market. However, Edwards (1988), Aggrwal (1988), Harris (1989), Kamara, Miller & Siegel (1992), Lee & Ohk (1992), and Bessembinder & Seguin (1992) argue that the listing of stock index futures does not affect the volatility of spot stock prices. There are also numerous studies concerning whether the inclusion of macro-economic factors have affected the volatility of stock prices. Homa & Jaffee (1971) and Gargett (1978) define that money supply affects the volatility of stock prices. Robichek & Cohn (1974) argue that the real growth rate and the inflation rate affect the volatility of stock prices. Both Fama (1981) and Ross (1986) conclude that the expected inflation rate and the industrial production growth rate affect stock prices volatility. Darrat (1990) argues that fiscal policy affects stock prices volatility. Jorion (1991) proposes that foreign exchange rate affects stock prices volatility. Abdullah & Hayworth (1993) find that fiscal deficits, long-term interest rates, and the growth of the money supply affect stock prices volatility. However, Schwert (1990) argues that macro-economic factor dose not affect stock prices voaltility.

III. Methodology

To investigate whether stock index futures affect volatility of spot stock prices, the Granger causality test is used. This test is used to examine whether, statistically, stock index futures detect the direction of causality when there is a temporary lead-lag relationship between stock index futures and spot stock price volatility. Due to the requirement of the Granger causality test that the time series should be stationary, a unit root test is used to examine whether the data is stationary. The most popular methods of unit root testing are the Dick-Fuller (DF) test and the Augmented Dick-Fuller (ADF) test. First, the equations for the DF test are as follows:

$$\Delta Y_t = (\rho - 1) Y_t + \varepsilon_t \tag{1}$$

$$\Delta Y_t = \alpha + (\rho - 1) Y_{t-1} + \varepsilon_t \tag{2}$$

$$\Delta Y_t = \alpha + \gamma t + (\rho - 1) Y_t + \varepsilon_t \tag{3}$$

$$\varepsilon_t \sim iid\left(0, \delta^2\right).$$

If ε_t is not only non-autocorrelated but also independent, then the error term is called strictly white noise. If $\rho - 1 = 0$, then this time series has a unit root. It indicates that the series is nonstationary. Secondly, the equation for the ADF test is as follows:

$$\Delta Y_t = (\rho - 1) Y_{t-1} + \sum_{i=1}^{k} \Delta Y_{t-i} + \varepsilon_t, \tag{4}$$

where, for example, $\Delta Y_{t-1} = \left(Y_{t-1} - Y_{t-2}\right)$, $\Delta Y_{t-2} = \left(Y_{t-2} - Y_{t-3}\right)$, etc. If the error term is auto correlated, the ADF test can allow for this contingency.

In order to include the most explanable macro-economic factors as the control variables, the present researchers used SAS software to run stepwise regression to determine the appropriate macro-economic factors for different countries. For example, the first four explanable macro-economic variables for the United States are the industrial production index, the money supply, the interest rate, and the wholesale price, whereas, the first four explanable macro-economic variables for Japan are the industrial production index, the money supply, the interest rate, and the balance of export and import. The possible explanation of the different macro-economic factors used is that the weight of international trade volume to the GNP in Japan is much higher than that in the United States. Then the impact of macro-economic factors and the trading volume (or open interest) of the stock index futures on the volatility of a spot stock index is investigated by establishing the following equations:

(i) For the trading volumes of the S&P 500 stock index futures:

$$\hat{\sigma}_{mt} = C + \alpha_1\Delta + \sum_{m=1}^{N} VO_{mt} + \alpha_2\Delta IP_t + \alpha_3\Delta MS_t + \alpha_4\Delta IR_t + \alpha_5\Delta WPI_t + \varepsilon_t \quad (5)$$

where $\hat{\sigma}_{mt}$ is the volatility of the monthly stock price where vo_m is the monthly trading volume of S&P 500 stock index futures, IP is the industrial production index, MS is the money supply, IR is the interest rate and WPI is the wholesale price index.

