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Article

Malaysian finance sector weak-form efficiency: Heterogeneity, structural breaks, and cross-sectional dependence

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ABSTRACT

This study examines the weak-form efficient market hypothesis (EMH) for the Finance Sector in Malaysian Stock Exchange, by exploring and scrutinizing the firm-level efficiency over for the period from 1st January 1997 to 31st December 2014. For this purpose, we apply panel nonlinear unit root test that accounts for heterogeneity, and panel stationarity test to allow for the presence of structural breaks and cross-sectional dependence (CSD). The main findings of this study suggest the following: first, there is a strong CSD among the price series of finance stocks; second, unlike the traditional panel unit root tests that provide mixed-results, the panel stationarity test which incorporates structural breaks and CSD suggests that these series are characterized as random walk processes implying the Finance Sector is weak-form efficient. The finding of weak-form efficiency has salient implications in terms of capital allocation, stock price predictability, forecasting technique, and the impact of shocks to stock prices.

Forma débil de la eficiencia del sector financiero malayo: heterogeneidad, brechas estructurales y dependencia transversal

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RESUMEN

Este estudio examina la forma débil de la hipótesis de los mercados eficientes (EMH) para el sector financiero de la Bolsa de Malasia, explorando y examinando la eficiencia a nivel empresarial durante el período transcurrido entre el 1 de enero de 1997 y el 31 de diciembre de 2014. A tal fin, aplicamos un test de raíz unitaria no lineal del panel para justificar la heterogeneidad, y un test de estacionalidad del panel para permitir la presencia de brechas estructurales y de dependencia transversal (CSD). Los principales hallazgos de este estudio sugieren lo siguiente: en primer lugar, existe una sólida dependencia transversal entre las series de precios de los valores financieros; en segundo lugar, a diferencia de los test tradicionales de raíz unitaria que aportan resultados mixtos, el test de estacionalidad del panel, que incorpora brechas estructurales y dependencia transversal, refleja que dichas series están caracterizadas por procesos de recorrido aleatorio que implican la forma débil de la eficiencia del sector financiero. El hallazgo de la forma débil de la eficiencia contiene implicaciones destacadas en términos de distribución del capital, previsibilidad de los precios de los valores, técnica de previsiones e impacto de las perturbaciones sobre los precios de las acciones.

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1. Introduction

Investors generally believe that stock prices are predictable based on the information of past trading, which this motivates short horizon trading and speculation in the stock market. Technical analysis hints that stock price series will enrol in trends which tend to repeat in future (Dana & Cristina, 2013). The basic tenet of technical theories stipulates that historical stock price behaviour tends to recur in future, thus successive price changes are dependent and can predict future price movements (Fama, 1965). For example, the Dow Theory states that markets are likely to move in trends until reversals are exhibited, in which a primary trend can be either bear or bull market and a secondary trend displays short-term reversal(s) in the primary trend (Ray, 2012). As investors expect to earn excess profits by exploiting any observable trends in stock price series, they prefer to trade for short-term (days, weeks, or months) as well as to speculate rather than using a strategy of simply buy-and-hold.

Short-term investment and speculation in the stock market may cause tremendous adverse impacts on an economy. First, the smooth functioning of stock market in facilitating long-term investment can be disrupted. Levine (1996) has mentioned that, some analysts view the stock markets in developing countries as casinos which have little impact on economic growth. Second, short horizon trading may cause the amplification of market shocks. Cella (2013) found that during market turmoil either as a consequence of actual shocks or due to the fear of future shocks, short-horizon institutional investors have tendency to sell their stockholdings to a large extent, causing the amplification of market shocks. Third, a market which is largely occupied by investors with short investment horizon is likely to be exposed to higher risk of capital inflow reversal. Radelet and Sachs (1998) highlight that, some Asian countries including Malaysia suffered from foreign capital sudden withdrawals during the outbreak of Asian financial crisis in 1997-1998.

However, the prediction of stock prices based on past price information is refuted under the weak-form EMH. The hypothesis claims that stock prices already fully reflect the information contained in the history of past trading (Bodie, Kane, & Marcus, 2008). Consistent with the hypothesis, the theory of random walks affirms that stock price changes have no memory thus historical price data cannot predict the future price movements in any meaningful way (Fama, 1965). The random walk hypothesis (RWH) states that successive price changes are independent, and a random walk model is used to describe the stochastic system of security return generating process. The model is usually applied to examine the weak-form EMH.

To date, the weak-form EMH has remained vital to dictate the behaviour of stock prices. It has several salient implications. First, efficiency is essential in policy making as it enables an effective allocation of capital across different productive sectors in an economy. If market is efficient, stock prices give accurate signals to guide investor decision making. In that sense, efficiency helps to enhance stock market liquidity and in turn stimulates long-term investment and economic growth. Conversely, inefficiency causes higher information costs and fluctuations in stock prices (Hubbard, 2008). Second, if efficiency holds, the information of past trading is useless for predicting future stock price movements. Third, efficiency implies that stock prices fully reflect the information of past trading, thus technical analysis is not likely to be effective in stock price forecast. Fourth, if a stock price series can be characterized as a random walk process, shocks to stock prices are permanent. Following a shock, stock prices will reach a new equilibrium. Hence, future price movements cannot be predicted based on past price information (Narayan & Smyth, 2004; Munir, Kok, & Furouka, 2012). However, if a stock price series displays mean reversion, the impact of shocks to prices is transitory.

Distinct from the majority of past studies emphasizing on the aggregate stock markets, this present study aims to examine the weak-form EMH for the Finance Sector in Malaysian Stock Exchange by exploring and scrutinizing the efficiency of individual finance stocks. This study covers the period from 1st January 1997 until 31st December 2014. We notice that, there are a number of studies on the weak-form efficiency of Malaysian stock market. Some studies report that the market is efficient, for examples, Barnes (1986), Laurence (1986), Annuar and Shamsher (1993a; 1993b; 1994), Kok and Lee (1994), Kok and Goh (1995), Lim, Liew, and Wong (2005), and Munir and Mansur (2009). However, Lai, Balachandher, and Fauzias (2003) found that the Malaysian stock market is inefficient. Further, the findings of Lim (2008) and Cheong (2008) show the evidence of sectoral inefficiency in Malaysia. So far, very limited studies have examined the weak-form EMH using the sample of individual finance stocks. For instance, Lim, Tan, and Law (2007) examine the random walk property of the return series of four bank stocks namely, Hong Leong Bank, Malayan Banking, Public Bank, and Southern Bank, by employing the data until June 2004. Firm-level disaggregation is necessary to pinpoint the efficiency for individual finance stocks. The findings of Narayan, Narayan, Popp, and Ahmad (2015) show that only 15 percent from the total 34 banking firms listed on the New York Stock Exchange are weak-form efficient. This reflects financial firms are heterogeneous.

Finance stock weak-form efficiency in Malaysia is the focus in this study. The motivations for considering the finance stocks are as follows: Firstly, the efficiency of finance stocks in Malaysia has direct implication on the effectiveness of capital allocation across various domestic financial firms (i.e. financial holding companies, commercial banks, insurance companies, capital market intermediaries, and finance companies). This is concerned with economic growth, the core of the country's macroeconomic goal. There are two recent policies highlighting the importance of the domestic finance sector in fostering economic growth. Over the last ten-year period, the Financial Sector Masterplan 2001-2010 (FSMP) has successfully enhanced the capacity of the domestic finance sector and promoted greater stability in the financial system. Throughout this period, policy makers emphasized more on building institutional capacity and strengthening the financial system. After FSMP ends, the Financial Sector Blueprint 2011-2020 was introduced to transform Malaysia into a developed and high income country by the year 2020. In order to reach this target, the size of the financial system has to enlarge by eight to eleven percent per year (Central Bank of Malaysia, 2011). At this stage, the growth-stimulating role of the domestic finance sector is deemed important. As clearly outlined in the Financial Sector Blueprint 2011-2020, the domestic finance sector plays three key roles: the role as an enabler to facilitate the transition of Malaysia to become a high value-added and high-income country by the year 2020; the role as a driver to generate higher national income; and the role as a catalyst to foster a rapid growth in the new niche industries.

