



# 行政院國家科學委員會專題研究計畫成果報告

## 國科會專題研究計畫成果報告撰寫格式說明

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#### 1、中文摘要

本研究探討新加坡國際金融交易所推出的摩根台股指數期貨正常交易時間的報酬率與盤後交易的報酬率間的互動關係。本文發現正常交易時間的報酬率對盤後交易的報酬率有正向且顯著的影響，但是盤後交易的報酬率對正常交易時間的報酬率的影響較不明確，另外盤後交易的報酬率的變動率對正常交易時間的報酬率的變動率有正向且顯著的影響，但是正常交易時間的報酬率變動率對盤後交易的報酬率卻無顯著的影響。

關鍵字：新加坡台股指數，盤後交易

**Abstract:** The extension of many futures exchange into after-hours trading allows investors to trade almost any time of the day. An important question remains as to whether activities in the after-hour trading section are informative to trading in the regular hours. This paper focuses on the interactions of SIMEX (Singapore International Monetary Exchange) MSCI (Morgan Stanley Capital International) Taiwan Stock Index futures and its after-hours automated trading. Our results show that return spillovers from regular to after-hours sessions are positive and significant, but the return spillovers from after-hours to regular sessions are mixed. On the other hand, after-hours shocks significantly spillover to the volatility in the

subsequent regular trading sessions, while shocks in the regular trading sessions have little impact on the after-hours volatility.

**Keywords:** MSCI, After-hour trading, GARCH

#### 2、Motivation of this study

Among the world emerging stock markets, Taiwan's stock market is known for its high annual turnovers and volatility. However, until January 1997, when SIMEX (Singapore International Monetary Exchange) launched the MSCI (Morgan Stanley Capital Investment) Taiwan Index Futures, investors in the Taiwan stock market have not been able to hedge their equity portfolio using stock index futures contracts. The SIMEX MSCI (Morgan Stanley Capital International) Taiwan Stock Index futures contracts and its Automated Trading System (ATS) were launched in 09/01/1997 and in 11/11/1997, respectively. The creation of these contracts opens a new dimension to local investors to hedge their portfolio risk and international investors who have not been able to access the Taiwan bourse in the past. Since then, the SIMEX MSCI Taiwan Index Futures contract has been the most liquid Taiwan Index Futures contract despite the creation of the local Taiwan Index Futures contract in July 1998.

This paper extends the earlier literature on volatility spillovers among markets in three ways. First, volatility spillovers between regular and after-hours index futures markets are explored in this paper. Though Ulibarri (1998) show the price and volume interactions of near-term crude oil futures contracts at the NYMEX, he did not provide information on the volatility spillovers between daytime and after-hours trading sessions. Second, Granger causality test and GARCH models are used to investigate the interactions between regular and after-hours trading sessions. Third, the asymmetric effects of negative and positive return shocks for volatility are examined in the regular and after-hours trading sessions. Results in this paper have important implications for hedging and trading strategies in stock index futures markets.

### 3 • Methodology and results

SIMEX regular trading sessions for MSCI Taiwan stock index futures contracts are from 8:45 am to 12:15 pm Monday through Saturday and the ATS hours are from 2:45 pm to 7:00 pm Monday through Friday. I apply Engle and Granger's (1987) tests on the price series, which use the augmented Dickey-Fuller tests on the residuals of regular trading prices regressed on the after-hours trading prices. If a long-run or equilibrium relationship between these prices exists, such a cointegration measure needs to be added when applying the Granger causality test on the return dynamics. The  $t$ -statistic for the error terms in the second stage Engle and Granger's (1987) test is  $-7.76$ , which indicates that for index futures prices considered in this paper, the prices changes are cointegrated at order one.

The error correction Granger causality tests are used to examine the interactions of price changes between regular and after-hours sessions. Results indicate that regular trading returns have a positive and significant

impact on the subsequent after-hours trading price changes, while the after-hours returns have a negative and significant effect on the following regular trading price changes at the 5 percent level. It is seen that there are significant interactions between the price changes in regular and after-hours trading sessions. The robustness of the Granger causality test on the return dynamics is confirmed by considering the ARCH effects of the error terms equation. The  $t$  statistics for the interaction parameters  $\mathcal{G}_1$  and  $\mathcal{G}_1'$  are  $-2.28$  and  $4.12$ , respectively. These results show that MSCI Taiwan futures returns seem to have two-way feedback effects from the regular (after-hours) and after-hours (regular) trading sessions.

