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Abstract: The Zivot and Andrews (1992) one-break and Lumsdaine and Papell (1997) two-break unit root tests are used to investigate the random walk hypothesis in Thai stock prices for the period December 1987 to December 2005. The results provide strong evidence that the Thai stock prices are characterized by a random walk, supporting this view that it is highly unlikely to make windfall profits in the Thai stock market using past price movements. Moreover, the dates of the endogenously determined structural break interestingly coincided with the Asian crisis and world recessions.

Keywords: Stock Market Management; Random Walk; Structural Break; Thailand.

JEL Classification: G14, G15, C22

1. Introduction

Stock markets are important to promote the growth of the economy. The essential function of stock markets is to allocate funds from the savers to the investors, which lead to the efficient productivities and economic growth. However, it does not mean that stock market is always beneficial to the economy. There are a great number of studies in financial literature that found an inefficient market cannot serve the economy as much as an efficient market. The efficient market hypothesis means the stock prices always reflect all the information which is available for participants. If the efficient market hypothesis is in perfect condition, there is no point to predict the value of the stocks. However, in emerging markets stock prices cannot reflect their real value and the efficient market hypothesis have thus been widely investigated in the financial studies (Narayan and Smyth, 2005; Narayan and Smyth, 2006). The Asian financial crisis in 1997 first began with the floating of the Thai currency in July 1997 and then spread rapidly to the Philippines, Malaysia, Indonesia and Korea (Barro, 2001). Following this crisis relatively small depreciation also engulfed Singapore and Japan. In this respect, the examination of structural breaks in Thailand is an interesting case.

The analysis of the efficient market hypothesis can be attributed to Fama (1970), who classified efficiency into three types: weak, semi-strong and strong forms of efficiency. First, only stock price data are referred to as the weak form of efficiency. Then semi-strong form, stock prices are not only determined by the historical prices, but also by all publicly available information such as financial statements and macroeconomic data. Finally, strong form is concerned with all previously mentioned information sources as well as insider information. There are several approaches to testing the efficiency of stock markets. Nonetheless, the random walk hypothesis has been widely used by a large number of financial analysts and these studies have produced different results (Chaudhuri and Wu, 2003).

Our study differs from previous studies in two ways. First, while most previous studies have focused on developed markets, few studies have examined the emerging markets. This paper tests the random walk hypothesis using Thai stock prices because it can be considered as a typical emerging stock market. In 2004, market turnover, number of listed domestic companies and value traded on the Stock Exchange of Thailand (SET) was 93.8 per cent, 465 companies and USD109949 million, respectively. The SET was classified as the 9th highest among emerging markets in terms of all above three measures, and the 19th, 20th and 24th on a global scale, respectively. In terms of market capitalization, the SET reached a record high USD115400 million which ranked 12th highest among all emerging markets and 31st in the world (Standard and Poor's, 2005).

Second, the Zivot and Andrews (ZA, 1992) one-break and Lumsdaine and Papell (LP, 1997) two-break tests are employed in addition to the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to test for the random walk hypothesis. Chaudhuri and Wu (2003) employed the ZA test which incorporates one structural break in trend function to examined the random walk hypothesis in emerging markets, however none of previous studies employed a two-break test in the context of Thai stock market. As Ben-David, Lumsdaine and Papell (2003) argued, if there are two structural breaks in the deterministic trend, then unit root tests with one structural break will also lead to a misleading conclusion.

The remainder of the paper is as the follows. Section 2 discusses briefly the data and methodology utilized in the analysis. Section 3 presents the empirical results. Section 4 provides some concluding remarks.

2. Data and Methodology

Monthly stock prices of Thai stock market over the period December 1987 to December 2005 with a base value of 100 in December 1987 were obtained from Morgan Stanley Capital International. We, first, perform the ADF unit root test to examine the time series properties of the data without allowing for any structural breaks using the following equation:

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{1}$$

where y_t denotes the time series being tested, Δ is the first different operator, t is a time trend term, k denotes the number of lagged terms and ε is a white noise disturbance term. To select the lag length (k), we use the sequential procedure suggested by Campbell and Perron (1991) with the maximum lag length (k_{max}) set to 12. In addition, the PP test has been used as an alternative nonparametric model to control for serial correlation in the testing procedure.

A main shortcoming associated with the ADF and PP tests is that they do not allow for the effect of structural breaks. Perron (1989) argued that if a structural break in a series is ignored, unit root tests can be erroneous in rejecting null hypothesis. ZA (1992) have developed methods to endogenously search for a structural break in the data. We employed model C which is the most comprehensive specification whereby a structural break in both the intercept and slope is allowed in the following equation:

$$\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{2}$$

where $DU_t = 1$ if $t > TB$, otherwise zero; TB denotes the time of break, $DT_t = t - TB$ if $t > TB$, otherwise zero. The lag length is selected using the same approach as in the ADF test. The "trimming region" in which we have searched for TB cover the 0.15T-0.85T period. We have chosen the break point base on the minimum value of t statistic for α.

