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Price Behaviors, Dynamics and Contrariness in Taiwan Futures Market

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計畫主持人：蘇永成

處理方式：可立既對外提供參考

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Intra-day price behavior and short term dynamics in equity markets has always been the focus in financial literatures in the recent decades. Many researchers investigated dynamics between stocks, such as small firms and large caps. Their empirical findings support the importance of information transmissions. Big caps have more information than small caps do. It explains the leading of big caps in capital markets. Other school of researches put emphasis on the dynamics between markets. They almost reach the same conclusion that the U.S. market is the leading market in the world. Intra-day pattern investigation help researchers to clarify twofold: first, can we make profit from market to market dynamics or large to small caps dynamics. Lo and Mackinlay (1990) develop a contrarian strategy arguing that if a stock is systematically lead or lag to another stock, then buying the low and selling the high makes an abnormal return. On the other hand, Eun and Shim (1989) argue that information transmissions play an important role in international capital market integration. Based on their arguments, we make no profit from market integration that based on efficient information transmission. However, if we believe that market is segmented, then we may develop a lead lag relation to profit from it. Almost all of the previous studies were focus on equity market dynamics. We seldom find researches on futures market dynamics, especially on the intra-day dynamics. We also find many studies on the dynamic relation between spot and futures markets. However, futures to futures market dynamics investigation were not the usual cases.

In this study, we examine the intra-day data of TAIMEX and SIMEX to describe price behavior, to develop a contrarian and to discuss information transmission and market integration. Basically, TAIMEX and SIMEX share a similar designated product and are in the same time zone. Geographic difference may play a role but is not a big issue in this case. Based on the similarity of these two markets, we intend to compare the price behaviors in these two markets, including mean returns, volatility and trading volumes. The concept of nesting GARCH proposed by Hentschel (1995) was used in this study to have better fit in return distributions. We don't intend to investigate the different shocks of good news or bad news in these two markets. However, The nesting GARCH model helps to closely examine market dynamics and spillovers.

Contemporaneous dynamics were examined in this study to test the integration between TAIMEX and SIMEX. We try to examine the efficiency of information transmission between them. Integration of Asian equity markets has been widely supported in previous studies. However, integration of futures markets between TAIMEX and SIMEX helps explain behaviors of derivatives market integration. In this study, we use five minutes data to closely examine short-term dynamics. The empirical results confirm the integration of these two markets. We also investigate the lead lag dynamics between them. The purposes are twofold: first, we try to develop a contrarian if we find information inefficiency between markets, i.e., a lead lag relation between them. Second, we use the information inefficiency to explain the fact. TAIMEX and SIMEX share many similarities in design. However, they do have some differences in terms of trading target, trading hour and regulations. These regulations with regard to price and volume play important roles in information transmission inefficiency, e.g. a price ceiling might not reflect a true price under an information shock because of the price constraint.

The rest of this paper consists of the following: section II is the literature review. Empirical data and methodology were discussed in section III and empirical results were presented in section IV. Section V is the conclusion.

II. Literature Review

There are intensive studies on intra-day return patterns recently. Intra-day data has a merit of short time period that apparently attracts many time series researchers. Usually time series researchers cannot find a good pattern except AR(1) in a monthly or yearly data set. Futures market is not an exception either. Even daily data may not show a good time series pattern. Most of the intra-day futures returns conclude a U shape pattern. Wood, McInish and Ord(1985) examine the distribution of intra-day returns time series data from September 1971 through February 1972 and the per minute data in NYSE. He documented U shapes in returns and variance. He also found positive returns in 30 minutes before opening and closing. The other trading intervals show a normal distribution for positive returns.

Harris(1986) used different data set but derived the same U shape distribution on 15 minutes returns in NYSE for a 14 months period. He also found several trades contribute to the opening high return but a single large trade to the closing high return. Jain and Joh (1988) replicate Harris study by using hourly instead of 15 minutes to conclude the same. Harris (1986) also documented a cross- sectional difference between weekdays. For big caps, the negative return in Monday was account for the information from Friday closing to Monday opening. On the other hand, the negative return was due to the Monday trading for small caps. The first 45 minute in Monday show a strong negative return which dominance the Monday's negative result.

McInish and Wood (1990) enlarge sample sizes of previous studies to 1,400 NYSE listed companies during the period of 1980 –1984. He didn't find a different pattern. The U shape is still there in the intraday return. Therefore, they expand the result in return volatility and also get a U shape pattern. They investigate deeper into intra-minute behavior. The pattern of five-minute volatility also shows a U shape. The similar results also were documented in Lockwood and Linn (1990) research. These empirical findings again support the U shape in return and return volatility no matter how short the time spectrum it is.