(ii) For the open interest of the S&P 500 stock index futures :

$$\hat{\sigma}_{mt} = f + \beta_1\Delta\sum_{m=1}^{N} IO_{mt} + \beta_2\Delta IP_t + \beta_3\Delta MS_t + \beta_4\Delta IR_t + \beta_5\Delta WPI_t + \mu \quad (6)$$

where IO_{mt} is the monthly open interest of the S&P 500 stock index futures.

(iii) For the trading volume of the Nikkei 225 stock index futures :

$$\hat{\sigma}_{mt} = C + \alpha_1\Delta\sum_{m=1}^{N} VO_{mt} + \alpha_2\Delta IP_t + \alpha_3\Delta MS_t + \alpha_4\Delta IR_t + \alpha_5\Delta EXIM_t + \varepsilon \quad (7)$$

where EXIM is the balance of export and import.

(iv) For the open interest of the Nikkei 225 stock index futures:

$$\hat{\sigma}_{mt} = f + \beta_1\Delta\sum_{m=1}^{N} IO_{mt} + \beta_2\Delta IP_t + \beta_3\Delta MS_t + \beta_4\Delta IR_t + \beta_5\Delta EXIM_t + \mu_t \quad (8)$$

IV.DATA

In order to best address the central questions of this research, the S&P 500 and the Nikkei 225 are used to investigate whether the stock index futures trading affects spot stock price volatility. Both the S&P 500 and the Nikkei 225 spot data were obtained from the AREMOS Data Bank of the Ministry of Education, Taiwan, R.O.C., while the S&P 500 stock index futures data were obtained from the Wall Street Journal, and the Nikkei 225 index futures data were obtained from the SIMEX. First listed on the CME on Apr. 21, 1982, the S&P 500 has been the most active stock index trading in futures since that time. The S&P 500 stock index futures data chosen are the monthly trading volume and open interest of the nearest month contracts. The Nikkei 225 stock index futures have been listed on the SIMEX since Sept. 3, 1986. The Nikkei 225 stock index futures data chosen are the monthly trading volume and open interest of the nearest month contracts.

If it is found that both variables are nonstationary or random walk stochastic processes, whether the linear combination of these two variables is stationary can be tested. The first step is estimating the coefficient of equation (9), then using the ADF test to examine whether the residual term follows a unit root process:

$$Y_t = d_0 + d_a x_t + \varepsilon_t \quad (9)$$

The sample period for the S&P 500 is from May 1982 to Dec. 1995, while the sample period for the Nikkei 225 is from Oct. 1986 to Dec. 1995 because the S&P500 was listed in May 1982 and the Nikkei 225 was listed in Oct. 1986. In order to be comparable with each other, the S&P 500 index period is divided into three intervals, one extending from May 1982 to Sept. 1986, the next from Oct. 1986 to Dec. 1989, and the third from Jan. 1990 to Dec. 1995. The Nikkei 225 index period is divided into two intervals, one extending from Sept. 1986 to Dec. 1989, and the other from Jan. 1990 to Dec. 1995. Concerning the macro-economic variables, data was obtained from Monthly International Finance statistics and Taiwan Economic Journal (TEJ) Data Bank.

1. To calculate the monthly stock price volatility from the daily data, French, Schwert and Stambauch (1987)'s formula is used:

$$\sigma_{mt} = \left[\sum_{i=1}^{n_t} r_{it}^2 + 2\sum_{i=1}^{n_t-1} r_{it} r_{i+1,t}\right]^{1/2}, \quad (10)$$

where σ mt is the monthly volatility of the stock price, N_t is the trading days in month t, ri,t is the daily return at the ith trading day in month t. ri is the average rate of stock return in month t.

2. To employ the monthly macro-economic data to estimate the monthly volatility of the stock returns:

$$R_t = \sum_{j=1}^{12} \alpha_j D_{jt} + \sum_{i=1}^{12} \beta_i R_{t-i} + \varepsilon_t, \quad (11)$$

$$\hat{\sigma}_{mt} = \left(\frac{\pi}{2}\right)^{\frac{1}{2}} |\hat{\varepsilon}_t| \quad , \qquad (12)$$

where $R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\%$, represents the rate of monthly stock return, Djt is a dummy variable, $\hat{\sigma}_{mt}$ is the estimated standard deviation from monthly data. $|\hat{\varepsilon}_t|$ is the absolute value of the residual, which multiplies an adjustment factor to fit in a normal distribution.

