

Market Opening and Stock Market Behavior: Taiwan's Experience

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Abstract

This paper studies the impact of market opening on stock market behavior. Taiwan opened its stock market in January 1, 1991. Using stock market data from Taiwan for both before and after the opening event, we found that while there is no significant changes in the stock mean returns, volatility is significantly reduced three months after Taiwan opened its stock market. As a result, the market efficiency, as measured by the Sharpe ratio, significantly increases three months after the opening event.

Key words: market opening; volatility; market efficiency

JEL classification: G14

1. Introduction

Capital mobility has been a significant feature in the global financial markets. Many countries opened up their stock markets to foreign investors in the past twenty to thirty years. It is important for governments and investors to evaluate the impact of the market opening on the market behavior. For example, does the opening increase speculation in the market and thus make the market more volatile and more vulnerable to foreign shocks?

Kawakatsu and Morey (1999a, 1999b) examine whether emerging market equity prices have become more efficient after financial liberalization. They find that liberalization does not improve the efficiency of emerging markets. In fact, they find

Received June 25, 2001, accepted October 15, 2001.

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that the markets were already efficient prior to the actual liberalization. Henry (2000) finds that emerging market openings are associated with a 3.3% increase per month in market returns during an eight-month window leading up to the implementation of its initial stock market liberalization. Henry argues that this is due to the fact that stock market liberalization may reduce the liberalizing country's cost of equity capital by allowing for risk sharing between domestic and foreign agents.

In this paper we investigate the impact of market opening on the market behavior in the Taiwan Stock Exchange. We will examine the change in market return, volatility, and market efficiency. In the next section we will introduce the methodology. Section 3 presents our results and is followed by some concluding remarks in Section 4.

2. Methodology

We use the Taiwan Stock Exchange (TSE) index data to empirically compare the market behavior before and after the event day (opening day). Specifically we examine the change of market return, volatility, and market efficiency. Taiwan opened its stock market on January 1, 1991. We use data from January 1, 1990 to January 1, 1992. Our data covers a two years period with one year of data before the opening event and one year of data after it. The data are retrieved from Datastream. We use continuously-compounded daily returns in this study: $r_t = \ln(p_t / p_{t-1})$, where p_t is the TSE index level on day t .

2.1 Volatility

We examine the change of volatility by comparing the variance of the returns before and after the event day. We will use $\{r_{1t}\}_{t=1}^{n_1}$ to denote the n_1 days of r_t immediately before the opening event, and $\{r_{2t}\}_{t=1}^{n_2}$ to denote the n_2 days of r_t immediately after the opening day. These two groups' data are indexed by $i = 1, 2$. Let σ_i^2 denote the variance of $r_{it}, i = 1, 2$. Then the null hypothesis of no volatility change is

$$H_0^a : \sigma_1^2 = \sigma_2^2$$

against the alternative hypothesis $H_1^a : \sigma_1^2 \neq \sigma_2^2$.

Note that r_{it} is the t th observation in the i th group ($i = 1, 2; t = 1, \dots, n_i$), and define $x_{it} = |r_{it} - \bar{r}_i|$, where $\bar{r}_i = n_i^{-1} \sum_{t=1}^{n_i} r_{it}$ is the sample mean of $\{r_{it}\}_{t=1}^{n_i}$ ($i = 1, 2$). The test statistic [Levene statistic, see Levene (1960)] we use is the ratio of between-group to within-group variance for x_{it} :

$$L = \frac{\sum_{i=1}^2 n_i (x_{i.} - x_{..})^2}{\sum_{i=1}^2 \sum_{t=1}^{n_i} (x_{it} - x_{i.})^2 / \sum_{i=1}^2 (n_i - 1)}, \quad (1)$$

where

$$x_{i.} = \frac{1}{n_i} \sum_{t=1}^{n_i} x_{it} \quad \text{and} \quad x_{..} = \frac{\sum_{i=1}^2 \sum_{t=1}^{n_i} x_{it}}{n_1 + n_2}. \quad (2)$$

Under H_0^a and the assumption that r_{it} is independently and normally distributed, the test statistic L has an $F(2, n_1 + n_2)$ distribution. However, as pointed out by Brown and Forsythe (1974), the Levene statistic L is sensitive to non-normality in the distribution of r_{it} .