Secondly, the importance of finance stock efficiency is due to the critical concern that finance stocks are highly vulnerable as compared to other stocks. During the time of market turmoil, fluctuations in stock market may not show the true picture of vulnerable sectors. However, finance stocks are fragile particularly during financial and banking crises, and the impact of crisis shocks to stock prices can be widespread via potential contagion effect. For listed banks, default risk is systemic or non-diversifiable (Fiordelisi & Marqués-Ibañez, 2013). In addition, banks are more fragile than other firms because of inherent maturity mismatch on their balance sheets which exposes them to potential bank runs.[1]

[1] According to Cabral (2013), since some large banks in the U.S. obtained high profits through balance sheet expansion and growing default, liquidity, and term

Moreover, banking sector contagion is more strong and rapid than other sectors. Further, banks are exposed to shocks emanating from financial system because banks interact most with the real economy (Narayan et al., 2015). Similarly, other financial firms are also exposed to shocks arising from financial system due to their participation in the provision of credit and financial investment products. Finance stock vulnerable and the likelihood of contagion effect are the important concerns of policy makers. To certain extent, these may indicate that financial markets do not respond to shocks from financial system in an efficient manner. The puzzling aspect is not why value has tumbled, but why it ever got so high in the first place (Howell & Bain, 2005). Finance stock efficiency is concerned with the resilience of finance sector. In addition, the prices of finance stocks in an efficient market may signal the emergence of financial crisis. As mentioned by Miller and Luangaram (1998), 'Asset prices can play a key role in signalling concern ex ante and in exacerbating problems when the crisis occurs.'

Nevertheless, bank stock efficiency is relatively more important than the efficiency of other finance stocks. Banks act as the traditional financial intermediaries in many countries. Bank credit predicts the growth in output, capital stock, and productivity (Levine & Zervos, 1998). Moreover, banks are still the key elements in financial system as they owned most of the non-bank financial intermediaries (FitzGerald, 2006).

In this contribution, the main methods used for analysis are the panel nonlinear heterogeneous unit root test developed by Ucar and Omay (2009), and the panel stationarity test advanced by Carrión-i-Silvestre, Barrio-Castro, and López-Bazo (2005) that accommodates the presence of multiple structural breaks and exploits the cross-section variations. In addition, we apply different univariate and panel unit root tests. The motivations for our choice of methodology are clear. Panel data analysis has an advantage of allowing for heterogeneity in individuals, firms, regions and countries, which is absent when using aggregated time series data (Baltagi, 2001). Further, we notice that structural breaks and CSD have not received much attention in the past panel based studies on the stock market efficiency in Malaysia. Unit root tests that do not account for structural breaks will have low power (Perron, 1989). Meanwhile, failing to take into account CSD may cause biased estimates and spurious inference (Chudik, Pesaran, & Tosetti, 2009). Thus, we simultaneously consider structural breaks and CSD in this present study.

Figure 1 depicts the log daily price series of selected Malaysian finance stocks which exhibit major dips around the time of the Asian financial crisis in 1997-1998. There may be other structural breaks in the series. Further, we believe that CSD may exist among the selected financial firms. These firms are highly interdependent in the financial system. International Monetary Fund (IMF, 2014) reveals that in Malaysia, banks, non-bank financial firms, and mutual funds have been highly interconnected through the domestic wholesale funding market.

The rest of this paper is structured as follows: Section 2 surveys the empirical literature. Section 3 discusses the datasets and methodology used. Section 4 reports and illuminates the empirical results. Last section summarizes and concludes the whole paper.

2. Literature review

Until currently, finance stock weak-form efficiency has received very little attention from researchers. Most past studies concentrate on the semi-strong form efficiency of particular bank stocks, but less considering the weak-form efficiency and other finance stocks.

There are a number of past studies on the relationship between firm's operational or technical efficiency and stock returns. Kirkwood and Nahm (2005) study a sample of ten retail banks listed on Australian Stock Exchange for the period of 1995-2002. The data envelopment analysis (DEA) approach is utilized to construct the efficiency frontier. The sources of stock returns are analyzed based on a model of excess return, where profit efficiency is an explanatory variable and captures both revenue and cost efficiencies. Bank's operation efficiency is found to have significant prediction ability on stock returns, implying the semi-strong form EMH is rejected.

Ioannidis, Molyneux, and Pasiouras (2008) study the returns of bank stocks and publicly available information over the period of 2000-2006. The cost and profit efficiencies are estimated for 19 Asian and Latin American public listed banks, including 260 commercial banks and bank holding companies. The finding of study shows that there exists a robust relationship between the changes in profit efficiency with the returns of bank stocks, suggesting profit efficiency can explain bank stock returns better than the traditional profits measure of return on equity.

Kasman and Kasman (2011) investigate the link between the performance of Turkish commercial bank stocks proxy by cumulative annual stock returns computed on monthly basis, with three measures of bank performance including technical efficiency, scale efficiency, and productivity. Efficiency is measured based on the DEA approach, then stock returns are regressed against the changes in bank efficiency measures and bank specific control variables. Over the period of 1998-2008, stock performance is significantly and positively affected by the changes in all three bank efficiency measures.

Janoudi (2014) investigates the relationship between bank efficiency and stock performance in the EU markets using 141 commercial banks over the period 2004-2010. In terms of bank efficiency, the study focuses on both cost and profit efficiencies. Using the stochastic frontier analysis (SFA), the cost and profit efficiencies of the EU banking sectors are estimated. The study further investigates if the changes in cost and profit efficiencies are reflected in the annual stock returns of banks. The finding of study indicates that the effects from both cost and profit efficiencies are significant. It suggests that stocks with cost and profit efficiencies tend to outperform their inefficient counterparts.

Different from the above previous studies, Gaganis, Hasan, and Pasiouras (2013) shift their attention towards insurance industry to further explore the relation between stock returns and firm efficiency. The sample employed consists of 399 insurance companies traded in the stock markets of 52 countries, and the period of study spans from 2002 to 2008. This study found significant positive relationship between profit efficiency and stock returns. However, there is no robust indication for the nexus between cost efficiency and stock returns.

In Malaysia, Habibullah, Makmur, Wan Ngah, Alias, and Ong (2005) find that bank stocks are inefficient in the semi-strong form because the information of bank technical efficiency has significant forecast power on bank stock returns. The DEA method is used to compute the overall technical efficiency for banks, in which the efficiency is decomposed into pure technical, scale and congestion efficiencies. Then, the relationship between technical efficiency and bank stock returns is analyzed. It is found that, the percentage of change in stock prices reflects the percentage of change in the overall technical efficiency.

Sufian and Majid (2007) investigate the X-efficiency and P-efficiency of the Malaysian banks listed on the Kuala Lumpur Stock Exchange during the period of 2002-2003. Using the DEA method, the results indicate that the X-efficiency of banks is on average significantly higher than the P-efficiency. The larger

risk mismatch between assets and liabilities, the leverage of these banks increased as they became less liquid during the financial crisis in 2007-2008.

banks are associated with relatively higher X-efficiency, and the smaller banks show higher P-efficiency. Bank stock prices are seen reacting more to the improvement in P-efficiency as compared to X-efficiency.

Sufian and Haron (2009) examine the efficiency of Malaysian banking sector by using a sample of seven banks listed on Kuala Lumpur Stock Exchange (KLSE), including Affin Bank Berhad, Bumiputera Commerce Bank Berhad, EON Bank Berhad, Maybank Berhad, Public Bank Berhad, Rashid Hussain Bank Berhad, and Southern Bank Berhad. Efficiency is estimated by employing individual bank market data and the DEA method. The findings reveal that Southern Bank Berhad is the most efficient bank, in which it is highly ranked in terms of returns with relatively low standard deviation and beta. All other banks which appear on the efficiency frontier display relative higher mean returns and lower standard deviations and betas. Since the returns on bank stocks are predictable based on the information of bank efficiency, thus the semi-strong form EMH is rejected.

However, the literature of finance stock weak-form efficiency is very limited. Stengos and Panas (1992) examine the weak- and semi-strong form EMH for the four largest banks listed on Athens Stock Exchange, over the period of January 1985-October 1988. By employing the test developed by Brock, Dechert and Scheinkman (1987) and log daily price data, the results are showing there is neither linear nor nonlinear dependency in the stock price series. Thus, the weak-form EMH is valid. In addition, there is no evidence of cointegration and thus no Granger causality between these stocks. This provides support for the semi-strong form EMH.