3. Regarding the variability of macro-economic factors, the following equation is used:

$$\Delta X = \ln(X_t) - \ln(X_{t-1}) \quad , \qquad (13)$$

where ΔX represents the difference between the natural log of the current value of macro-economic factors (X_t) and the value of macro-economic factors in the previous period (X_{t-1}). For example, the industrial production, the money supply, the interest rate, the wholesale price index, and balance of exports and imports are the macro-economic factors used.

V. Empirical Results

First, the ADF test was used to examine whether the stock-price-volatility time series has a unit root. The result showed that no unit root problem exists, meaning that the time series is stationary. Secondly, the ADF test was used to examine whether the monthly volume and open interest of stock index futures each follows a unit root process. The results are listed in Tables 5-8. Tables 5 and 6 indicate that the S&P 500 index futures did not have any unit root problem. Table 7 indicates that the trading volume of Nikkei 225 Index Futures did not have any unit root problem, either. However, the result in Table 8 indicates that the open interest of Nikkei 225 stock index futures had a unit root problem during the period of 1986 to 1989; yet after the natural log of difference terms was included in the ADF test, the requirement of stationarity was met. All other variables had no unit root problems under 5% significance levels, indicating that the time series is stationary.

Thirdly, the Granger causality test was used to detect the lead-lag direction of stock index futures and spot stock price volatility for both S&P 500 and Nikkei 225 stock indices. The results in Tables 9 and 10 indicate the following: in all three time intervals for the S&P 500, the trading volume of futures did not affect the spot stock price volatility. However, Table 10 indicates that over the three sub-sample periods, the trading volume of Nikkei 225 futures on the SIMEX significantly influenced the volatility of the spot stock price on the Osaka Stock Exchange (OSE).

Fourthly, after controlling for the effect of macro-economic variables, a multiple regression model was used to test whether the trading of stock index futures affect spot stock markets. The results shown in Tables 11 and 12 indicate once again, that S&P 500 stock index futures trading has no significant effect on spot stock price volatility. However, Nikkei 225 stock index futures trading in SIMEX has destablized the spot stock market on the OSE, thereby causing higher stock price volatility.

VI. Conclusion

The empirical results indicate that during any of the time intervals studied, the S&P 500 stock index futures did not affect the volatility of the spot stock market. However, the Nikkei 225 stock futures traded on the SIMEX significantly affected the spot stock market volatility on the OSE.

According to the empirical results of the multiple regression model, the S&P 500 stock index futures trading volume did not have any significant impact on the volatility of the spot stock market. However, the Nikkei 225 stock index futures trading on the SIMEX did have a positively significant effect on the Nikkei 225 spot stock market trading on the OSE. This result is consistent with that of the Granger Causality test.

According to Brenner, Subrahmanyam and Uno (1990), the Japanese government has regulated restrictively on Nikkei 225 stock index futures, thereby causing mispricing and arbitrage opportunities for Singapore security dealers or large enterprises and further affecting the price volatility of the Nikkei 225 spot stock market.

The differences in the results between the S&P 500 and the Nikkei 225 can be explained as follows: (1) From the investors viewpoint, the financial market in the U.S. is a major international market, and U.S. dollars are more stable than Japanese Yen. Therefore, when investors look for hedging instruments, they are prone to invest in the U.S. market. Consequently, there is less impact on stock market volatility in the U.S. than in Japan. (2) The S&P 500 index is more popular than the Nikkei 225 for international investors. Therefore, any minor change in the S&P 500 will have an immediate reaction; hence, it will seldom have abnormal volatility. (3) The Nikkei 225 stock index is more regional than the S&P 500; therefore, it is easily affected by regional economic conditions. Also, since it is very sensitive to technical information, the volatility of the spot stock market usually deviates from that of the stock futures and causes arbitrage opportunities.