Wei (1992) try to examine the different patterns between exchanges and volume. He employed intra-day trading volume and return volatility based on per trade in NYSE and AMEX in September and October 1987. He found different patterns between different trading volume period. A U shape is exhibited in high trading volume period while no pattern is found in low one. His empirical finding show that volume does play an important role in return and volatility patterns.

Market structure might also play a role in return and volatility pattern. Christie and Schltz (1995) compared the difference in NASDAQ and NYSE. They investigate intra-day bid-ask spread in NASDAQ. They find a stable bid-ask spread in every trading period except the closing. Market structure attributes the pattern difference. They explain the market structure difference by inventory control of dealers in NASDAQ and specialists in NYSE.

Smirlock and Starks (1986) challenge weekend effect by examining per hour data of DJIA from 1963 to 1983. They attribute the weekend effect in Monday to the weekend period with no trades. In other words, Monday return was changed from negative to positive while the weekend on the other way around. Jain and Joh (1988) find a reverse U shape in weekday trading volume when they use NYSE trading volume to examine intra-day and weekday effects.

Amihud and Mendelson (1987) investigate the opening and closing data of 30 listed companies in NYSE during 1982 through 1983. Their empirical results show different pattern between opening and closing. Opening return apparently show a larger volatility than that of the closing. However, both exhibit a fat tailed and opening show a higher kurtosis. They try to use ARMA(1,1) to fit the pattern and find a larger residual noise in opening. A strong autoregressive effect appeared in opening and the random walk was rejected. They believe the pattern is the result of different trading mechanism.

III. Empirical Data and Methodology

This study tries to investigate the price behaviors and short term dynamics in futures exchanges. We choose TAIMEX and SIMEX futures 5 minutes spot and futures trading data from July 21 through November 26, 1998. In investigate TIMAX futures, we find the average returns of each interval are insignificantly different from zero and the average returns for each period are significant different to each other. The first interval in 9:00 and 9:05 has a significant high variance. The average variances for each period are also significantly different to each other. The average trading volume in 9:15-9:20 is the peak. The average trading volumes for each period also show significantly different to each other. In examining weekday returns, we find that Wednesday and Thursday exhibit significant different to other weekdays. Monday's variance is significantly higher than that of other weekdays while Friday's trading volume shows a significantly higher than that of other days.

In SIMEX futures market, we find returns of each interval are significantly different to each other and so are the variances and trading volumes for each interval. SIMEX shows similar patterns in average returns, variances and trading volumes in weekdays as TIMAX does.

In order to examine dynamics between TAIMEX and SIMEX, we employ the nesting GARCH concept proposed by Hentschel(1995). We describe price behavior of TAIMEX and SIMEX futures by fitting a model in Hentschel's nest. The Newton-Raphson algorithm was used in iterating maximum likelihood. Under Hentschel's (1995) framework, we consider every member in nesting GARCH family without prior information regarding to a market. All of the seven members in nesting GARCH family were examined, including GARCHM, GJRGARCHM, NAGARCHM, TGARCHM, SGARCHM and AVGARCHM. We developed SGARCHM, AVGARCHM and TGARCHM models in our study based on the maximization of likelihood..

An exogenous SGARCHM model can be expressed as follows.

$$R_t = \alpha + \beta h_t^{1/2} + \varepsilon_t - \theta\ \varepsilon_{t-1}$$
$$\varepsilon|\varphi_{t-1} \sim N(0,h_t)$$
$$h_t^{1/2} = A + B_1 h_t^{1/2} + C_1\ |\varepsilon_{t-1}| + \lambda X_t$$

where R_t : Five minutes return at time t

X_t : variance of exopenous variable at time t

h_t : conditional variance at time t

$\alpha, \beta, \theta, A\ , B_1, C_1, \lambda$: Parameters

An exogenous AVGARCHM be modeled as:

$$R_t = \alpha + \beta h_t^{1/2} + \varepsilon_t - \theta\varepsilon_{t-1}$$
$$\varepsilon_t|\varphi_{t-1} \sim N(0,h_t)$$
$$h_t^{1/2} = A + C_1\left[|\varepsilon_{t-1} + \gamma| - C_2(\varepsilon_{t-1} + \gamma)\right] + \beta_1 h_t^{1/2} + \lambda X_t$$

where R_t : Five minutes return at time t

X_t : variance of expoenous variable at time t

h_t : conditional variance at time t

$\alpha, \beta, \theta, A\ , B_1, C_1, C_2,, \lambda, \gamma$: Parameters

And an exogenous TGARCHM can be modeled as follows.