Bashir, Ilyas, and Furrukh (2011) found the evidence of market inefficiency for 11 high trading volume bank stocks listed

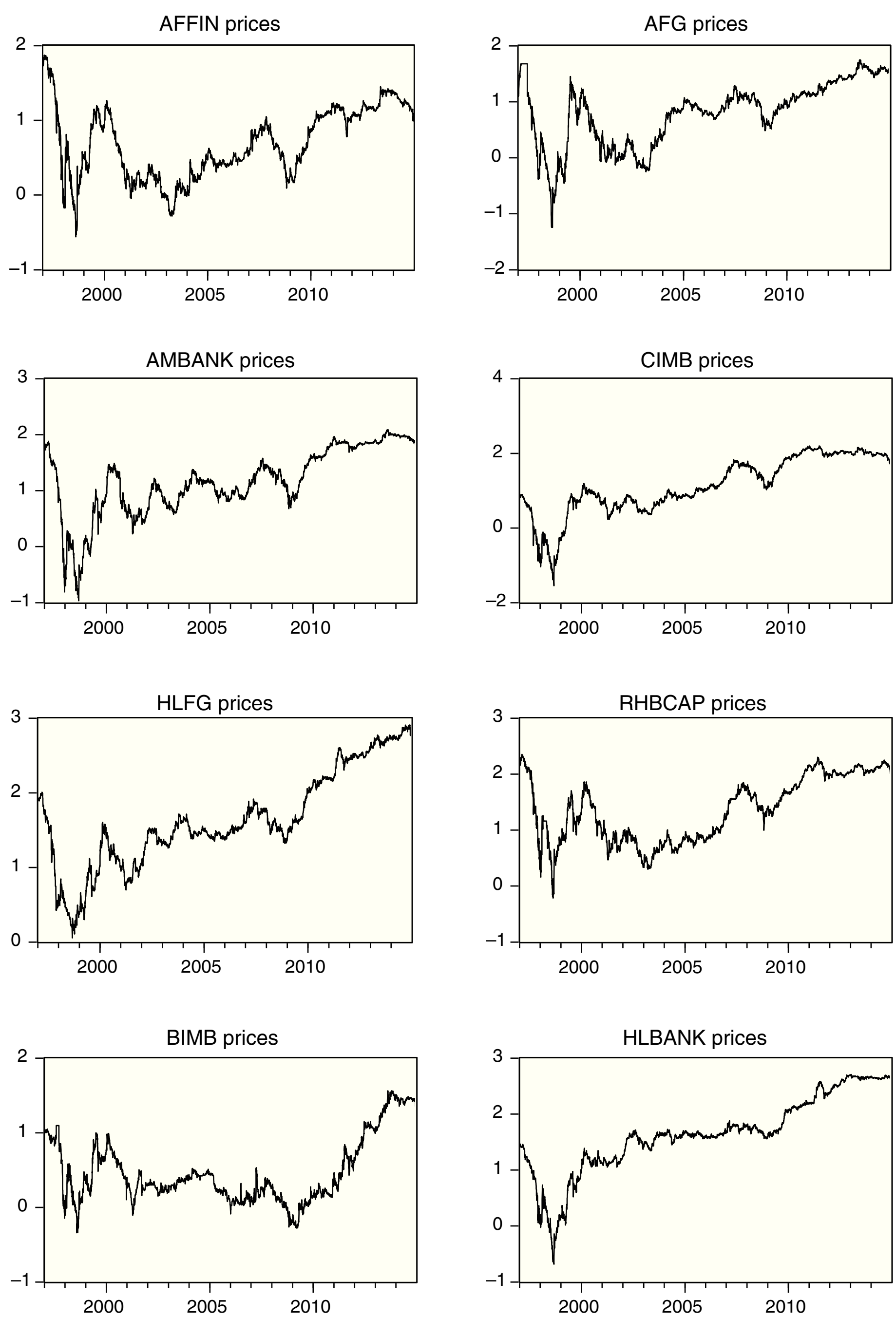

Figure 1. Log daily prices of selected Malaysian finance stocks.
Source: Datastream.

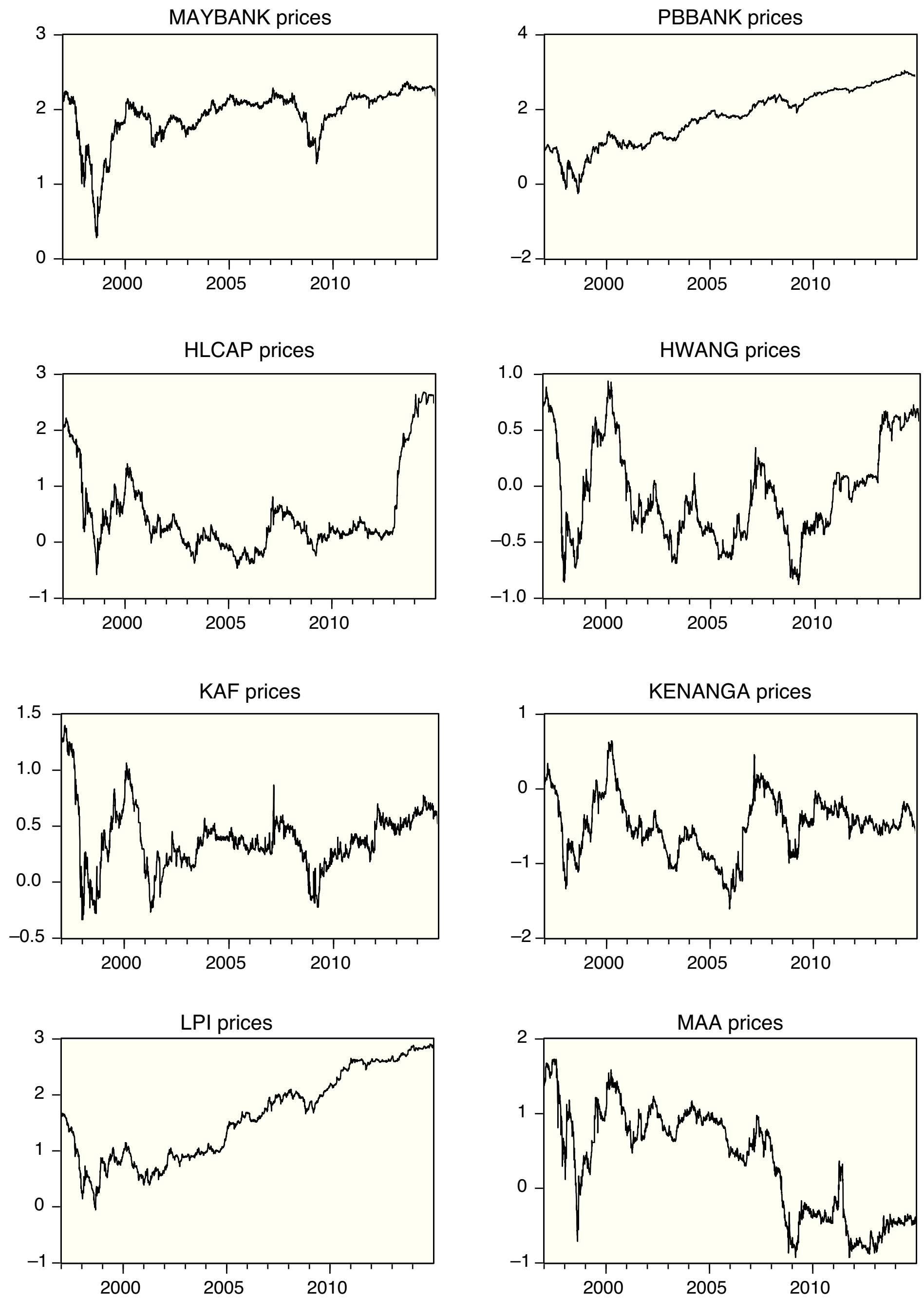

Figure 1. (*Continued*)

on Karachi Stock Exchange, over the period of June 1997-April 2009. The study employs ADF and PP tests for stationarity check, and co-integration and VAR tests for testing the weak-form EMH. The estimation is applied on bank stock daily closing prices. The observed inefficiency is explained as a consequence of speculative bubbles.

Narayan et al. (2015) examine the weak-form EMH for 34 banking-related stocks from NYSE by using the daily stock price data over the period of 2nd January 1998-31st December 2007. The authors claim that EMH and day-of-the-week hypothesis are interrelated. Thus, they propose the hypothesis that EMH is day-of-the-week dependent. The Augmented Dickey-Fuller (1979) test and Bai and Perron (1998) procedure that allows for the maximum number of breaks for each series indicate that market efficiency is day-of-the-week dependent. The unit root tests applied to each of the five trading days indicate that the null hypothesis of a unit root is rejected for all five trading days, for 21 firms which represent about 62 percent of the whole sample. The overall findings of the study are against the weak-form EMH.

Instead of bank stocks, Chiş (2012) uses sample of study related to the insurance industry. The study explores on the weak-form efficiency of insurance company unit-linked funds. In order to empirically assess the return predictability of eight ING unit-linked funds, the martingale difference hypothesis (MDH) is examined for the period of 21st July 1999-1st June 2012, which posits that stock returns are uncorrelated with their past values. The MDH is rejected for almost all unit-linked fund markets, except for ING Poland Bonds Sub-Fund and ING Poland Balanced Sub-Fund. This implies that most of these markets are yet to achieve the weak-form efficiency.