VII. Appendix

Table 1. Comparison of CME's DJGI Taiwan Index and SIMEX's MSCI Taiwan Index

Exchange	CME	SIMEX
1. Underlying Index	DJGI Taiwan Index	MSCI Taiwan Index
2. Contract Months	3,6,9,12※current month, next month	Current Month, Next Month, 3,6,9,12
3. Contract Size	US$250× 170 (DJGI Taiwan Index) =US$42,500	US$100× 280 (MSCI Taiwan Index) =US$28,000
4. Minimum Fluctuation	US$250× 0.02=US$5	US$100× 0.1=US$10
5. Trading Hours	7:30 am to 12:30 pm; (Monday) 4:30 am to 12:30 am (Tuesday thru Friday) 8:30 am to 11:00 am (Saturday)	8:45 am to 12:15 pm (Monday thru Friday) 8:45 am to 11:15 am (Saturday)
6. Method of Trading	GLBOEX	Open Outcry
7. Daily Limit	7%	7% to 10%

※CME added current month and next month contracts since Feb.21, 1997.

Table 2. Comparison of S&P 500 Stock Index and Nikkei 225 Stock Index on the SIMEX vs. Nikkei 225 stock index on the OSE

Exchange	CME	SIMEX	OSE
Contract	S&P 500 Stock Index	Nikkei 225 Stock Index	Nikkei 225 Stock Index
Contract Months	3,6,9,12	3,6,9,12	3,6,9,12
Trading Hours (Taipei Time)	9:30 pm.-4:15 am.	7:55 am.-10:15 am. 11:15 am.-2:15 pm.	8:00 am.-10:15 am. 11:15 am.-2:15 pm.
Contract Size	$500× Index	¥500× Index	¥1,000× Index
Minimum Fluctuation	0.05pt.=US$25	5pt.=¥2,500	1pt.=¥10,00
Last Trading Day	hird Thursday of Contract onth	Second Thursday of Contract Month	Third business day, prior to tenth of Contract Month
Daily Limit	Varies	Varies	3% of previous settlement price
Daily Contract Launched	Apr.21,1982	Sept.3,1986	Sept.3,1988

Reference：Futures 1995 Source Book

Table 3. Empirical results of unit root test on S&P 500 stock index

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-11.5297	-9.2424	-7.7110
Critical value at 0.05 level	-3.4221	-3.3764	-3.4155
Critical value at 0.10 level	-3.1330	-3.1136	-3.12302

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-11.8372	-9.6867	-7.0734
Critical value at 0.05 level	-3.4189	-3.4190	-3.4193
Critical value at 0.10 level	-3.1316	-3.1316	-3.1317

Interval 3

	Four Periods	Eight Periods	Twelve Periods
t statistic	-17.3407	-12.9800	-10.9134
Critical value at 0.05 level	-3.4161	-3.4165	-3.4175
Critical value at 0.10 level	--3.1299	-3.1301	-3.1305

Table 4. Empirical results of unit root test on Nikkei 225 stock index

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-9.7855	-7.2786	-5.1636
Critical value at 0.05 level	-3.4217	-3.4219	-3.4232
Critical value at 0.10 level	-3.1335	-3.1336	-3.1341

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-13.8483	-10.9418	-9.9636
Critical value at 0.05 level	-3.4183	-3.4338	-3.4140
Critical value at 0.10 level	-3.1310	-3.1376	-3.1292

Table 5. Empirical results of the unit root test on trading volume of S&P 500 stock index futures

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-7.1640	-6.3101	-5.4463
Critical value at 0.05 level	-3.4213	-3.4377	-3.4146
Critical value at 0.10 level	-3.1326	-3.1396	-3.1398

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-6.5601	-5.2648	-5.4072
Critical value at 0.05 level	-3.4178	-3.4190	-3.4193
Critical value at 0.10 level	-3.1311	-3.1311	-3.1317

