

# Behavioural finance perspectives on Malaysian stock market efficiency

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## Abstract

This paper provides historical, theoretical, and empirical syntheses in understanding the rationality of investors, stock prices, and stock market efficiency behaviour in the theoretical lenses of behavioural finance paradigm. The inquiry is guided by multidisciplinary behavioural-related theories. The analyses employed a long span of Bursa Malaysia stock market data from 1977 to 2014 along the different phases of economic development and market states. The tests confirmed the presence of asymmetric dynamic behaviour of prices predictability as well as risk and return relationships across different market states, risk states and quantiles data segments. The efficiency tests show trends of an adaptive pattern of weak market efficiency across various economic phases and market states. Collectively, these evidences lend support to bounded-adaptive rational of investors' behaviour, dynamic stock price behaviour, and accordingly forming bounded-adaptive market efficiency.

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## 1. Introduction

In finance, the assumption of the state of market efficiency is the heart in every finance modelling, strategies, and policies design in financial markets. Since its development in the 1960s, the notion of efficient markets has been subjected to intense theoretical and empirical debate for more than century (Ackert & Deaves, 2010; Shefrin, 2007). Nonetheless, this fundamental issue remains puzzled today after for more than 40 years (Verheyden, de Moore, & den Bossche, 2015). In this line of enquiries, the debated issue is whether the market is fully efficient in accordance to efficient market hypothesis (EMH) in modern finance paradigm or adaptively efficient according with the adaptive market hypothesis (AMH) in behavioural finance paradigm. While the AMH is still new

with limited empirical support, mounting evidence of market imperfection and inefficiency challenge the validity of EMH.

To recap, the issue of stock market imperfections and inefficiency has been voiced by scholars since in the 1960s (Grossman & Stiglitz, 1980; Rosenberg, Reid, & Lanstein, 1985; Stigler, 1967). This instability and inefficiency although short lived, will persist consistently in the market so long normal people are trading in the market because of constant human nature that will regularly produce financial fads, euphoria and gloom (Sanford, 1994; Slezak, 2003). In behavioural finance paradigm, this instability and inefficiency are due to behavioural risks that are critical for Asia emerging financial markets (Kim & Nofsinger, 2008). Despite the above arguments, the importance of investor and market imperfection has been ignored in academic and practice due to the popularity of modern finance thoughts. However, relying solely on modern finance perspective probably mislead practitioners as noted below;

*“Today's methods to control and price risk are still based on the neoclassical assumptions of normal distributions and*

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*Brownian motions. This is probably one of the reasons that explain the failure of risk management systems in times of crisis”*

Chittedi, 2014, p. 3.

Our literature observation concludes that the main obstacle lies in philosophy, theories, and methods dispute and divergence of opinions among finance scholars in modern- and behavioural-finance paradigms. The competing perspectives on market efficiency studies between the two paradigms are discussed here based on interconnected theoretical perspectives as presented in the following Fig. 1, which will be briefly summarized thereafter.

Modern finance ideologies are borrowed from modern economics that is based on normative philosophy. This paradigm postulates that reasonable people should act rationally as postulated in rational choice theory (Arrow, 1958). The rational decision means that human think and decides to maximize wealth as described in expected utility theory idealize by von Neumann and Morgenstern in 1944 (Quiggin, 1982). This implies that individual preference is static with risk adverse behaviour and asset prices only influenced by fundamental. Accordingly, constant rational human behaviour expected to imply normality, random walk, mean reversion properties of stock prices, and no expected excess returns. This theorized in the random walk behaviour of stock prices by Louis Bachelier in 1900 and a martingale model of stock prices by Paul Samuelson in 1965 (Fama, 1965). Collectively, this will imply the non-predictability of stock prices to exploit arbitrage conditions. Holding investor and prices behaviours as assumed, a random process of financial series will exhibit independent and identical distribution, such as a Gaussian with zero mean and constant variance (Lim, Liew, & Wong, 2005).

Guided by the above theoretical perspectives, Fama idealizes the EMH as a theoretical framework for market behaviour (Fama, 1965, 1970). There are three versions of the market efficiency measurement, namely weak, semi-strong, and strong. The weak EMH claims that the prices on assets already reflect all past publicly available information. Semi-strong EMH claims both that prices reflect all publicly available information and those prices instantly change to reflect new public information. While, strong EMH additionally claims that prices instantly reflect even hidden or insider information.

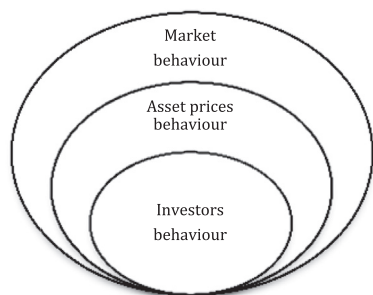


Fig. 1. Theoretical perspectives on market efficiency.

EMH postulates that securities are always efficiently and fairly priced. However, EMH validity comes with several assumptions. First, markets are made up of large, competent and fully informed investors that are always aiming for profit-maximization and risk averse in their decision-making. Second, all agents have homogeneous expectations. Third, current information about the economy and individual firm fundamental are freely available and always instantaneously and correctly fully reflect available information. Fourth, no taxes, no transaction costs, and no danger of bankruptcy. Fifth, competitive pressure among economic agents will keep securities fairly priced as any opportunity to realize an excess profit is exploited without delay and thus disappears (Chittedi, 2014; Fama, 1970). These will collectively form an equilibrium financial market with perfect and competitive under conditions of uncertainty (LeRoy, 1989). However, some scholars are sceptical of EMH's ideas due to both theoretical and empirical disputes that have been well documented in reputed journals.