In addition, a bivariate GARCH (1,1) model similar to the one proposed by Engle, Ito and Lin (1990) is used to examine volatility spillover effects between regular and after-hours MSCI Taiwan Stock Index futures markets. The specification of the GARCH conditional variance for regular trading session ( $h_{Regular,t}$ ) and after-hour trading session ( $h_{Afterhours,t}$ ) are as follows:

$$\begin{aligned} \varepsilon_{i,t} | \psi_{i,t} &\sim N(0, h_{i,t}), \\ h_{i,t} &= c_i + \beta_{ii} h_{i,t-1} + \sum_{j=1}^{i-1} \alpha_{ij} \varepsilon_{j,t}^2 + \sum_{j=i}^2 \alpha_{ij} \varepsilon_{j,t-1}^2 \end{aligned}$$

Results for the GARCH(1,1) models show that return spillovers from regular to after-hours trading sessions are positive and significant, but the return spillovers from after-hours to regular trading sessions are mixed. Furthermore, it is seen that after-hours shocks significantly spillover to volatility in the subsequent regular trading session, while shocks in the regular trading session have little impact on the after-hours volatility. The most general specification used in this paper is the GARCH-GJR models. Results for the GARCH-GJR models show that spillovers from regular trading to after-hours sessions are positive and significant. The asymmetric effects of after-hours shocks on regular trading volatility are positive, which indicate that a negative

shock in the after-hours session increase the volatility in the subsequent regular trading session. However, there is no significant impact from regular trading shocks on the after-hours volatility. Results of this study are informative for investors engaging in hedging and trading strategies in the MSCI Taiwan index futures and options markets.

#### 4 • References

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**Table 1: Summary of SIMEX MSCI futures contracts**

Trading sessions:	Regular	After-hours
Contract size	US\$100	US\$100
Settlement:	Cash	Cash
Beginning of trade	January 9, 1997	November 11, 1997
Trading hours	8:45 a.m.– 12:15 p.m.* (Monday to Saturday)	2:45 p.m.– 7:00 p.m. (Monday to Friday)
Average trading volume (during the sample period)	5,046	276

Note: \*Returns in regular trading hours on Saturday are deleted due to the lack of after-hours trading data.

**Table 2: Results of bi-variate GARCH(1,1) model on return and volatility dynamics****Panel A: Estimation for after-hours shocks on regular trading return and volatility**

Parameters	$\mathcal{G}_1$	$c_1 * 10^4$	$\beta_{11}$	$\alpha_{11}$	$\alpha_{12}$
	-0.16	0.83	-0.02	0.04	0.98
	(-1.60)	(4.92)	(-0.16)	(0.97)	(2.73)*

**Panel B: Estimation for regular trading shocks on after-hours return and volatility**

Parameters	$\mathcal{G}_1'$	$c_2 * 10^4$	$\beta_{22}$	$\alpha_{22}$	$\alpha_{21} * 10^2$
	0.04	0.07	0.06	0.88	0.04
	(3.72)*	(4.64)	(0.64)	(5.81)	(0.13)

The following equations are estimated for bi-variate GARCH model on the dynamics of intraday volatilities:

$$\text{Panel A: } \varepsilon_{\text{Regular},t} \sim N(0, h_{\text{Regular},t})$$

$$h_{\text{Regular},t} = c_1 + \beta_{11} h_{\text{Regular},t-1} + \alpha_{11} \varepsilon_{\text{Regular},t-1}^2 + \alpha_{12} \varepsilon_{\text{Afterhours},t-1}^2$$

$$\text{Panel B: } \varepsilon_{\text{Afterhours},t} \sim N(0, h_{\text{Afterhours},t})$$

$$h_{\text{Afterhours},t} = c_2 + \beta_{22} h_{\text{Afterhours},t-1} + \alpha_{22} \varepsilon_{\text{Afterhours},t-1}^2 + \alpha_{21} \varepsilon_{\text{Regular},t}^2$$

\* represent significant at the 5% level.