Interval 3

	Four Periods	Eight Periods	Twelve Periods
t statistic	-7.2613	-4.7011	-4.1802
Critical value at 0.05 level	-3.4521	-3.4158	-3.4158
Critical value at 0.10 level	-3.1296	-3.1299	-3.1299

Table 6. Empirical results of unit root test on open interest of S&P 500 stock index futures

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-4.0541	-3.7865	-3.9997
Critical value at 0.05 level	-3.4213	-3.4377	-3.4146
Critical value at 0.10 level	-3.1326	-3.1396	-3.1298

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-6.3757	-6.1673	-6.4073
Critical value at 0.05 level	-3.4178	-3.4190	-3.4192
Critical value at 0.10 level	-3.1311	-3.1316	-3.1317

Interval 3

	Four Periods	Eight Periods	Twelve Periods
t statistic	-9.9099	-8.3987	-8.3987
Critical value at 0.05 level	-3.4161	-3.4146	-3.4165
Critical value at 0.10 level	-3.1299	-3.1299	-3.1301

Table 7. Empirical results of unit root test on trading volume of Nikkei 225 stock index futures

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-5.1664	-6.0782	-8.7905
Critical value at 0.05 level	-3.4217	-3.4219	-3.9830
Critical value at 0.10 level	-3.1335	-3.1336	-3.1336

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-5.8990	-4.9994	-4.5337
Critical value at 0.05 level	-3.4179	-3.4221	-3.4131
Critical value at 0.10 level	-3.1308	-3.1326	-3.1288

Interval 3

	Four Periods	Eight Periods	Twelve Periods
t statistic	-7.2613	-4.7011	-4.1802
Critical value at 0.05 level	-3.4521	-3.4158	-3.4158
Critical value at 0.10 level	-3.1296	-3.1299	-3.1299

Table 8. Empirical results of unit root test on open interest of Nikkei 225 stock index futures

Interval 1

	Four Periods	Eight Periods	Twelve Periods
t statistic	-2.2743	-2.0048	-2.1349
Critical value at 0.05 level	-3.4178	-3.4190	-3.4192
Critical value at 0.10 level	-3.1311	-3.1316	-3.1317

After the natural log of difference terms, results of unit root test is as follows:

	Four Periods	Eight Periods	Twelve Periods
t statistic	-10.2136	-4.9994	-7.1046
Critical value at 0.05 level	-3.4201	-3.4221	-3.4232
Critical value at 0.10 level	-3.1335	-3.1326	-3.1341

Interval 2

	Four Periods	Eight Periods	Twelve Periods
t statistic	-4.3996	-4.2309	-3.8118
Critical value at 0.05 level	-3.4178	-3.4221	-3.4131
Critical value at 0.10 level	-3.1308	-3.1326	-3.1288

Table 9. Results of Granger Casuality Test on S&P 500 stock index futures on spot stock price volatility

(a) Effect of the trading volume on stock price volatility

Interval 1

		F-statistic	probability
Four Periods	V_t not caused by Σ VO_m	0.949318	0.4349
Eight Periods	V_t not caused by Σ VO_m	0.836537	0.5706
Twelve Periods	V_t not caused by Σ VO_m	0.842087	0.6068

Interval 2

		F-statistic	probability
Four Periods	V_t not caused by Σ VO_m	0.873897	0.4791
Eight Periods	V_t not caused by Σ VO_m	0.584987	0.7307
Twelve Periods	V_t not caused by Σ VO_m	0.651668	0.7381

Interval 3

		F-statistic	probability
Four Periods	V_t not caused by Σ VO_m	2.102661	0.0784
Eight Periods	V_t not caused by Σ VO_m	1.307399	0.2357
Twelve Periods	V_t not caused by Σ VO_m	0.781783	0.4642

(b) Effect of open interest on stock price volatility

Interval 1

		F-statistic	probability
Four Periods	V_t not caused by Σ IO_m	1.108271	0.3515
Eight Periods	V_t not caused by Σ IO_m	1.035167	0.4078
Twelve Periods	V_t not caused by Σ IO_m	0.758570	0.6936