Meanwhile, the behavioural finance paradigm provides an alternative perspective of human behaviour based on the positive theory that is open to the multidisciplinary understanding of human behaviour. Specifically, investor decision and preference are believed to be boundedly and adaptively rational. Bounded rational means investor decision making involving both elements of rational and irrational. The bounded rational theory asserts that a normal human being is not entirely rational in their decision making due to various behavioural heuristics and biases (Simon, 1955) and individual decisions are under time-inconsistent preferences, incomplete information, and different learning environment (Brocas & Carrillo, 2000). Further, neuroscience perspectives justify the dual process (i.e. cognitive and affective) of human neural basis that rationalize the rational (i.e. cognitive logic) and irrational (i.e. cognitive heuristics and affective bias) factors influencing human decision making (Carmerer, Loewenstein, & Prelec, 2004; Shimp, Mitchell, Beas, Bizon, & Setlow, 2015). While adaptive rational means human preference and expectation are not static but heterogeneously adaptive due to behavioural forces (Tinbergen, 1939).

On asset price behaviour, a number of scholars pointed that financial asset prices are not rationally related to firm and economic fundamentals (Shiller, 1981; Summers, 1986), stock market prices do not follow random walks (Lo & MacKinlay, 1988), and nonstationarity of time series stock market data and incomplete data on information of market participants (Campbell & Shiller, 1987). This evidence cause persuasive proof of market inefficiency that has been theoretically neglected instead has been termed as stylized facts puzzle (Suarez-Garcia & Gomez-Ullate, 2014).

As for the market behaviour, two perspectives of market functioning have been offered that are compatible with behavioural finance perspectives. The first theory is bounded rational market has been suggested in Miller (1987) as a result of bounded rational human behaviour. Bounded rational decision influences the market fluctuations in the following three ways. First, it adds noise to investor decisions and cause

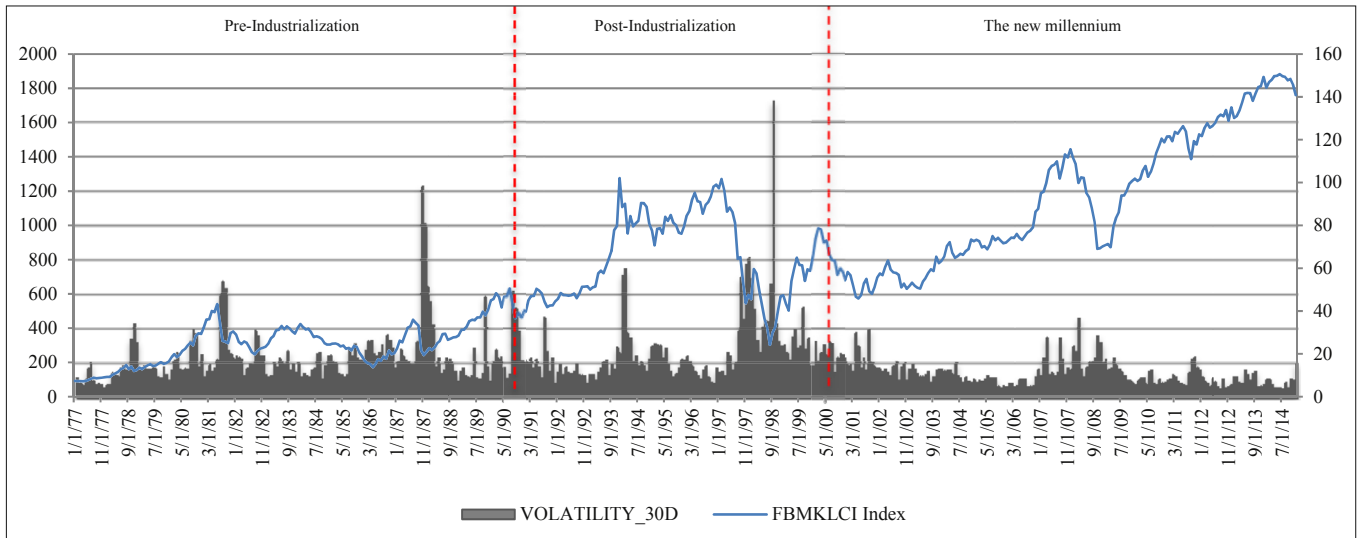


Fig. 2. Malaysian stock market boom and bust cycles (1977–2014). Notes: Scale on the right side represents the value for volatility 30 days. While scale on the left side represents FBMKLCI index values.

disturbances in market fluctuations. Second, it will lead investor to replace the optimizing behaviour with rules of thumb which will result in a frequent fluctuation in market behaviour. Third, it creates a new cost to decision deliberation that may engender various adjustments in behaviour and affect the market fluctuations accordingly (Conlisk, 1996). The second theory is AMH introduced by Lo (2004), which is idealized based on interdisciplinary theories that consist of bounded rationality, complex systems, evolutionary biology, and evolutionary psychology. AMH is relevant in recognizing the variation of investor and market behaviours in today the complex and dynamic market environment (Meier, 2014; Soufian, Forbes, & Hudson, 2014). Additionally, the evolving stock return predictability can be rationalized within the framework of the adaptive markets hypothesis (Lim & Brooks, 2011).