$$R_t = \alpha + \beta h_t^{1/2} + \varepsilon_t - \theta\varepsilon_{t-1}$$
$$\varepsilon_t|\varphi_{t-1} \sim N(0,h_t)$$
$$h_t^{1/2} = A + C_1\left[|\varepsilon_{t-1}| - C_2\varepsilon_{t-1}\right] + \beta_1 h_t^{1/2} + \lambda X_t$$

where R_t : Five minutes return at time t

X_t : variance of expoenous variable at time t

h_t : conditional variance at time t

$\alpha, \beta, \theta, A\ , B_1, C_1, C_2,, \lambda$: Parameters

IV. Empirical Results

The main purpose of this study is to examine the short-term dynamics between TAIMAX and SIMAX. We investigate contemporaneous and lead-lag relations to find a possible contrariness between markets. Table 1 shows the contemporaneous dynamics from TAIMEX to SIMEX. In TGARCHM setting, we document a significant information transmission from TAIMEX to SIMEX. The empirical results were consistent in SGARCHM and AVGARCHM settings. Information transmissions between the two markets are significant. It also shows that the systematic risk in TIMEX is also in SIMEX and the policy changes from TIMEX to SIMEX have efficient transmission although they have geographic differences. It also implies that the two markets actually are integrated in term of information transmissions.

We examine the other way around from SIMEX to TIMEX. The empirical results were exhibited in table 2. In contemporaneous framework, we expect the same results from SIMEX to TIMEX. The empirical results confirm our prior expectation. Information transmissions from SIMEX to TIMEX show a significant efficiency. In our TGARCHM, SGARCHM and AVGARCHM settings, we find significant spillovers from SIMEX to TIMEX. The empirical result is consistent with the market integration between two markets.

We take a further step to investigate the lead-lag relation between these two markets. A lead-lag relation represents an arbitrage opportunity. We may develop a contrariness to buy the low and sell the high and simultaneously earn an arbitrage profit. Based on the concept, we have to identify the lead lag direction first therefore we set TAIMEX lead a five minutes and SIMEX lag a five minutes. Secondly, we have to show a significant dynamic in our lead lag setting. Table 3 shows the empirical results. We apparently cannot take an arbitrage profit from our setting because the lead lag relation is insignificant in our TGARCHM and AVGARCHM settings. In other words, TAIMEX is not a leading market of SIMEX. The information transmission is contemporaneous and is not allow a lead lag even in a five minutes dynamic. It also implies that SIMEX is efficient in transmitting TAIMEX information. In other words, we cannot use TAIMEX information to stimulate SIMEX and TAIMEX shocks are ineffective in SIMEX within a short five minutes interval.

However, we find a different picture on the other way around from SIMEX to TAIMEX. The five minutes contrariness works in the case. SIMEX show significant spillovers to TAIMEX in our lead lag setting no matter what models we use. The empirical findings were exhibited in table 4. We document the strong lead lag relation from SIMEX to TAIMEX due to capital market efficiency. First, SIMEX uses Morgan Taiwan index which is popular in term of information transmission and in investment banking industry. It explains the efficiency in SIMEX. Second, SIMEX uses quarterly term plus current and next months in trades which is more efficient than quarterly basis in TAIMEX in term of trading terms. Third, the trading hours explain some of the efficiency in SIMEX. TAIMEX is under one session trade from 9:00 to 12:15 while SIMEX is under two sessions of 8:45-12:15 and 14:45-19:00. From liquidity point of view, SIMEX is more efficient. Fourth, price ceiling is more restricted in 7% of TAIMEX. SIMEX sets a 7% ceiling but allows a higher ceiling of 10% in 15 minutes after hitting the ceiling.

V. Summary

Information transmission between TAIMEX and SIMEX is the major focus of this research. We employ Hentschel's (1995) nesting GARCH approach to identify price behaviors in TAIMEX and SIMEX. We find SGARCHM, AVGARCHM and TGARCHM are good fits in describe their price behaviors. Our empirical findings suggest that information transmissions between TAIMEX and SIMEX are efficient and the market integration was supported. We also investigate the lead lag relation between two markets and find the leading in SIMEX. The efficiency of SIMEX was attributed to the popularity in trading index, trading term, trading hours and price ceiling restrictions.