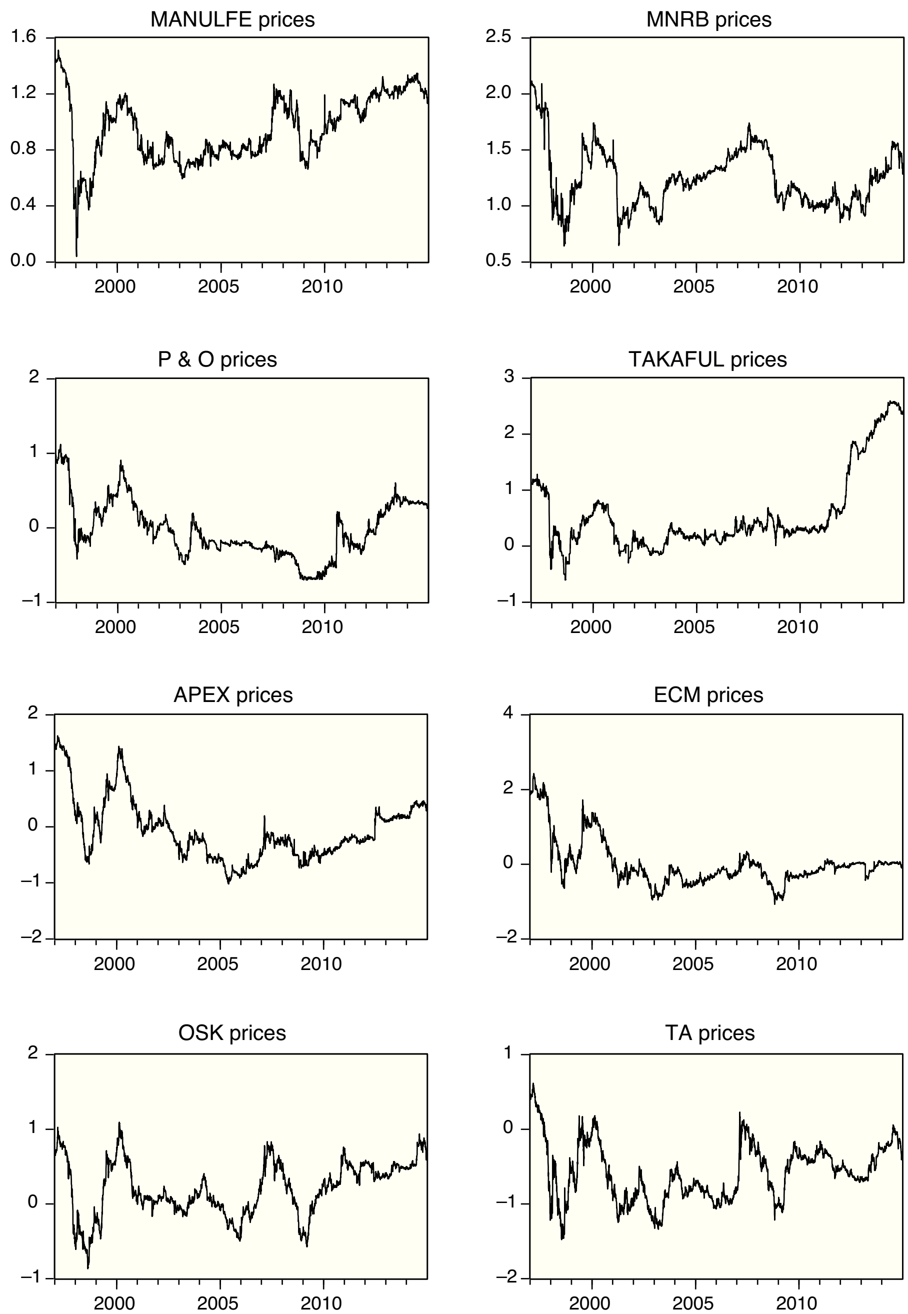

Figure 1. (*Continued*)

In Malaysia, Lim et al. (2007) study the random walk behaviour of stock prices using a sample of four bank stocks, namely Hong Leong Bank, Malayan Banking, Public Bank, and Southern Bank. The analysis of study is by employing the log daily returns data for the period of 1st January 1990-30th June 2004. The results of the windowed-test procedure of Hinich and Patterson (1995) show the presence of linear and nonlinear dependencies in the series, but the observed patterns are non-persistent. The findings suggest that the task of designing a profitable trading rule based on these patterns is extremely difficult.

3. Data and methodology

3.1. Datasets

We use balanced datasets of finance stock price series covering the period from 1st January 1997 to 31st December 2014, in which we obtain a total of 4696 observations for each series. The daily closing prices data of individual finance stocks are sourced from Datastream. Out of 34 finance stocks, we select 28 stocks to be included as the sample of study. These include six financial holding companies: Affin Holdings Berhad (AFFIN), Alliance Financial Group Bhd (AFG), AMMB Holdings Berhad (AMBANK), CIMB Group Holdings Berhad (CIMB), Hong Leong Financial Group Bhd (HLFG), and RHB Capital Bhd (RHBCAP); four commercial banks: BIMB Holdings Bhd (BIMB), Hong Leong Bank Berhad (HLBANK), Malayan Banking Berhad (MAYBANK), and Public Bank Berhad (PBBANK); four investment banks: Hong Leong Capital Berhad (HLCAP), Hwang Capital (Malaysia) Berhad (HWANG), Kaf-Seagroatt & Campbell Bhd (KAF), and K & N Kenanga Holdings Berhad (KENANGA); six insurance companies: LPI Capital Bhd (LPI), MAA Group Berhad (MAA), Manulife Holdings Berhad (MANULFE), MNRB Holdings Berhad (MNRB), Pacific & Orient Berhad (P & O), Syarikat Takaful

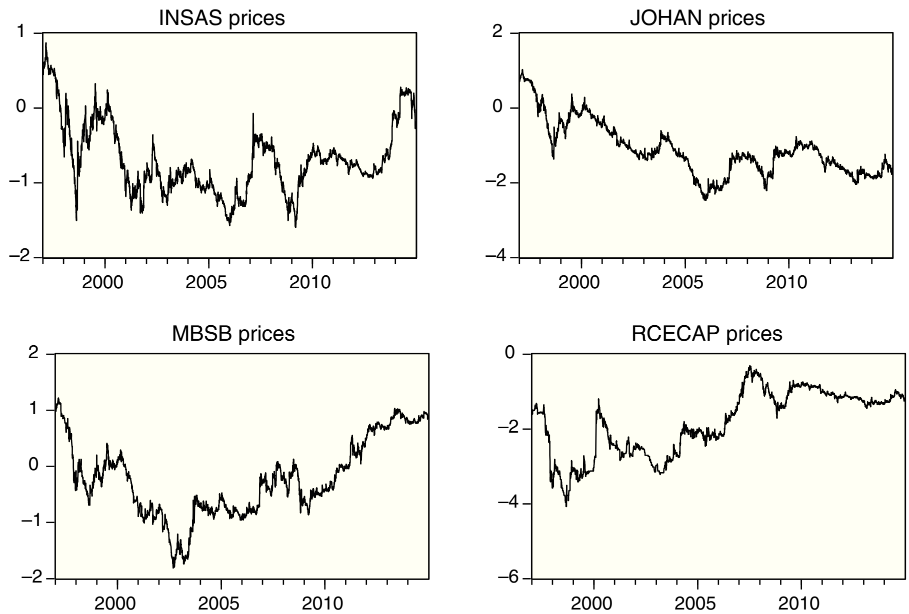

Figure 1. (*Continued*).

Malaysia Berhad (TAKAFUL); four capital market intermediaries: Apex Equity Holdings Berhad (APEX), ECM Libra Financial Grp Bhd (ECM), OSK Holdings Berhad (OSK), and TA Enterprise Berhad (TA); and also four finance companies: Insas Berhad (INSAS), Johan Holdings Berhad (JOHAN), Malaysia Building Society Berhad (MBSB), and RCE Capital Bhd (RCECAP). Five firms are excluded due to the data are unavailable on 1/1/1997, namely, MPHB Capital Berhad (MPHBCAP), Tuneins Holdings Berhad (TUNEINS), Bursa Malaysia Berhad (BURSA), AEON Credit Service (M) Berhad (AEON), and ELK-Desa Resources Berhad (ELKDESA). In addition, Allianz Malaysia Bhd (ALLIANZ) is excluded as the stock of this firm has displayed un-changing prices for long-periods of time.

For estimation, we use the log daily price data of the selected finance stocks. Log transformation is beneficial as it reduces non-normality of data series (Osborne, 2002). As depicted in Figure 1, the log daily price series appear to be subject to several structural changes. We observe wild behaviours for all series around 1997, a time of Asian financial crisis. It seems that all the datasets contain many non-normal observations for which robust tests may be more appropriate than the usual tests.