So far, a test of market efficiency based on AMH theoretical perspectives is still very limited globally (Verheyden et al., 2015) with no exception to Malaysia studies. This implies the still dominance of modern finance paradigm to the majority finance scholars. Nonetheless, the awarding of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2013<sup>1</sup> to Eugene Fama, Lars Peter Hansen and Robert Shiller provides a testimony that both modern- and behavioural-finance are a valid paradigm in finance. This paper revisits this efficiency issue in Malaysian stock market in the context of behavioural finance paradigm. Guided by multidisciplinary behavioural theories, we position our investigation of Malaysian stock market efficiency based on the belief that investors are bounded-adaptive rational, stock prices are asymmetrically dynamic, and the market is bounded-adaptive efficient. In this research, the findings lend

support to the validity of behavioural finance's theoretical perspectives on the nature of individual, asset prices, and stock market behaviours.

## 2. Review of Malaysia stock market performance and efficiency

### 2.1. Malaysian stock market performance

The Malaysian capital market is an important emerging Asian market. Stock market, which offers to sell, purchases or exchange of securities was the most active component of the capital market in Malaysia since the 1960s (Butler, Dhillon, & Thiagarajah, 1991). In the modern context, the secondary exchange for stock market, i.e. the Kuala Lumpur Stock Exchange (KLSE)<sup>2</sup> was established in May 1973 (Ali, 1997) after the stock exchange for Malaysia and Singapore were separated (Kean, 1986; Yong, 1994). At the end of 1989, there were only 252 companies listed on the KLSE and served by 53 stock broking firms located only in major towns (Nasir & Mohamad, 1993). At the end of 2014 after for about 25 years later, there were 911<sup>3</sup> companies listed on the Main and ACE market boards. Historically, the performance of KLSE has undergone a series of ups and down cycles influenced by both internal and external's political, economic, social, and technological factors as illustrated in Fig. 2.

*Political and regulatory forces* – The stability of the political environment in Malaysia has always influenced the performance of the stock market. A stable political environment stimulates confidence for inflow of funds that will indirectly enhance the performance of the firm, the industry, and the economy in general (Ali, 1997). Historically, various

<sup>1</sup> Understanding asset prices, the Economic Science Prize Committee of the Royal Swedish Academy of Sciences, 14 October 2013.

<sup>2</sup> The KLSE was renamed as Bursa Malaysia on 20 April 2004 (Lim et al., 2005) following a demutualization exercise.

<sup>3</sup> Sourced from KLSE listing statistics website.

political events both in local and international fronts have, to a certain degree influenced the performance of the Malaysian stock market and in some cases, the effect on the stock market is very drastic particularly for politically connected firms (Ali, 1997; Mitchell & Joseph, 2010). Political shocks can cause either overreaction or underreaction in the stock market (Ali, Nassir, Hassan, & Abidin, 2010) and this will result in short-term non-linearity in prices (Lim & Hinich, 2005). Regulatory changes (amendments) have also been performed to promote further the efficiency and growth of the capital market in Malaysia (Yong, 1994). For instance, the Second Board was introduced in 1989 to encourage listings of small firms. The government had implemented a short-term capital control in 1994 and in 1998 (Ocampo & Stiglitz, 2008) to curb financial market excessive volatility due to speculative activities.

*Economic forces* – Generally, the healthy economic development provides growth opportunities for the industry and the firms. In this respect, various economic cycles in Malaysia have influenced the stock market. In the early 1970s–1990s, Malaysia economy is concentrated on resources-based and export-oriented and has been known as the world's leading exporter of tin, rubber and palm oil (George, 1991; Kean, 1986). Accordingly, most of the quoted firms very much dependent on the export of primary commodities and soaring commodity prices in the 1980s have been the main driver for stock market boom during this time (Kean, 1986; Yong, 1994). In line with the economic and capital market liberalization moves in 1990, Malaysia experienced rapid economic growth spurred by increased government spending, foreign direct investments and exports (Ocampo & Stiglitz, 2008). Capital market liberalization provides both opportunities and challenges to the Malaysian stock market. Advocates of capital market liberalization believes that it will increase economic growth and market efficiency as well as reduce risk (Ang & McKibbin, 2007; Kim & Singal, 2000; Lim & Kim, 2011; Ben Rejeb & Boughrara, 2013). However, empirical evidence revealed that capital market liberalization does not bring the benefits promised by the theory. Rather, it further contributes to the degree of financial market volatility (Chittedi, 2014) and instability (worsening of market efficiency) especially in thin stock markets in developing countries with worldwide cross-boarders influx of irrational and rational exuberance and pessimism that created a contagion of opinions and bubbles in financial markets (Ocampo & Stiglitz, 2008). In no exception, the Malaysian stock market has been very sensitive to both internal and external economic and financial crises. Those crises, including the following; Iran–Iraq war (06/81–08/82), Black Monday (08/87–12/87), US recession (08/90–09/90), Mexican financial crisis (01/94–01/95), Asian financial crisis (02/97–09/98), 911 attacks and technology slump (04/01–04/02), SARS (04/02–03/03), Subprime crisis (01/08–10/08), and US crisis (10/08–12/09) (The Edge Malaysia, 2008<sup>4</sup>; Chong, 2011).