It is well known that stock returns, especially daily returns, have fat-tailed distributions and hence are non-normal. To deal with non-normality of stock return data, we will use a bootstrap method to obtain the critical values of the test statistic L . The bootstrap steps are as follows: Collect data for k days before and after the opening event, the $2k$ daily returns are used to compute the Levene statistic. The bootstrap sample is randomly drawn with replacement and subsequently divided into two groups, with the first k assigned to group 1 and the remaining k to group 2. The Levene statistic is computed using the bootstrap group 1 and group 2 data. This procedure is repeated 1,000 times to give 1,000 bootstrap Levene statistics which are used to yield bootstrap significance levels for the original Levene statistic. See Efron and Tibshirani (1993) for general discussions on using the bootstrap method to approximate finite sample null distributions of test statistics. Similar approaches are also used by Li, Lin, and Li (1997) and Li and Lin (1998) to examine the volatility changes in China's stock market.

2.2 Mean Return

To assess the impact of market openings on mean return, we compute the mean returns before and after the event. Denoting these by $\mu_i = E(r_{it})$ ($i = 1, 2$), we test the null hypothesis of equal mean return:

$$H_0^b : \mu_1 = \mu_2$$

against the alternative hypothesis $H_1^b : \mu_1 \neq \mu_2$.

For k trading days before and k days after the event, we denote the return by $(r_{11}, r_{12}, \dots, r_{1k})$ and $(r_{21}, r_{22}, \dots, r_{2k})$, respectively. The test statistic is

$$t(r) = \frac{\bar{r}_1 - \bar{r}_2}{\sqrt{\hat{\sigma}_1^2/k + \hat{\sigma}_2^2/k}}, \quad (3)$$

where \bar{r}_i and $\hat{\sigma}_i^2$ are the sample mean and sample standard deviation of $\{r_{it}\}_{t=1}^k$, respectively ($i = 1, 2$). To address the non-normal distribution of stock returns, we test H_0^b using bootstrap significance levels. The bootstrap procedure is the same as discussed in the previous section except that now we use the bootstrap sample to

compute the $t(r)$ test defined in (3). The bootstrap procedure is repeated 1,000 times to give 1,000 bootstrap $t(r)$ statistics which are used to yield bootstrap significance levels for the original $t(r)$ statistic.

2.3 Sharpe Ratio

To examine the reward-to-risk ratio of Taiwan's stock market after the opening event, we compare the Sharpe ratio change before and after the event day. A higher return or a smaller volatility leads to a higher Sharpe ratio.

Recall that $\bar{r}_i = n_i^{-1} \sum_{t=1}^k r_{it}$ is the sample mean and σ_i is the sample standard deviation of $\{r_{it}\}_{t=1}^k$. Also let $r_{f,it}$ denote the continuously-compounded daily risk-free return on day t of the i th group, i.e., $r_{f,it} = \ln(m_{it}/m_{i,t-1})$, where m_{it} is the risk-free index on day t for the i th group. Let $r_{f,i} = E[r_{f,it}]$ denote the mean value of the risk-free return for group i . Group i 's Sharpe ratio is defined as the ratio of excess return to return's standard deviation [$\mu_i = E(r_{it})$]

$$SR_i = \frac{\mu_i - r_{f,i}}{\sigma_i},$$

where $\mu_i = E(r_{it})$.

The null hypothesis is

$$H_0^c : SR_1 = SR_2$$

against the alternative hypothesis $H_1^c : SR_1 \neq SR_2$.

Our test statistic for testing H_0^c is given by

$$SR_D = \sqrt{k/2} (SR'_{1,k} - SR'_{2,k}),$$

where

$$SR'_{i,k} = (\bar{r}_i - \bar{r}_{f,i}) / \hat{\sigma}_i,$$

with $\bar{r}_i = n_i^{-1} \sum_{t=1}^k r_{it}$ and $\bar{r}_{f,i} = n_i^{-1} \sum_{t=1}^k r_{f,it}$.

It can be shown that SR_D has an asymptotic (as $k \rightarrow \infty$) standard normal distribution under H_0^c . To better approximate the finite sample null distribution of the test statistic, we use the bootstrap method to obtain the significant level of the test statistic. The bootstrap procedure is similar to that discussed earlier.

3. Empirical Results

We empirically examine the stock market behavior change in Taiwan's stock market after the opening event.

3.1 Market Volatility

First we report the result of testing whether the volatility changes after the opening event. In Table 1 we report the sample standard deviation of stock returns for k days before and after the opening event, where $k = 15, 30, 50, 75, 100, 150, 200$. As can be seen from Table 1, except for the $k = \pm 15$ case, sample standard deviations after the event day are all smaller than the corresponding counterparts before the event day.