3.2. Methodology

3.2.1. Panel nonlinear heterogeneous unit root test

We apply the panel nonlinear unit root test developed by Ucar and Omay (2009) for heterogeneous panel, which is in the framework of Kapetanios, Shin, and And Snell (2003)[2]. This test is written as follows:

$$\Delta y_{i,t} = \alpha_i + \phi_i y_{i,t-1} + \gamma_i y_{i,t-1}\left[1 - \exp\left(-\theta_i y_{i,t-d}^2\right)\right] + \varepsilon_{i,t} \quad (1)$$

Where y_{it} denotes the Panel Exponential Smooth Transition Autoregressive Process (PESTAR(1)) of order one on the time domain $t = 1, 2, \ldots, T$ for cross section units $i = 1, 2, \ldots, N$, assuming that y_{it} follows the DGP with fixed effect or heterogeneous intercept parameter α_i. Further, $d \geq 1$ represents the delay parameter, and $\theta_i > 0$ indicates the speed of mean reversion for all cross section units. By setting $\phi_i = 0$ for all cross section units so that y_{it} has a unit root process in the middle regime and given that $d = 1$, the PESTAR(1) model is derived as Equation (2) below:

$$\Delta y_{i,t} = \alpha_i + \gamma_i y_{i,t-1}\left[1 - \exp\left(-\theta_i y_{i,t-d}^2\right)\right] + \varepsilon_{i,t} \quad (2)$$

Based on Equation (2), testing the nonlinear unit root in panel is to test the null hypothesis $\theta_i = 1$ for all cross section units against $\theta_i > 0$ for some cross section units under the alternative hypothesis. However, γ_i is not identified under the null hypothesis, thus the null hypothesis cannot be tested directly using Equation (2). We need to apply first-order Taylor series approximation to the PESTAR(1) model around $\theta_i = 0$ for all cross section units. This allows us to obtain the auxiliary regression as written below:

$$\Delta y_{i,t} = \alpha_i + \delta_i y_{i,t-1}^3 + \varepsilon_{i,t} \quad (3)$$

Then, we derive the hypotheses for unit root testing from the regression as translated in Equation (3). The null hypothesis $H_0 : \delta_i = 0$ for all cross section units implies linear nonstationarity. Whereas, the alternative hypothesis $H_1 : \delta_i < 0$ for some cross section units implies nonlinear stationarity.

A panel unit root test is computed through taking the average of individual KSS statistics. The KSS statistic for the i_{th} individual is the t-ratio of δ_i in the above regression which is expressed as Equation (4) below:

$$t_{i,NL} = \frac{\Delta y_i' M_\tau y_{i,-1}^3}{\hat{\sigma}_{i,NL}(y_{i,-1}' M_\tau y_{i,-1})^{\frac{3}{2}}} \quad (4)$$

For a fixed T, the below expression is used:

$$\bar{t}_{NL} = \frac{1}{N}\sum_{i=1}^{N} t_{i,NL} \quad (5)$$

By satisfying the invariant property that for all $t_{i,NL}$ hold for each cross section unit; and the existence of moments by truncating $t_{i,NL}$ distribution in which the individual statistics $t_{i,NL}$ are iid random variables with finite means and variances, the usual normalization

[2] Following the reviewer's suggestion, the panel nonlinear heterogeneous unit root test of Ucar and Omay (2009) is applied in our analysis which this demonstrates an advancement of the nonlinear unit root test. We would like to express our appreciation for the suggestion of reviewer.

of $\bar{t}_{NL}$ statistics have the limiting standard normal distribution as $N \to \infty$ such that,

$$\bar{Z}_{NL} = \frac{\sqrt{N\left(\bar{t}_{NL} - E\left(t_{i,NL}\right)\right)}}{\sqrt{Var\left(t_{i,NL}\right)}} \to N(0,1) \quad (6)$$

This provides us the $\bar{Z}_{NL}$ statistic critical values.

3.2.2. Panel stationarity test with structural breaks and CSD

Our main method for analysis is based on the panel stationarity test developed by Carrion-i-Silvestre et al. (2005) that incorporates multiple structural breaks and exploits the cross-section variations across the series analyzed. We use Equation (1) for the expression of this test:

$$P_{i,t} = \alpha_i + \sum_{k=1}^{m_i} \theta_{i,k} DP_{i,k,t} + \beta_i t + \sum_{k=1}^{m_i} \gamma_{i,k} DT^*_{i,k,t} + \varepsilon_{i,t} \quad (1)$$

Where $P_{i,t}$ represents the price of finance stock i =1,..., N and t = 1,..., T denote time periods; and $\varepsilon_{i,t}$ is the error term. The dummy variables $DP_{i,k,t}$ and $DT^*_{i,k,t}$ are defined as $DP_{i,k,t} = 1$ for $t > T^i_{b,k}$ and 0 otherwise; and $DT^*_{i,k,t} = t - T^i_{b,k}$ for $t > T^i_{b,k}$ and 0 otherwise; where $T^i_{b,k}$ denotes the kth date of the break for the ith individual, k =1,. . .,m_i, $m_i \geq 1$.

The specification in Equation (1) allows for unit-specific intercepts and linear trends in addition to unit-specific mean and slope shifts. The panel stationarity test of Carrion i-Silvestre et al. (2005) tests the null hypothesis of a stationary panel following the Hadri (2000) procedure by using a simple average of the univariate stationarity test in Kwiatkowski et al. (KPSS, 1992). The test statistic is as Equation (2) below:

$$LM(\lambda) = N^{-1} \sum_{i=1}^{N} \left(\hat{\omega}_i^{-2} T^{-2} \sum_{t=1}^{T} \hat{S}^2_{i,t} \right) \quad (2)$$

Where $LM(\hat{\lambda}_i) = \hat{\omega}_i^{-2} T^{-2} \sum_{t=1}^{T} \hat{S}^2_{i,t}$ is the univariate KPSS (1992) test for individual i, and $\hat{S}_{i,t} = \sum_{j=1}^{t} \hat{\varepsilon}_{i,j}$ represents the partial sum process that is obtained using the estimated OLS residuals from Equation (1), with $\hat{\omega}_i^{-2}$ being a consistent estimate of the long-run variance of $\varepsilon_{i,t}$. We follow the procedure of Kurozumi (2002) and estimate the long-run variance non-parametrically with the bandwidth of the Bartlett kernel fixed. Kurozumi (2002) suggests that the lag selection procedure in Andrews and Monahan (1992) should not be used to calculate the long-run variance for the KPSS test as it may lead to inconsistency in the test.

$$\hat{l} = \min \left\{ 1.1447 \left(\frac{4\hat{a}^2 T}{\left(1+\hat{a}\right)^2 \left(1-\hat{a}\right)^2} \right)^{1/3'} \quad 1.1447 \left(\frac{4k^2 T}{(1+k)^2 (1-k)^2} \right)^{1/3} \right\}' \quad (3)$$

Where $\hat{a}$ is the autoregressive parameter estimated with the method proposed by Andrews (1991) and k = 0.7 is the preferred value according to Kurozumi's simulations that maintains a compromise between size and power performance.

Since the test is dependent on the vector $\lambda_i = \left(\lambda_{i,1,\ldots,}\lambda_{i,m_i}\right)' = \left(T^i_{b,1}/T, \ldots, T^i_{b,m_i}/T\right)'$ for each i, which indicates the relative positions of the break dates on the whole time period (T), we estimate the vector λ_i for each unit using the procedure of Bai and Perron (1998) which is based upon the global minimization of the sum of squared residuals (SSR). The procedure is chosen as the location estimation of the breaks for the argument that minimizes the sequence of the unit-specific $SSR\left(T^i_{b,1}/T, \ldots, T^i_{m_i,1}\right)$ obtained from Equation (1) such that:

$$\left(\hat{T}^i_{b,1}, \ldots, \hat{T}^i_{b,m_i}\right) = \arg\min SSR\left(T^i_{b,1}, \ldots, T^i_{b,m_i}\right) \quad (4)$$

After obtaining the dates for all possible $m_i \leq m^{\max}$ for each i, where $m^{\max}$ is the maximum number of breaks, we select the appropriate number of structural breaks using the modified Schwarz information criterion (LWZ) of Liu, Wu, and Zidek (1997), which is designed for the case of trending variables. Once the vector $\hat{\lambda}_i$ is determined, we compute the normalized test statistic as follows:

$$Z(\hat{\lambda}) = \frac{\sqrt{N}\left(LM\left(\hat{\lambda}\right) - \bar{\xi}\right)}{\bar{\zeta}} \xrightarrow{d} N(0,1) \quad (5)$$

Where $\bar{\xi}$ and $\bar{\zeta}^2$ are calculated as the respective averages of the individual means and variances of $LM_i(\hat{\lambda}_i)$. The computation of the $Z(\hat{\lambda})$ statistic requires the individual series to be cross-sectionally independent with asymptotic normality. Since the above assumptions may be overly simplistic, we apply the bootstrap distribution of panel stationary test with multiple breaks following Maddala and Wu (1999). This allows for any kind of cross-sectional dependence and is expected to correct finite-sample bias.