*Social forces* – Various non-fundamental risks impacting the society's psychology and health have been associated with stock market performance. The first racial crisis occurred on May 13th in 1969 which had slow down the private investments and consequently the economic growth in 1971–1972 (Kean, 1986). Other social risks reflected in Malaysian stock market include the Severe Acute Respiratory Syndrome “SARS” (Ali et al., 2010), panic due to terrorism effects (Drakos, 2010; Ramiah, 2012), poor consumer confidence during bubbles (Leger & Leone, 2008), herding contagion during the financial crisis (Khan & Park, 2009) and believe on unlucky numbers (Auer & Rottmann, 2014). All of these factors have psychological connections to investors' sentiment, emotion, and mood that will directly determine their trading strategies. Investors' crowd influenced by exciting news or rumours and investors becomes irrational in their trading based on the impulse of psychology and sociology forces are normal phenomenon seen in Malaysian stock market radar.

*Technology forces* – Revolution in information technology also influence the development of the stock market. Enhancement of technology used in the KLSE and stock broking companies has made it possible for the system to handle a significant increase in trading volume (Ali, 1997). In 1982, KLSE started to use computerization by setting up the data processing department in May 1982. However, the first daily business report was only published in February 1983. Initiated the computerization of clearing systems in November 1983 and was fully completed in March 1984. Installation of real-time share prices reporting and corporate announcements (MASA) was available in 1987 for brokers and subscribers that have enhanced the speed of information transmissions (Butler et al., 1991). In May 1989, a semi-automated trading system called system of computerized order routing and execution (SCORE) was implemented to facilitate and improve the speed of shares trading through electronic systems (Nasir & Mohamad, 1993; Yong, 1994). In recent years, with the innovation of internet technology and computer savvy society, further enhance retail participation in stock market investment (Bogan, 2008).

## 2.2. Malaysian stock market efficiency

Review of literature on stock market efficiency studies in Malaysia is segmented into three clusters to take into account the different economic and market development stages (Table 1). First cluster (1970–1990) is for pre-industrialization/liberalization/information technology revolution. During this period, trading activity in the stock market is relatively limited and slow (Arief, 1975) and the market characteristic has been noted to reflect the weak-form EMH. A second cluster (1991–1999) is for post-industrialization/liberalization/information technology revolution. In the post-1990, consensus on market efficiency in Malaysia has been generally in support for the weak form of EMH while acknowledging the present of temporary inefficiency. The third cluster is the new millennium era (2000–current). This period is associated with a high degree

<sup>4</sup> The Edge Malaysia, November 3, 2008.

Table 1  
Summary of Malaysian stock market efficiency research.

Authors (Year)	Data used	Data frequency/(timeframe)	Theory	Methods	The state of efficiency
<b>The first cluster (Data: 1960–1990) – Pre-industrialization/liberalization/information technology revolution</b>					
Arief (1975)	60 firm stocks	Monthly 1965–1968	RWH/Information theory	Information inaccuracy model	Information inaccuracy is higher
Nassir (1983)	101 actively traded stocks	Monthly (1974–1980)	EMH/RWH	Serial correlation, Run test	Weak-form
Kean (1986)	n/a	n/a	EMH/RWH	Historical discussion	Not at all efficient
Laurence (1986)	16 firms stocks prices	Daily (1973–1978)	EMH/RWH	Serial correlation and Run test	Weak-form
Barnes (1986)	30 firms stocks prices and 6 sector indices	Monthly (1973–1980)	EMH/RWH	Serial correlation, Run test, and Spectral analysis	Weak-form
Saw and Tan (1989)	6 sector indices	Weekly & Monthly (1975–1982)	EMH/RWH		Weak-form
Yong (1994)	All 170 firms stocks traded in KLSE	Weekly (1977–1985)	EMH/RWH	Serial correlation, Run test, and Normal distribution test	Weak-form
Nasir and Mohamad (1993)	All stocks traded in KLSE	Monthly (1975–1989)	EMH/RWH	Serial correlation, Box-Pierce Q-Statistics	Weak-form
Jerrett (2010)	Individual stock prices, trade volume, trade value	Daily (1977–2001)	EMH/RWH	Ordinary least squares	Weak-form does not hold
<b>The second cluster (Data: 1991–1999) – Post-industrialization/liberalization/information technology revolution</b>					
Cajueiro and Tabak (2004)	KLSE Composite Index	Daily (1992–2002)	Long memory	Hurst exponent	Time-varying weak-form
Lim et al. (2005)	KLSE Composite Index	Daily (1990–2002)	AMH	Windowed test for correlation and serial dependency	Weak-form
Hoque, Kim, and Pyun (2007)	KLSE Composite Index	Weekly (1990–2004)	EMH/RWH	Variance ratio tests	Weak-form
Jiang, Ma, and Cai (2007)	KLSE Composite Index	Daily (1984–2005)	EMH/Nonlinear/Multifractal	Detrended fluctuation analysis.	Multifractal efficiency
Kim and Shamsuddin (2008)	KLSE Composite Index	Daily & Weekly (1990–2005)	EMH	Variations ratio tests (Chow-Denning test, Wild bootstrap test, Joint sign test, Small sample VR test)	Inefficient
Lim (2007)	KLSE Composite Index	Daily (1992–2005)	AMH/Nonlinear	Portmanteau bicorrelation test	Non-static weak-form market efficiency
Lim (2008)	KLSE Composite Index	Daily (1992–2005)	AMH/Nonlinear	Portmanteau bicorrelation test	Non-static weak-form
<b>The third cluster (Data: 2000–Current) – The new millennium</b>					
Zunino et al. (2008)	KLSE Composite Index	Daily (1995–2007)	Multifractal	Multifractal detrended fluctuation analysis.	Multifractal efficiency
Kristoufek and Vosvrda (2013)	KLSE Composite Index	Daily (2000–2011)	Multifractal	Hurst exponent, Detrended fluctuation analysis, Detrending moving average, Height–height correlation analysis, Fractal analysis	Less efficient
Rizvi, Dewandaru, Bacha, and Masih (2014)	KLSE Composite Index	Daily (2001–2013)	Multifractal	Multifractal detrended fluctuation analysis.	Multifractal efficiency