The Levene statistic and its significance levels (using the bootstrap method) are also reported in Table 1. We reject the null of $\sigma_1^2 = \sigma_2^2$ in favor of $\sigma_2^2 < \sigma_1^2$ for $k \geq 75$ at the 1% level. This outcome suggests that by opening the market, the volatility of Taiwan's stock market did not change for the immediate three months after the event. However, between three months to one year after the opening event, Taiwan's stock volatility is significantly reduced.

Table 1. Testing Volatility Change

	± 15	± 30	± 50	± 75	± 100	± 150	± 200
Std Dev (Before)	0.0445	0.0495	0.0493	0.0488	0.0492	0.0486	0.0442
Std Dev (After)	0.0526	0.0447	0.0401	0.0354	0.0330	0.0298	0.0287
Levene Statistic	0.2540	0.3840	1.8840	9.8020	26.0700	61.2900	48.9300
Significance Level	0.5930	0.5490	0.1850	0.0010	0.0000	0.0000	0.0000

3.2 Mean Return

The computed mean returns \bar{r}_i , the test statistic $t(r)$ for testing H_0^b , and the bootstrap significance level (using k days data) are reported in Table 2.

Table 2. Testing Mean Return Change

	± 15	± 30	± 50	± 75	± 100	± 150	± 200
Mean $\times 10^2$ (Before)	-0.641	0.542	1.095	0.316	-0.176	-0.425	-0.463
Mean $\times 10^2$ (After)	-1.115	0.296	0.099	0.313	0.231	0.078	-0.017
Test Statistic	0.267	0.202	1.108	0.004	-0.687	-1.080	-1.198
Significant Level	0.397	0.407	0.119	0.531	0.744	0.858	0.882

We observe a systematic pattern that, for $t \leq 75$, the mean returns after the opening are less than that before the opening. However, for $t \geq 100$, the mean returns after the opening become larger than those before the opening. However, the significance levels (using the bootstrap method) show that, for all the sample period considered, we cannot reject the null hypothesis of $\mu_1 = \mu_2$. Therefore, we conclude that there is no significant change in mean return one year before and one year after the opening event.

3.3 The Sharpe Ratio

From the results of Tables 1 and 2, we know that the variance (or standard

deviation) of the return is significantly reduced after the opening event for $k \geq 75$, while we cannot reject the hypothesis that the mean returns remain unchanged before and after the opening event for all the k -values considered. From these results one would expect that the Sharpe ratio should be significantly increased after the opening day for $k \geq 75$.

Table 3 reports the result of testing the equality of Sharpe ratio using k days data. We observe that while we cannot reject the null hypothesis of H_0^c for $k \leq 75$, H_0^c is rejected for $k \geq 100$ at the 1% level. Therefore, we conclude that the Sharpe ratio is significantly increased three months after Taiwan opened its market.

Table 3. Sharpe Ratio Change

	± 15	± 30	± 50	± 75	± 100	± 150	± 200
S-Ratio (Before)	-0.1440	0.1100	0.2210	0.0648	-0.0358	-0.0875	-0.1050
S-Ratio (After)	-0.2110	0.0662	0.0246	0.0884	0.0701	0.0261	-0.0058
Significant Level	0.2300	0.4690	0.5680	0.1460	0.0020	0.0000	0.0010

The above results show that, while there is no significant change in mean return before and after the opening day for Taiwan's stock exchange market, volatility significantly decreased three months after Taiwan opened its stock market. As a result, the Sharpe ratio is significantly increased three months after the opening event.

4. Concluding Remarks

It should be mentioned that there might be other factors affecting stock return and volatility. For example, the Persian Gulf War also occurred around the event date (I owe this observation to a referee). Iraq occupied Kuwait on August 2, 1990, and the Persian Gulf War took place from January 16, 1991 to February 28, 1991. All these occurred during our data period. Of course it is difficult, if not impossible, to disentangle the effect of the Persian Gulf War from the opening event. One way to minimize the Persian Gulf War effect is to remove the data m days before and after the event day. For example if we choose $m = 100$ or $m = 150$, we remove data three months or five months before and after January 1, 1991. The Persian Gulf War should have much less effect on Taiwan's stock market for the remaining period. The estimation results using the remaining data still show a significant reduction in volatility, and a significant increase in Sharpe-Ratio. Thus, our findings seem to be robust to the Persian Gulf War effect.

In summary, the results indicate that foreign investors have had a stabilizing influence on the Taiwan stock market. The liberalization of the capital market enables risk sharing between domestic and foreign investors. Large international investors tend to study companies more thoroughly. The involvement of foreign investors means a better dissemination of information, which leads to a more efficient market.

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