4. Empirical results

4.1. Univariate unit root tests

The analysis based on unit root test method has commenced through traditional univariate unit root tests to provide a benchmark of results. The Augmented Dickey-Fuller (ADF, 1979) and Phillips-Perron (PP, 1988) tests are used to examine the null hypothesis of a unit root (non-stationary) in the log daily price series of each finance stock. Meantime, the Kwiatkowski et al. (KPSS, 1992) unit root test is applied to examine the null hypothesis that a series is stationary. On the basis of traditional univariate unit root tests, mixed-results are provided. As depicted in Table 1 below, when only includes intercept, the null hypothesis of unit root is rejected for KAF, MANULFE, MNRB, ECM, TA, INSAS, and JOHAN at least at the 5 percent level of significance, and KENANGA, P & O, and APEX at the 10 percent level of significance. When includes intercept plus trend in the ADF (1979) and PP (1988) tests, the null hypothesis of unit root is rejected for AMBANK, HLFG, PBBANK, KAF, LPI, MANULFE, and TA at least at the 5 percent level of significance, and AFFIN, RHBCAP, HLBANK, and MNRB at the 10 percent level of significance. The KPSS (1992) test produces very different results when compared with the ADF (1979) and PP (1988) tests. The results of tests for both intercept only and with trend reject the null hypothesis of stationarity for all the series at least at the 5 percent level of significance, except for KAF and KENANGA which the test results for intercept only can reject the null hypothesis at the 10 percent level of significance. Inconsistent with the ADF (1979) and PP (1988) tests, the KPSS (1992) test provides strong evidence showing all the series are random walk processes suggesting the market for these stocks are weak-form efficient. However, the results of univariate unit root tests are for benchmarking.

4.2. Conventional panel unit root tests

Traditional univariate unit root tests such as the ADF (1979) and PP (1988) tests are known to have low power against the alternative of stationarity of the series especially when small samples are used. In order to overcome this issue, we employ different conventional panel unit root tests (first generation) which differ in

Table 1
Results from univariate unit root tests.

Series	ADF (1979)		PP (1988)		KPSS (1992)	
	Constant	With trend	Constant	With trend	Constant	With trend
AFFIN	-2.510	-3.403***	-2.533	-3.419**	2.667*	0.995*
AFG	-1.586	-2.960	-1.641	-3.022	4.528*	0.316*
AMBANK	-1.565	-3.744**	-1.610	-3.761**	5.327*	0.172**
CIMB	-1.148	-2.945	-1.173	-2.999	6.949*	0.159**
HLFG	-0.316	-3.944**	-0.342	-3.947**	6.705*	0.500*
RHBCAP	-1.896	-3.399***	-1.909	-3.399***	4.549*	1.119*
BIMB	-1.505	-2.132	-1.454	-2.088	2.004*	1.393*
HLBANK	-0.612	-3.395***	-0.535	-3.334***	7.032*	0.285*
MAYBANK	-1.956	-2.964	-1.929	-2.944	3.255*	0.224*
PBBANK	-0.592	-3.568**	-0.561	-3.478**	8.107*	0.264*
HLCAP	-0.747	-1.231	-0.784	-1.264	1.332*	1.209*
HWANG	-1.833	-2.020	-1.998	-2.164	1.068*	1.019*
KAF	-3.775*	-3.777**	-3.682*	-3.681**	0.381***	0.381*
KENANGA	-2.725***	-2.730	-2.845***	-2.850	0.444***	0.439*
LPI	0.236	-4.272*	0.045	-4.236*	7.837*	0.788*
MAA	-1.753	-2.713	-1.772	-2.777	6.491*	0.669*
MANULFE	-2.926**	-3.802**	-2.904**	-3.777**	2.505*	0.659*
MNRB	-3.486*	-3.307***	-3.479*	-3.311***	0.538**	0.288*
P & O	-2.822***	-2.489	-2.759***	-2.408	2.000*	1.257*
TAKAFUL	-0.004	-1.653	-0.161	-1.757	3.641*	1.396*
APEX	-2.702***	-2.250	-2.682***	-2.207	2.271*	1.311*
ECM	-3.137**	-2.887	-3.219**	-3.020	2.441*	1.059*
OSK	-2.218	-2.650	-2.310	-2.747	1.155*	0.397*
TA	-3.304**	-3.440**	-3.361**	-3.505**	0.731**	0.563*
INSAS	-2.895**	-2.736	-2.903**	-2.742	1.294*	1.137*
JOHAN	-2.622**	-2.770	-2.569**	-2.598	5.029*	1.104*
MBSB	-1.613	-2.586	-1.587	-2.573	2.905*	1.595*
RCECAP	-1.371	-2.808	-1.414	-2.865	5.662*	0.495*

Note: Above *t*-statistics and *p*-values are obtained using the automatic lag length selection based on Schwarz Info Criterion: 1 to 31. *, ** and *** are used to denote the rejection of null hypothesis at 1, 5 and 10 percent level of significance, respectively.
Authors' estimation

Table 2
Results from traditional panel unit root tests.

Test	Constant		With trend	
	t-statistic	*p*-value	*t*-statistic	*p*-value
LLC *t*-stat	0.375	0.646	-6.618	0.000
IPS *w*-stat	-2.327	0.010	-5.283	0.000
Hadri *Z*-stat	158.498	0.000	109.799	0.000

Note: Above *t*-statistics and *p*-values are obtained using the automatic lag length selection based on Schwarz Info Criterion: 1 to 31.
Source: Authors' estimation.

their treatments of the null hypothesis. For examples, the Breitung (2000) *t*-test and Levin et al. (LLC, 2002) test specify the null as a unit root and assumes common unit root processes. The Im et al. (IPS, 2003) *w*-test and the ADF and PP Fisher chi-squared tests proposed by Maddala and Wu (1999) specify the null as a unit root but assume individual unit root processes. Further, the Hadri (2000) *z*-test treats the null as no unit root and assumes common unit root processes.

Table 2 summarizes the results from the conventional panel unit root tests employed. The results are mixed irrespective of whether a trend is included in the specification. With intercept only, the LLC (2002) *t*-stat suggests non-rejection of the null hypothesis of unit root, but the IPS (2003) *w*-stat indicates rejection of null hypothesis of unit root at the 1 percent level of significance. Whereas, the Hadri (2000) *Z*-stat suggests rejection of the null hypothesis of stationarity at the 1 percent level of significance. Thus, only the results of LLC (2002) *t*-stat and Hadri (2000) *Z*-stat are consistent. After includes trend, the results of LLC (2002) *t*-stat and IPS (2003) *w*-stat strongly reject the null hypothesis of unit root at the 1 percent level of significance. Meantime, Hadri (2000) *Z*-stat shows the null hypothesis of stationarity can be rejected at the 1 percent level of significance, implying all series are non-stationary and contain a unit root. Thus, the results of both LLC (2002) *t*-stat and IPS (2003) *w*-stat are contrasting with Hadri (2000) *Z*-stat. The mixed-results is due to the negligence of accounting for CSD and structural breaks.

4.3. Test for cross section dependence

Until now, the presentation of the panel statistics has assumed that individuals are cross-section independent. Nevertheless, this assumption might be restrictive in practice since the analysis of macroeconomic time series for different financial firms are affected by similar important events that might cause dependence among individuals in the panel dataset. The selected financial firms are interrelated in the domestic financial system. IMF (2014) suggests that these firms are highly interdependence through the domestic wholesale funding market. Thus, it is very likely that these firms are simultaneously affected by common observed shocks such as, the Asian financial crisis in 1997-1998, the global financial crisis in 2008-2009, and changes in oil prices around the time period of 2004-2006. As noted by O'Connell (1998) and Maddala and Wu (1999), conventional panel unit root tests derived under the assumption of cross-sectional independence are subject to large size distortions when a substantial degree of cross-correlation exists. However, panel unit root tests that allow for cross-correlation suffer from power losses in the absence of CSD in the data.

Due to foregoing considerations, we use the CD statistic of Pesaran (2004) to test the cross-section dependence across the finance stock price series. If the presence of common shocks generate dependence among the units in the panel, we need to select panel unit root test which is robust to CSD so that to prevent size distortion of the test. In more details, Pesaran (2004) has proposed a simple test of error CSD which is suitable for both stationary and nonstationary panels under general conditions. The cross section dependence test is based on the average of pair-wise correlation

Table 3
Results from cross-section dependence test.