Source: Summarized from the respective authors' papers.

of individual involvement in the stock market that increases trading and volatility (Hollifield, 2002; Sanderson, 1998; Schwert, 2002). However, recent research provides evidence of multifractal market efficiency. A summary of these researches are summarized in Table 2.

Some previous researches challenged the validity of the EMH in Malaysia. Evidence against EMH including;

invalidity of the random walk hypothesis which implies predictability of stock prices (Jerrett, 2010; Ming, Guru, & Nor, 2007); non-linear behaviour of stock prices (Lim, 2008; Lim & Hinich, 2005); evidence of long memory in the market (Tan, Chin, & Galagedera, 2014); rational expectation assumption does not confirm to the properties of stock market data (Yeong, Ho, Dollery, & Kogid, 2010). The first study to

Table 2  
Data descriptive statistics.

Statistics	Overall period	Economic development phases			Market states	
		Pre-Industrialization	Post-Industrialization	Millennium	Non-crisis	Crisis
Mean	0.0028	0.0045	0.0011	0.0025	0.0076	-0.0136
Median	0.0047	0.0081	0.0013	0.0041	0.0066	-0.0088
Maximum	0.1279	0.0861	0.1279	0.0552	0.1279	0.1169
Minimum	-0.1863	-0.1863	-0.1236	-0.0717	-0.0715	-0.1863
Std. Dev.	0.0322	0.0363	0.0404	0.0183	0.0257	0.0446
Skewness	-0.6354	-1.2572	0.1162	-0.5275	0.4678	-0.5938
Kurtosis	7.2963	7.3269	4.4927	4.8583	4.9343	5.0545
Jarque–Bera	379.7228	173.2236	11.4114	31.9657	67.7163	23.9335
Probability	0.0000	0.0000	0.0033	0.0000	0.0000	0.0000
Sum	1.2884	0.7467	0.1282	0.4136	2.6772	-1.3888
Sum Sq. Dev.	0.4687	0.2179	0.1939	0.056	0.2317	0.2013
Observations	454	166	120	168	352	102
<b>Equality tests</b>						
Mean	n/a		0.3476		37.9340***	
Median	n/a		566.9538***		493.0887***	
Variance	n/a		88.4067***		55.76071***	

Notes: The equality tests are performed using; ANOVA F-test (for mean), Chi-square (for median), Bartlett (for variances). The sign \*\*\* denotes 1% significant level as indicated by *p*-value.

reconcile the evidence of Malaysian stock market efficiency based on the AMH is given by Lim and others through a series of empirical research. This research noted that linear and non-linear dependencies play a role in the data generating process. The nature of price dependency is not stable which is in line with the adaptive nature of price evolution as postulated by AMH (Lim, 2007, 2008, Lim et al., 2005).

The following behavioural finance researches are urged to be possibly the driver of market efficiency instability. Behavioural finance researches have confirmed bounded rationality of Malaysian investors. Irrational behaviours including; considered gossip, rumours and tips as an information (Bauman, 1989), use of technical analysis (Mohamad & Nassir, 1997), reference to recent returns (Richards, 2005). Retail investor irrationality due to behavioural biases, including; reference to past company performance (Muhammad, 2009), attention to extreme price changes (Toh & Ahmad, 2010) and winner and loser (Toh & Ahmad, 2010) as well as 52 weeks prices high and low (Chun & Ming, 2009).

Other behavioural biases have also been highlighted in market level studies. First, overreaction, underreaction, and overconfidence biases due to various events like attention to winners and losers stocks, market rumours, and speculative political issues (Ahmad & Hussain, 2001; Ali, Ahmad, & Anusakumar, 2011; Ali et al., 2010, Ali, Nassir, Hassan, & Abidin, 2011; Chun & Ming, 2009; Lai, Tan, & Chong, 2013). Second, herding bias due to psychological and sociological influences (Brahmana, Hooy, & Ahmad, 2012). Third, momentum-trading bias like trades based on actively traded securities and sizes (Drew & Veeraraghavan, 2002; Hameed & Ting, 2000). Fourth, culturally induced biases, including high level of collectivism in society (Durand, Koh, & Tan, 2013; Statman, 2008) and seasonality forces including; Chinese New Year effect (Ahmad & Hussain, 2001; Pandey, 2002; Wong, Neoh, Lee, & Thong, 1990), Aidilfitri effect