LP (1997) argued that a unit root test that accounts for two structural breaks can be more powerful than those which only accommodate for one structural break. They introduced a new procedure to capture two structural breaks as an extension of model C by including two endogenous breaks in Equation (1). Consequently, model CC can be represented as follows:

$$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{3}$$

where $DU1_t = 1$ if $t > TB1$, otherwise zero; $DU2_t = 1$ if $t > TB2$, otherwise zero; $DT1_t = t - TB1$ if $t > TB1$, otherwise zero; $DT2_t = t - TB2$ if $t > TB2$, otherwise zero. Two dummy variables (*i.e.* $DU1_t$ and $DU2_t$) are indicators for structural breaks in the intercept at $TB1$ and $TB2$, respectively. However, the other dummy variables (*i.e.* $DT1_t$ and $DT2_t$) are indicators for structural breaks in trend at $TB1$ and $TB2$, respectively. The lag length and break points are selected using the same approach as in the ZA test.

3. Empirical Results

As mentioned earlier, we first used the ADF and PP tests to determine the order of integration of the Thai stock prices. Based on the results of the unit root tests presented in Table 1, the ADF and PP tests cannot reject the random walk hypothesis. We thus concluded that Thai stock prices employed in this paper are I(1), in other words, they follow a random walk.

[Table 1 about here]

In the second stage, we subject each variable to one and two structural breaks. For each series, we then estimated model C and reported the results in Table 2. The Thai stock prices still contain a unit root, similar to the ADF and PP tests. According to the ZA test, the estimated coefficients μ and θ are statistically significant, therefore at least there has been one structural break in the intercept during the sample period for the Thai stock prices. The reported *TB*s are endogenously determined in the ZA test. It is not surprising to note that most important structural break in the Thai stock prices occurred in 1996 just before the Asian crisis.

[Table 2 about here]

Table 3 presents the results of the LP test allowing for the two most significant structural breaks. The results once again confirm that we cannot reject the hypothesis of a unit root in the Thai stock prices for the two-break case. The estimated coefficients for θ, γ, ω and ψ are all statistically significant indicating that structural changes at *TB*1 and *TB*2 have impacted on both the intercept and trend. Moreover, two important breaks occurred in 1993 and 2000, which coincide with two world-wide recessions.

[Table 3 about here]

4. Conclusion

The main purpose of this empirical analysis is to examine the random walk hypothesis in Thai stock prices using monthly data for the period December 1987 to December 2005. The results of the ADF and PP tests suggest that there is a unit root in the stock prices; supporting a weak form of efficiency. In addition, the results of both the ZA test (including one endogenously-determined structural break in the testing procedure) and the LP test (including two endogenously-determined structural breaks in the testing procedure) did not provide any evidence against random walk hypothesis for the Thai stock prices. It is interesting to recognise that the dates of the estimated structural breaks coincide with the Asian crisis (*i.e.* 1997) and two world-wide recessions (*i.e.* 1993 and 2000). According to the weak form of the efficient market hypothesis, the Thai stock prices completely reflect the information contained in the data and consequently no one can devise an investment strategy to obtain abnormal profits on the basis of an analysis of past price patterns.

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Table 1: Unit Root Test Results, December 1987-December 2005

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$$

Variable	ADF test		PP test	
	No trend	Trend	No trend	Trend
$\ln P_t$	-1.4089 (0)	-1.9847 (0)	-1.4812 (5)	-2.0463 (5)
$\Delta \ln P_t$	-8.5907*** (1)	-8.5677*** (1)	-14.1899*** (7)	-14.1695*** (7)

Notes: (a) For the ADF test, the lag lengths are in the parentheses while for the PP test the bandwidth if in the parentheses. (b) *** indicates that the corresponding null hypothesis is rejected at the 1 per cent significance level.

Table 2: The Zivot and Andrews (1992) Test Results

$$\Delta y_t = \mu + \beta t + \theta DU_t + \gamma DT_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$$

Estimated parameters	Model C
TB	1996:10
μ	0.4202*** (3.7875)
β	0.0007 (1.3390)
θ	-0.1703*** (-3.6590)
γ	-0.0001 (-0.0712)
α	-0.0779 (-3.5737)
k	12

Notes: (a) t statistics are in parentheses; *** indicates that the corresponding null hypothesis is rejected at the 1 per cent significance level. (b) Critical value for t_α at the 10, 5, and 1 per cent are -4.82, -5.08 and -5.57, respectively (Zivot and Andrews, 1992).

Table 3: The Lumsdaine and Papell (1997) Test Results

$$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$$

Estimated parameters	Model CC
$TB1$	1993:10
$TB2$	2000:05
μ	0.8008*** (5.1180)
β	0.0012 (1.2946)
θ	0.5379*** (4.1493)
γ	-0.0057*** (-3.7326)
ω	-1.1646*** (-4.6958)
ψ	0.0075*** (4.7489)
α	-0.1529 (-5.0995)
k	12

Notes: (a) t statistics are in parentheses; *** indicates that the corresponding null hypothesis is rejected at the per cent significance level. (b) Critical values for t_α at the 10, 5, and 1 per cent are -6.49, -6.82 and -7.34, respectively (Lumsdaine and Papell, 1997).