	Statistics
H₀: cross-sectional independence	
CD test	609.508
p-value	0.000
Average (*Pi, j*)	0.527

Notes: The CD statistic tests for the null of cross-sectional independence and is distributed as a two-tailed standard normal distribution.
Source: Authors' estimation.

coefficients of OLS residuals obtained from standard ADF (1979) regressions for each individual. Let $\hat{\rho}_{ij}$ be the sample estimate of pair-wise correlation coefficients of OLS residuals such that:

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} e_{it} e_{jt}}{\left(\sum_{t=1}^{T} e_{it}^2\right)^{1/2} \left(\sum_{t=1}^{T} e_{jt}^2\right)^{1/2}}$$

Where e_{it} represents the OLS estimated residuals for individual *i*. Based on pair-wise correlation coefficients, the Pesaran (2004) test does not depend on any particular spatial weight matrix as is the case for the Breusch and Pagan (1980) LM test when the cross-sectional dimension (*N*) is large. The CD statistic in Pesaran (2004) is given by:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \rightarrow N(0, 1)$$

The Pesaran's CD statistic tests the null hypothesis of cross-sectional independence and is distributed as a two-tailed standard normal distribution.

4.4. Cross-section dependence test results

As depicted in Table 3, the CD statistic of Pesaran (2004) is highly significant for the finance stock price series. The null hypothesis that innovations to the variable are cross-sectional independent is strongly rejected at the 1 percent significance level. Although it is not the case here, a possible drawback of the CD test is that adding up positive and negative correlations may result in failing to reject the null hypothesis even if there is substantial of CSD in the errors. Since the average absolute correlation is 0.527 which is a very high value, therefore there is enough evidence for the presence of CSD in the series. This result is in accordance with our expectation that there is a high level of cross-sectional dependencies across the selected financial firms due to common shocks.

4.5. Panel nonlinear heterogeneous unit root test

Nonlinear behaviour of stock prices is well-documented in the literature, therefore the panel nonlinear heterogeneous unit root test developed by Ucar and Omay (2009) is employed to test whether the finance stock price series contain a unit root or not. If the null hypothesis linear non-stationarity cannot be rejected, this will suggest the finance stocks are efficient as a group. On the other hand, this group is inefficient if the null hypothesis is rejected. As reported in Table 4, when we include intercept only, the results show that we cannot reject the null hypothesis of linear non-stationarity. When we include intercept and trend, the results significantly change. The *p*-values are showing 0.027 which rejecting the null hypothesis at 5 percent level of significance. This

Table 4
Results from panel nonlinear heterogeneous unit root test.

	$\bar{t}_{NL}$	$\bar{Z}_{ANL}$
Intercept	-1.563	0.415
	(0.561)	(0.561)
Intercept and trend	-1.565	2.083
	(0.027)	(0.027)

Note: The *p*-values in parenthesis with 20000 bootstrap replications.
Source: Authors' estimation.

implies that the finance stocks as a group are seen to be inefficient in the weak-form. This result may due to the fact that this test has low power against structural break stationary process. In addition, the alternative hypothesis of Ucar and Omay (2009) panel unit root test indicates that at least one series is stationary but it does not provide evidence which series is stationary. Therefore, we apply Carrión-i-Silvestre et al. (2005) panel stationarity test to address the ignorance of structural breaks and the stationary of the specific series.

4.6. Panel stationarity test with structural breaks and CSD

Since the series appear to be cross-sectional correlated, we proceed by testing for a unit root using the panel stationarity test advanced by Carrión-i-Silvestre et al. (2005). This method allows for endogenously determined multiple structural breaks, and is flexible enough to control for CSD by accommodating the appropriate critical values by using the bootstrapping procedure.

Table 5 reports the results from Carrión-i-Silvestre et al. (2005) panel stationarity test. The last four columns in Panel A of Table 5 show the computed 10 percent, 5 percent, and 1 percent finite KPSS critical values, by means of Monte Carlo simulations of 20 000 draws. These critical values are used to control for the finite sample bias that might be present in small samples used in the paper. The panel KPSS statistics are clearly larger that the finite sample KPSS 1 percent critical values. Therefore, we reject the null hypothesis of stationarity for all the finance stock price series.

Next, we compare the panel KPSS statistics using the assumptions of homogeneous and heterogeneous variance, with the bootstrapped empirically distributed critical values at the 1 percent, 5 percent, and 10 percent levels of significance. For both the homogeneous and heterogeneous variance assumptions, the actual panel KPSS statistics are greater than the bootstrapped critical values at the 1 percent, 5 percent, and 10 percent levels of significance. Thus, we reject the joint null hypothesis of stationarity. We conclude that, after allows for multiple structural breaks and controls for CSD, the selected finance stock price series are non-stationary and these stocks are weak-form efficient. The findings of Lim et al. (2007), Bashir et al. (2011), and Narayan et al. (2015) are not in favour of the weak-form efficiency particularly when bank stocks are considered. Thus, our results are inconsistent with their findings. Our results match the finding of Stengos and Panas (1992) who found evidence showing bank stocks are weak-form efficient.

Our results from the panel stationarity test of Carrión-i-Silvestre et al. (2005) suggest that there are infrequent large fluctuations in the series studied. The estimated breakpoints are summarized in Table 6. The first observed common breaks in all these series are around the time of September 1999-December 2000 which may correspond to two important policy changes introduced to the domestic financial system. The capital-lock imposed under the September 1998 capital controls aftermath to the Asian financial crisis lapsed on 1st September 1999, as the economy of Malaysia was recovering from the second quarter of 1999[3]. Meantime, the

[3] Jomo (2005) provides a detailed discussion regarding the September 1998 capital controls in Malaysia.

Table 5
Results from panel stationarity and individual tests with structural breaks and CSD.

Panel A: Country-by-country tests					
	KPSS	m	Finite sample critical value		
			10%	5%	1%
AFFIN	0.066	4	0.020	0.023	0.029
AFG	0.062	5	0.015	0.017	0.020
AMBANK	0.062	5	0.015	0.017	0.020
CIMB	0.064	5	0.015	0.017	0.020
HLFG	0.061	5	0.016	0.018	0.022
RHBCAP	0.057	5	0.015	0.017	0.020
BIMB	0.052	5	0.015	0.017	0.020
HLBANK	0.060	5	0.016	0.018	0.022
MAYBANK	0.062	5	0.015	0.017	0.020
PBBANK	0.057	5	0.015	0.017	0.020
HLCAP	0.054	5	0.015	0.017	0.021
HWANG	0.062	4	0.021	0.023	0.029
KAF	0.067	5	0.015	0.017	0.020
KENANGA	0.061	5	0.015	0.017	0.020
LPI	0.060	5	0.015	0.017	0.020
MAA	0.044	5	0.015	0.017	0.020
MANULFE	0.059	5	0.015	0.017	0.021
MNRB	0.054	4	0.022	0.026	0.034
P & O	0.057	4	0.020	0.023	0.029
TAKAFUL	0.055	5	0.015	0.017	0.020
APEX	0.056	5	0.015	0.017	0.020
ECM	0.056	4	0.020	0.022	0.028
OSK	0.060	5	0.015	0.017	0.021
TA	0.058	5	0.015	0.017	0.020
INSAS	0.067	5	0.016	0.017	0.021
JOHAN	0.056	5	0.015	0.017	0.020
MBSB	0.050	5	0.015	0.017	0.020
RCECAP	0.064	5	0.015	0.017	0.021

Panel B: Panel KPSS tests with multiple breaks assuming cross-sectional independence.		
	t-statistic	*p*-value
LM(λ)(Homo)	56.984	0.000
LM(λ)(Hetero)	56.307	0.000

Panel C: Bootstrap distribution allowing for cross-sectional dependence			
	90%	95%	99%
LM(λ)(Homo)	18.426	19.670	22.247
LM(λ)(Hetero)	12.516	13.687	16.106

Note: The finite sample critical values were computed by means of Monte Carlo simulation using 20,000 replications following Maddala and Wu (1999). All bootstrap critical values allow for cross-section dependence.
Source: Authors' estimation.

Government announced a major consolidation plan of 71 domestic financial institutions into six banking groups on July 1999, but the plan was frozen in September 1999 and then revised to ten banks in October 1999. The merger process had only completed end of 2001[4].

Our results indicate that there are other breakpoints in the series. For examples, the break dates around the year 2002 may correspond to the events of global economic downturn and Dotcom crash in 2000-2002, the observed breaks in June-August 2009 may relate to the 2009 flu outbreak (H1N1) in Malaysia, the fluctuations in world crude oil prices in 2004-2006 may explain breaks around this particular period, the US subprime mortgage crisis and Great Recession can explain the drastic changes in the series during 2008-2009, and the period of 2011-2012 corresponds to global economic downturn and the European sovereign debt crisis. These events could have increased the level of risk aversion among stock market investors, causing large changes in stock market investment.

[4] A clear picture of bank restructuring in Asia is found in the study by Ito and Hashimoto (2007).

Table 6
Location of the breaks for each series.