Interval 2

		F-statistic	probability
Four Periods	V_t not caused by Σ IO_m	0.535607	0.7096
Eight Periods	V_t not caused by Σ IO_m	0.625889	0.7564
Twelve Periods	V_t not caused by Σ IO_m	0.648400	0.8010

Interval 3

		F-statistic	probability
Four Periods	V_t not caused by Σ IO_m	0.249717	0.9099
Eight Periods	V_t not caused by Σ IO_m	0.390225	0.9263
Twelve Periods	V_t not caused by Σ IO_m	0.390850	0.9673

Table 10. Results of Granger Casuality Test of Nikkei 225 stock index futures on spot stock price volatility

(a) Effect of trading volume on stock price volatility

Interval 1

		F-statistic	probability
Four Periods	V_t not caused by Σ VO_m	2.484049	0.0114 *
Eight Periods	V_t not caused by Σ VO_m	2.741656	0.0011 * *
Twelve Periods	V_t not caused by Σ VO_m	1.759936	0.0135 *

Interval 2

		F-statistic	probability
Four Periods	V_t not caused by Σ VO_m	6.049887	0.0001 * *
Eight Periods	V_t not caused by Σ VO_m	3.899678	0.0002 * *
Twelve Periods	V_t not caused by Σ VO_m	2.901382	0.0006 * *

* * : $p<0.01$, * : $p<0.05$.

(b) Effect of open interest on stock price volatility

Interval 1

		F-statistic	probability
Four Periods	V_t not caused by Σ IO_m	2.899158	0.0006 * *
Eight Periods	V_t not caused by Σ IO_m	3.176294	0.0131 *
Twelve Periods	V_t not caused by Σ IO_m	2.815794	0.0008 * *

Interval 2

		F-statistic	probability
Four Periods	V_t not caused by $\Sigma\ IO_m$	3.175868	0.0132 *
Eight Periods	V_t not caused by $\Sigma\ IO_m$	2.263336	0.0212 *
Twelve Periods	V_t not caused by $\Sigma\ IO_m$	3.588821	0.0021 * *

* * : p<0.01, * : p<0.05.

Table 11. Multiple regressions of S&P 500 stock index volatility on macro-economic factors

(a) Trading volume of S&P500 and macro-economic factors

$$\hat{\sigma}_{mt} = c + \beta_1 \Delta \Sigma VO_{mt} + \beta_2 \Delta IP_t + \beta_3 \Delta MS_t + \beta_4 \Delta IR_t + \beta_5 \Delta WPI_t + \varepsilon_t$$

Independent	Coefficients	t-statistic	P-value
C	0.0112432	8.4298860	0.0000 * *
$\Delta \Sigma VO_m$	9.728E-05	0.7964308	0.2108
Δ IP	0.2314699	-1.4464516	0.0751
Δ MS	0.2100110	1.2521306	0.1063
Δ IR	0.0102073	0.4266716	0.3352
Δ WPI	-1.7602196	-8.7235526	0.0000 * *

R^2=0.416449 D-W=2.019047 F=20.55301

$\bar{R}^2$=0.396187 RSS=0.019740 P=0.000000

$\bar{R}^2$: Adjusted R-squared, RSS : Sum of squared residual, P : Prob(F-statistic);
* * : p<0.01, * : p<0.05,

$\Sigma\ VO_m$:monthly trading volume of stock index futures,
IP: Industrial Production Index,
MS: Money Supply,
IR: Interest Rate,
WPI: Wholesale Price Index.