(Bialkowski, Etebari, & Wisniewski, 2012; Wong et al., 1990), and Monday anomaly (Brahmana et al., 2012). Fifth, negativity bias during the crisis (Chen, Huang, Wang, & Cheng, 2010). Sixth, speculation bias (Chan, McQueen, & Thorley, 1998), and possibly many more to be uncovered. To summarize the nature of stock market efficiency in Malaysia and consideration for future market efficiency research, the following authoritative opinions are re-emphasized;

*“Given the world and the KLSE evidenced both collaborator and contradictory, market efficiency and behavioral finance co-exist just as God created us and many observations in pairs. Chaotic (irrational) and rational behaviors co-exist in any market be it efficient, moderately efficient and inefficient. At times, we may act rationally, at other times irrational. It is a matter of degree”*

Nassir, 2002, p. 15.

*“We cannot maintain (EMH) in their pure form as accurate descriptors of actual markets ... we have to distance ourselves from the presumption that financial markets always work well and that price changes always reflect genuine information”*

Shiller, 2003, p. 102.

### 3. Methodology

#### 3.1. Theoretical framework

The bounded-rational theory (Simon, 1955), prospect theory (Kahneman & Tversky, 1979), and adaptive expectation theory (Tinbergen, 1939) collectively describes heterogeneity roles of investor decision and preferences. In line with this

assumption, the asset prices formation in financial markets is believed to be best described by the dynamic asset price theory (Westerhoff, 2003). Taken together, the investor and price formation behaviour will form an adaptive efficient market as described by AMH (Lo, 2004, 2005, 2012) that prescribed the dynamic behaviour of financial markets due to a complex combination of investor behaviour across time and circumstances that are adapting to information and technological changes (Nawrocki & Viole, 2014). While AMH is still in infancy stage, the theory's validity is supported by empirical research from both developed and emerging financial markets (see Hiremath & Kumari, 2014; Kim, Shamsuddin, & Lim, 2011; Lo, 2004; Todea, Ulici, & Silaghi, 2009; Urquhart & Hudson, 2013; Verheyden et al., 2015). The current research offers a different theoretical and methods to examine the AMH validity. Specifically, the prospect theory's hypothetical value function (Fig. 3) and the quantile regression  $p$  function (Fig. 4) are used to analyse the heterogeneity of risk–return relationships. This idea is motivated by other scholars' works as briefly discussed herein.

The use of prospect theory is more appropriate in behavioural finance research as suggested by prominent scholars in this area (Barberis, 2013; Barberis, Huang, & Santos, 2001; Shiller, 1999). To be specific, the prospect theory postulates that individuals behave differently in their decision making that is risk-seeking in losses domain and risk-averse in gains domain with the middle point being the reference points. Due

to the expected heterogeneity behaviour of investors at the individual security and market level, the nonparametric and nonlinear statistics are best suited for inferential analysis in behavioural finance (Nawrocki & Viole, 2014). In line with this idea, quantile regression is one of the suitable methods. This nonparametric quantile-based risk measures seek to estimate risks without making strong assumptions about the distribution under consideration and estimate risk measures from the entire distribution. Thus, this method avoids the risk of model misspecification, which could bias the estimated risk measures (Dowd & Blake, 2006). More importantly, this method is compatible in validating the adapting preferences as postulated by the prospect theory. In particular, quantile regression can distinguish between negative returns (lower quantiles) and positive returns (upper quantiles) behaviours. In this regard, the beta is expected to be greater in negative conditions (due to risk-seeking over losses) and smaller in positive conditions (due to risk-averse over gain) (Baur & Schulze, 2010). In the market efficient test, the quantile autoregressive model approach has been recently used by Muller, Righi, and Ceretta (2015). We also acknowledge that earlier works have investigated the dynamic behaviour of risk–return relationships and market efficiency in emerging markets, including Malaysia<sup>5</sup> but guided by different theoretical underpinnings and methods. As the research focuses exclusively on behavioural finance perspective, we neglected the bulk of modern finance literature concerning the same issue.

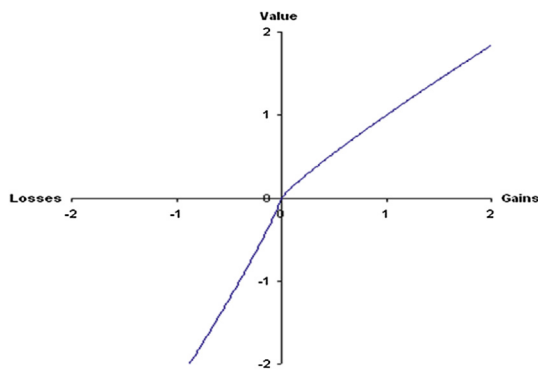


Fig. 3. Prospect theory hypothetical value function. Source: Adapted from <http://prospect-theory.behaviouralfinance.net/>.

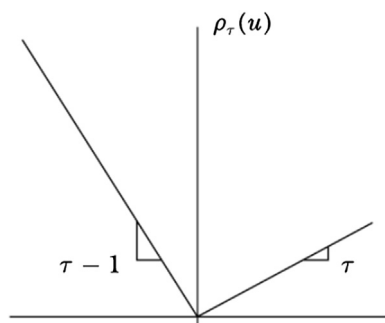


Fig. 4. Quantile regression  $p$  function. Source: Adapted from Koenker and Hallock (2001).