	$T_{b,1}$	$T_{b,2}$	$T_{b,3}$	$T_{b,4}$	$T_{b,5}$
AFFIN	13/9/99	6/6/03	8/9/08	20/5/11	-
AFG	13/9/99	11/9/02	24/5/05	3/10/08	19/4/12
AMBANK	13/9/99	24/5/02	28/3/05	12/8/08	25/4/11
CIMB	13/9/99	1/7/03	23/11/06	5/8/09	17/4/12
HLFG	13/9/99	24/5/02	27/11/06	7/8/09	19/4/12
RHBCAP	4/10/99	25/11/02	5/10/05	17/6/08	24/8/11
BIMB	13/9/99	24/5/02	11/3/05	7/10/08	19/4/12
HLBANK	13/9/99	24/5/02	27/11/06	7/8/09	19/4/12
MAYBANK	13/9/99	12/9/02	25/5/05	2/10/08	15/6/11
PBBANK	13/9/99	24/5/02	11/8/05	12/9/08	26/5/11
HLCAP	13/9/99	2/7/03	15/11/06	28/7/09	19/4/12
HWANG	13/9/99	1/7/03	9/11/06	22/7/09	-
KAF	13/9/99	24/5/02	28/2/05	15/9/08	27/5/11
KENANGA	13/9/99	2/7/03	28/7/06	29/4/09	15/3/12
LPI	13/9/99	24/5/02	3/2/05	7/10/08	22/7/11
MAA	13/9/99	30/1/03	12/10/05	1/7/08	4/8/11
MANULFE	13/9/99	24/5/02	27/1/06	9/10/08	27/6/11
MNRB	13/9/99	24/5/02	8/9/08	2/12/11	-
P & O	13/9/99	1/7/03	8/10/08	19/4/12	-
TAKAFUL	13/9/99	3/6/03	30/5/06	19/3/09	26/3/12
APEX	13/9/99	24/5/02	31/3/05	27/6/08	19/4/12
ECM	13/9/99	5/6/03	11/6/08	13/9/11	-
OSK	13/9/99	5/6/03	21/11/06	3/8/09	19/4/12
TA	13/9/99	10/6/03	27/11/06	7/8/09	19/4/12
INSAS	13/12/00	11/3/04	22/11/06	4/8/09	19/4/12
JOHAN	13/9/99	14/1/03	26/9/05	6/6/08	7/6/11
MBSB	13/9/99	3/7/03	9/11/06	7/8/09	19/4/12
RCECAP	7/1/00	19/9/02	1/6/05	18/2/08	2/12/10

Source: Authors' estimation.

5. Summary and conclusion

This paper has examined the weak-form EMH using a sample of 28 finance stocks from the Finance Sector in Malaysian Stock Exchange, and covers the period spanning 1st January 1997 until 31st December 2014. We consider that finance stocks have paramount importance in terms of the effectiveness of capital allocation across different financial industries such as, commercial banking, investment banking, insurance business, capital market intermediation, and finance company business. In addition, financial firms as well as finance stocks are considerable fragile during financial crises. In particular, bank soundness can be affected by the inherent maturity mismatch on a bank's balance sheet. Further, banking sector contagion is more strong and rapid that other sectors (Narayan et al., 2015). To the best of our knowledge, there has been no study examining the empirical validity of the weak-form EMH for finance stock price series by addressing the issues of CSD and structural breaks.

Our results from traditional univariate unit root tests are mixed. For instance, when includes intercept and trend, the results of the ADF (1979) and PP (1988) tests indicate that 11 finance stock price series do not follow a random walk process including AFFIN, AMBANK, HLFG, RHBCAP, HLBANK, PBBANK, KAF, LPI, MANULFE, MNRB, and TA, and the rest of the series are random walk processes. However, the KPSS (1992) test suggests that all the series are non-stationary and contain a unit root, thus providing strong evidence showing the market for these finance stocks is efficient in weak-form sense. As it is known that univariate unit root tests have low power especially when small samples are used, we proceed with conventional panel unit root tests but again contradicting results are obtained. When includes intercept plus trend, only the Hadri (2000) *Z*-stat indicates the series are non-stationary implying efficiency, but both the LLC (2002) *t*-stat and IPS (2003) *w*-stat show the series do not contain a unit root suggesting inefficiency. We suspect the contrasting results obtained so far are due to the negligence of accounting for CSD and structural breaks, therefore we apply the CD statistic of Pesaran (2004) to test for cross section dependence in the series. We found strong CSD among the finance stock series as the Pesaran (2004) CD statistic strongly rejects the null hypothesis of cross section independence (1 percent level of significance). Further, by applying nonlinear heterogeneous panel unit root test of Ucar and Omay (2009), our results suggest that the finance stock series as a group are inefficient in the weak-form sense. In the final step, we employ the panel stationarity test advanced by Carrión-i-Silvestre et al. (2005) that accommodates both structural breaks and CSD. Based on the results of panel KPSS (1992) test using the assumptions of homogeneous and heterogeneous variance, with the bootstrapped empirically distributed critical values at the 1 percent, 5 percent, and 10 percent levels, we reject the joint null hypothesis of stationarity. This result allows us to conclude that all the series are random walk processes, suggesting the market for these finance stocks is weak-form efficient. In addition, important breakpoints in the series are captured which may correspond to the major policy changes in Malaysia and several global events.

The overall findings of this present study suggest that the market for the selected finance stocks in Malaysia are weak-form efficient. In Malaysia, a large portion of shareholdings in the listed financial holding companies and commercial banks are held by the main government-linked institutions, including Boustead Holdings Berhad, Employees' Provident Fund, Khazanah Nasional Berhad, Lembaga Tabung Angkatan Tentera, Permodalan Nasional Berhad, and Skim Amanah Saham Bumiputera. According to IMF (2014), these institutions held about 40-60 percent of total shareholdings in Affin, CIMB, Maybank, and RHB. The government-linked institutions are typically long-horizon institutional investors. Unlike long-term investors, short-horizon institutional investors tend to sell their holdings substantially during the time of market turmoil (Cella, Ellul, & Giannetti, 2013). This amplifies the shocks to the prices of stocks held by short-horizon investors. However, long-horizon investors are less affected in such condition. Since the government-linked institutions held substantial shareholdings in finance stocks, these stocks are likely to be efficient. Aside from this, the selected finance stocks are efficient because these stocks are attractive to long-term investors.

The finding that the Finance Sector in Malaysian Stock Exchange is weak-form efficient has several important implications. First, the selected financial firms are expected to be able to raise long-term capital through their equity issues. As compared to other stocks, the efficient stocks are more attractive to long-term investors because these stocks provide accurate price signals to guide the decision-making by investors. In other words, the efficient stocks are more liquid allowing investors to buy and sell shares quickly and cheaply. Market efficiency for these finance stocks will enhance the role of the finance sector in stimulating economic growth and transforming Malaysia into a high value-added and high income country by the year 2020.

Second, we foresee that efficiency will contribute to the good prospect of Malaysian commercial banks in complying with the minimum capital requirements set by the International Regulatory Framework for Banks (Basel III), by 1st January 2019. The minimum equity tier 1 of 7 percent equals to minimum equity of 4.5 percent with capital conservation buffer of 2.5 percent. Presently, the banking groups of Malaysia are expected to be able to meet the minimum capital requirements in the low and baseline growth scenarios, but not in the high growth scenario[5].

Third, the weak-form efficiency would suggest that any techniques used for predicting stock prices are futile in the long-run. Our findings show that the selected finance stocks are weak-form efficient, suggesting investors are better-off by simply buy-and-hold over long-term investment horizon rather than frequently trade and speculate. Frequent buying and selling will lead to higher transaction costs.

Fourth, if stock prices follow a random walk or unit root process, the impact of shocks to stock prices will be permanent, thus the order of past price changes cannot predict future prices (Narayan & Smyth, 2004; Narayan & Narayan, 2007; Munir et al., 2012). Our findings suggest that shocks to the prices of the selected finance stocks are permanent and investors cannot exploit mean-reversion for prediction.

The scope of weak-form EMH tests is broad including various aspects under the rubric of return predictability that are beyond the random walk model. So far, our findings suggest that the prices of Malaysian finance stocks are characterized as random walk processes. Therefore, we infer that techniques used to predict the future movements in the stock prices are futile in the long-run. Future research may pay attention on the existence of anomalies for the insight of specific investment rules and strategies based on the observed patterns in the finance stock series (i.e. contrarian investment strategy, momentum-based investment strategy, and calendar anomalies).

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[5] Low growth scenario reflects yearly real gross domestic product (GDP) growth of 2 percent, inflation of 1 percent, and loan growth of 3.6 percent; Baseline growth scenario indicates yearly real GDP growth of 5 percent, inflation of 2.5 percent, and loan growth of 8.2 percent; High growth scenario is associated with yearly real GDP growth of 6.5 percent, inflation of 4 percent, and loan growth of 12.2 (IMF 2014).

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