(b) Open interest of S&P 500 and macro-economic factors

$$\hat{\sigma}_{mt} = c + \beta_1 \Delta \Sigma IO_{mt} + \beta_2 \Delta IP_t + \beta_3 \Delta MS_t + \beta_4 \Delta IR_t + \beta_5 \Delta WPI + \varepsilon_t$$

Independent Variables	Coefficients	t-statistic	P-value
C	0.0111835	8.7579795	0.00000 * *
$\Delta \Sigma IO_m$	0.0046170	1.4323591	0.07705
Δ IP	-0.2592180	1.6796635	0.04755 *

Δ MS	0.2375189	1.4444480	0.07535
Δ IR	0.0090846	0.4135636	0.33990
Δ WPI	-1.7519747	-9.0164427	0.00000 ＊＊

R^2 =0.425967　D-W=2.021780　F=21.96500

$\bar{R}^2$ =0.406574　RSS=0.019583　P=0.000000

＊＊ : p<0.01, ＊ : p<0.05,

Σ IO_m: Open interest of stock index futures

Table 12. Multiple regressions of Nikkei 225 stock index volatility on macro-economic factors

(a) Trading volume of Nikkei 225 and micro-economic factors

$$\hat{\sigma}_{mt} = c + \beta_1 \Delta \Sigma VO_{mt} + \beta_2 \Delta IP_t + \beta_3 (EXIM) + \beta_4 \Delta MS_t + \beta_5 \Delta IR + \varepsilon_t$$

Independent Variables	Coefficients	t-statistic	P-value.
C	-0.0003844	-0.1815187	0.42820
Δ Σ VO_m	0.0343675	2.0385447	0.02230 ＊
Δ IP	0.5339665	4.2547309	0.00005 ＊＊
Δ (EXIM)	0.0854133	-2.6897874	0.00430 ＊＊
Δ MS	0.0275860	0.7319723	0.23310
Δ IR	0.0185262	0.5343554	0.29752

R^2 =0.260543　D-W=1.947576　F=5.989845

$\bar{R}^2$ =0.217046　RSS=0.029581　P=0.000086

＊＊ : p<0.01, ＊ : <0.05,

(EXIM): Balance of export and import.

(b) Open interest of Nikkei 225 and macro-economic factors

$$\hat{\sigma}_{mt} = c + \beta_1 \Delta \Sigma IO_{mt} + \beta_2 \Delta IP_t + \beta_3 (EXIM) + \beta_4 \Delta MS_t + \beta_5 \Delta IR + \varepsilon_t$$

Independent Variables	Coefficients	t-statistic	P-value.
C	-0.0002905	-0.1400987	0.44445
Δ Σ IO_m	1.439E-05	2.0460621	0.02190 ＊
Δ IP	0.5836969	4.7898875	0.00000 ＊＊
Δ (EXIM)	0.1081329	-3.7899776	0.00015 ＊＊
Δ IR	0.0337660	0.9048974	0.18400
Δ WPI	-0.0030931	-0.0934843	0.46228

R^2 =0.262016　D-W=1.981817　F=6.177744

$\bar{R}^2$=0.219603　　RSS=0.029630　　P=0.000060

＊＊：p<0.01, ＊：p<0.05.

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史坦普 500 與日經 225 股價指數期貨對現貨股價波動性實證研究

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摘　要

新加坡國際金融期貨交易所(SIMEX)與美國芝加哥商業交易所(CME)已分別於民國八十六年一月九日分別開放台股指數期貨交易。而臺灣期貨交易所(TAIMEX)也於八十七年七月二十一日成立。從國外期貨交易經驗發現，股價指數期貨雖有其正面貢獻，但亦有其負面影響。其中最常被討論的是股價指數期貨對股票價格穩定性的影響。綜觀相關文獻，兩方面各持其論點。本研究以美國 S&P500 股指期貨與在新加坡 SIMEX 交易之日經 225 股指期貨為樣本。實證結果如下：1·在 CME 上市的 S&P500 股價指數期貨不會影響現貨股價的波動。但在新加坡上市的日經 225 股指期貨交易會影響大阪日經 225 現貨股價的波動。2·若同時考慮其他對股價波動有顯著影響的總體經濟因素，則 S&P500 股價指數期貨交易變動量對股價波動無顯著影響。但新加坡日經 225 股指期貨交易變動量對大阪日經 225 現貨波動的正向影響非常顯著。此與 Granger 因果檢定的結果一致。

關鍵詞：S&P500 股指期貨、台股指數期貨、波動性、新加坡日經 225 股指期貨。