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Table 1. Contemporaneous Volatility dynamics from TAIMEX to SIMEX

Models	TGARCHM	SGARCHM	AVGARCHM
α	.00732269	.000301667	.00671002
	(21.020***)	(6.061***)	(21.763***)
A	.00000934	.000003989	.00006541
	(24.919***)	(19.084***)	(7.251***)
B1	.967422	.950171	.982796
	(1008.67***)	(735.92***)	(472.51***)
θ	.027517	.028626	.068195
	(2.542**)	(1.824*)	(5.108***)
C1	.017011	.077845	.006395
	(13.426***)	(36.360***)	(3.008***)
C2	-.999946	------	-.999799
	(-6.215***)	------	(-1.211)
λ	-.012281	-.035086	-.028362
	(-14.926***)	(-19.626***)	(-21.037***)
β	-1.61845	-.122190	-2.14702
	(-13.866***)	(-4.143***)	(-20.399***)
γ	-------	-------	-.003494
	-------	-------	(-4.083***)
Log Likelihood	1461.45	2903.08	2903.08

*** 1% significant level

** 5% significant level

* 10% significant level

Table 2. Contemporaneous Volatility dynamics from SIMEX to TAIMEX

Models	TGARCHM	SGARCHM	AVGARCHM
α	.0101077	.0001289	.000198
	(48.031***)	(3.208***)	(2.661***)
A	.00000338	.00000315	.00000875
	(31.079***)	(57.291***)	(28.519***)
B1	.993585	.980978	.943825
	(5097.48***)	(2921.63***)	(507.52***)
θ	.0600305	-.012028	-.043773
	(9.667***)	(-1.095)	(-2.718***)
C1	.003296	.031338	.072895
	(13.506***)	(55.212***)	(30.640***)
C2	-.999161	------	-.016512
	(-6.889***)	------	(-.365)
λ	-.005420	-.030744	-.003933
	(-20.198***)	(-75.068***)	(-2.267**)
β	-3.75178	-.065548	-.142838
	(-40.019***)	(-2.116**)	(-4.104***)
γ	-------	-------	-.000723
	-------	-------	(-11.532***)
Log Likelihood	3025.19	4118.84	4114.66

*** 1% significant level

** 5% significant level

* 10% significant level

Table 3. Lead-lag Volatility dynamics from TAIMEX to SIMEX

Models	TGARCHM	SGARCHM	AVGARCHM
α	.005806	-.000453	.005654
	(16.010***)	(-2.362**)	(14.940***)
A	.0000144	.000086	.000013
	(14.969***)	(11.891***)	(14.132***)
B1	.933821	.922577	.936775
	(272.55***)	(193.96***)	(261.424***)
θ	-.009086	.027697	-.006011
	(-.602)	(1.365)	(-.411)
C1	.032567	.068936	.027408
	(9.803***)	(18.215***)	(8.896***)
C2	-.999579	------	-.999586
	(-5.741***)	------	(-4.569**)
λ	.000753	-.002439	.000698
	(.306)	(-3.959***)	(.318)
β	-.774394	.165400	-.811530
	(-6.860***)	(2.160**)	(-6.739***)
γ	-------	-------	-.000555
	-------	-------	(-1.730*)
Log Likelihood	1004.3	2853.75	2851.01

*** 1% significant level

** 5% significant level

* 10% significant level

Table 4. Lead-lag Volatility dynamics from SIMEX to TAIMEX

Models	TGARCHM	SGARCHM	AVGARCHM
α	.005745	-.000280	.001347
	(63.387***)	(-2.791***)	(37.452***)
A	.00000371	.000065	-.00000436
	(22.785***)	(27.999***)	(-15.028***)
B1	.984120	.820690	.946327
	(1272.51***)	(181.416***)	(447.593***)
θ	-.030424	.062865	.002950
	(-2.793***)	(5.416***)	(.202)
C1	.013452	.252550	.071850
	(13.783***)	(41.942***)	(31.211***)
C2	-.999299	------	-.426427
	(-7.726***)	------	(-8.695***)
λ	-.004333	-.028799	.013031
	(-4.166***)	(-12.712***)	(6.395***)
β	-1.73493	.081911	-.661531
	(-38.576***)	(2.798**)	(-27.827***)
γ	-------	-------	-.000555
	-------	-------	(-9.584***)
Log Likelihood	2250.51	3287.29	2851.01

*** 1% significant level

** 5% significant level

* 10% significant level