### 3.2. Data and methods for market efficiency test

We employ monthly Bursa Malaysia index (BMKLCI) series together with selected fundamental and behavioural risk proxies spanning from January, 1977 to December, 2014. The analyses are segmented into six different period clusters, namely; overall, pre-industrialization, post-industrialization, millennium, non-crisis, and crisis. Similar approach (use of sub-sample) has also been undertaken by some researchers reviewed in this article. The weak informational efficiency is examined using autocorrelation (AR) and variance ratio (VR) tests. As a robustness test, the behaviour of stock prices and risk–return relationships are inspected using ordinary least squares (OLS) and quantile (QR) regression approaches.

In the first analysis, the AR test is performed. The AR tests as presented in Eq. (1), measure the serial correlation coefficient between a series of returns and its lagged value with the null hypothesis;  $AR = 0$  for all lag. The objective is to examine whether the return series is truly random in a sense that it will exhibit zero autocorrelation behaviour. This indicates a predictability pattern of stock returns based on its past series information. From this model, a positive and significant autocorrelation indicates that the series contains a

<sup>5</sup> See among others; Zalewska-Mitura and Hall (1999), Nguyen and Fontaine (2006), Ben Rejeb and Boughrara (2013, 2014).

trend. While a negative one implies a reversal in series behaviour (Ratner, 1996).

$$R_t = a_i + \beta_i R_{t-k} + \varepsilon_t \quad (1)$$

In the second analysis, the VR test is conducted. The VR test of Lo and MacKinlay (1988) is one of the standard measures of market efficiency that examine whether the variance of the logarithms of a variable series following a random walk. The variance ratio at lag  $q$  ( $VR(q)$ ) of the  $q$  difference series is calculated as in Eq. (2) with the null hypothesis;  $VR = 1$  for all lag. Where  $\sum \sigma_c^2(q)$  is an unbiased estimator of  $1/q$  of the variance of the  $q$ th-differenced series. While  $\sum \sigma_a^2(q)$  is an unbiased estimator of the variance of the first-differenced series. Theoretically, if the natural logarithm of the series ( $p_t$ ) to follow a random walk behaviour which is defined as  $p_t = \alpha + p_{t-1} + \varepsilon_t$ , the variance of the  $q$ th differenced series ( $r_t - r_{t-q}$ ) is expected to equal to  $q$  times the variance of the first difference series ( $r_t - r_{t-1}$ ). The  $VR(q)$  in Eq. (2) will be estimated using two alternative test statistics. The first statistic  $Z(q)$  is a test based on homoscedastic data behaviour which assumes i.i.d. error terms. The second statistic  $Z^*(q)$  provide adjustment on possible heteroscedasticity in the error terms and does not require the assumption of normality. Technically, VR less than unity implying a mean reverting process. While, VR increasing in  $q$  indicates mean aversion behaviour (Jasic & Wood, 2006).

$$VR(q) = \frac{\sum \sigma_c^2(q)}{\sum \sigma_a^2(q)} \quad (2)$$

To uncover the dynamic behaviour, in the final analysis, the stock returns autocorrelations and risk–return relationships are examined and compared using the standard OLS and QR approach. In the standard linear regression of OLS method as presented in Eq. (3), the relationship between the dependent and independent variables is summarized based on the conditional mean function,  $E(y_i|x_i)$  that provides at best, only the average perspectives. In OLS method, the estimation of model prediction error ( $\varepsilon_i$ ) is based on minimization of  $\sum_i \varepsilon_i^2$ . As an alternative, in QR method as presented in Eq. (4), the relationship between dependent and independent variables are estimated based on the conditional median function,  $Q^{(q)}(y_i|x_i)$  of specific quantile ( $q$ ) of the empirical distribution. Where conditional quantiles range between  $0 < q < 1$  and the QR can be performed from  $q0$  to  $q1$  with  $q0.5$  known as the median regression. This means that, the data is split into proportions of  $q$  below and  $1 - q$  above. In the estimation of the model prediction error, median regression minimizes  $\sum_i \varepsilon_i$  and QR minimizes a sum that gives asymmetric penalties  $(1 - q)|\varepsilon_i|$  for overprediction and  $q|\varepsilon_i|$  for underprediction. Unlike OLS, the QR is more robust to outliers and does not require fulfilment of normal distribution of the error process (Koenker & Bassett, 1978; Koenker & Hallock, 2001).

$$y_{iOLS} = \beta_0 + \beta_1 x_i + \varepsilon_i \quad (3)$$

$$y_{iQR} = \beta_0^{(q)} + \beta_1^{(q)} x_i + \varepsilon_i^{(q)} \quad (4)$$

## 4. Results and discussions

### 4.1. Behaviour of Bursa Malaysia Kuala Lumpur Stock Exchange (BMKLSE)

The analyses are segmented into three data clusters, namely the overall period, economic development phases, and market states. As shown in Table 2, these data show a statistically significantly different in risk and return characteristics along different clusters. The skewness statistics which measure the asymmetry of the distribution of the index series indicated a non-normal distribution (i.e. non-zero). The data also show the presence of both positive and negative skewness. The non-normal distribution behaviour also confirmed by the kurtosis statistics and the significant of Jarque–Bera statistics (Bai & Ng, 2005).

### 4.2. Informational efficiency of BMKLSE

The relative weak efficiency of BMKLSE is first inspected using autocorrelation of BMKLSE at lag  $k$  (i.e. 1 month to 12 months) that reflects the informational efficiency in the short term. Similarly, the analyses are performed on segmented data as explained earlier, and the results are as summarized in Table 3. In the overall period, series autocorrelation with its historical values are statistically significant and slowly decaying as the number of lags increases. This indicates the long memory effect and a sign of market inefficiency (Cao, Deng, & Li, 2010). However, in the segmented data, evidence of autocorrelation only statistically significant in the post-industrialization period and during non-crisis market states. This provides a clue that market efficiency is adapting.

In the second stage, the state of market efficiency is further examined using VR that are conducted based on two tests, namely unbiased variance estimation and heteroskedastic robust standard error estimation. Tests periods chosen are months 2, 4, 8, and 12. Details of the adaptive behaviour of market efficiency assessments based on individual lags and joint tests for all lags are summarized in the following Table 4. The VR tests for all segmented data are statistically significant for all lags examined. In addition, the joint tests provide confirmation that efficiency in different lags is significantly different. The tests indicate that the Malaysian stock market efficiency ratios are below one, the benchmark for full efficiency (Ghazani & Araghi, 2014). The Malaysian market efficiency level for lags 2 months data ranging from 0.43 to 0.58 that is within the range of weak efficient markets. This evidence is in confirmation with the previous market efficiency studies conducted in Malaysia. In addition, the level of market efficiency decreases as the number of lags increases. This is in accordance with observation provided in Jasic and Wood (2006) that can be referred to psychology reasoning that people remember and influence more by recent event than the past (Table 5).



Table 3  
Autocorrelation tests.

Statistics	Overall period	Economic development phases			Market states	
		Pre-Industrialization	Post-Industrialization	Millennium	Non-crisis	Crisis
Lag (1)	0.1220***	0.123	0.113	0.1590**	0.053	0.104
Lag (2)	0.1380***	0.082	0.2180**	0.028	0.1170*	0.051
Lag (3)	-0.0900***	-0.059	-0.1560**	-0.017	0.028	0.017
Lag (4)	-0.0520***	-0.007	-0.1450**	0.041	0.022	0.032
Lag (5)	-0.0030***	0.059	-0.1190**	0.153	0.085	0.024
Lag (6)	-0.0890***	-0.079	-0.0860**	-0.051	0.0870*	-0.145
Lag (7)	0.0860***	-0.024	0.2130***	0.048	0.0110*	0.164
Lag (8)	-0.0130***	-0.064	0.0740***	-0.096	0.0840*	-0.056
Lag (9)	0.0710***	-0.035	0.2000***	-0.06	0.1000**	0.095
Lag (10)	0.0489***	0.074	0.0570***	-0.139	0.0020**	-0.003
Lag (11)	-0.0090***	0.135	-0.1360***	-0.1520**	-0.0220*	-0.111
Lag (12)	-0.0490***	-0.076	-0.0670***	-0.0590*	0.0540*	0.073

Notes: The figures for autocorrelation represent the Q-Statistic. The sign \*\*\*, \*\*, and \* denotes 1%, 5%, and 10% significant level respectively as indicated by *p*-value.

Going beyond the existing studies, this research examines the nature of evolving market efficiency level across different economic development phases and different market states. This is in line with the AMH description that the evolving efficiency is due to the changing behaviour of investors that adapt to changing information sets and particular conditions. The AR test in Table 3 and VR test in Table 4 provides a consistent statistic description on the evolving nature of market efficiency given different economic and market conditions. The conclusion of these tests is as summarized below.

Based on the economic development phase segmentation, market efficiency seems to be evolving with the Millennium economic phase recording higher level of market efficiency compared to the pre- and post-industrialization periods. These differences could be rationally justified by the fact that the recent economic development phase is more fundamentally robust after the economic and financial market liberalization. The results are in line with some scholars' findings, which noted that economic and financial market liberalization has helped improved the economy in general and enhanced capital

Table 4  
Variance ratio tests.

Sample periods	Test specification	Statistics	Individual tests				Joint tests
			Lag 2	Lag 4	Lag 8	Lag 12	
Overall	Homo	VR(q)	0.4916	0.3010	0.1460	0.1016	119.8790***
		Z(q)	-10.8205***	-7.9524***	-6.1444***	-5.1000***	
	Hetero	VR(q)	0.4905	0.2990	0.1438	0.0992	
Pre-Industrialization	Homo	Z*(q)	-6.7270***	-5.1893***	-4.2959***	-3.6663***	37.2384***
		VR(q)	0.5251	0.2871	0.1525	0.1047	
	Hetero	VR(q)	0.5219	0.2819	0.1460	0.0977	
Post-Industrialization	Homo	Z*(q)	-4.2585***	-3.5490***	-2.9091***	-2.5658**	42.1085***
		VR(q)	0.4399	0.3265	0.1346	0.1061	
	Hetero	VR(q)	0.4362	0.3183	0.1266	0.0963	
Millennium	Homo	Z*(q)	-4.3828***	-3.0020***	-2.5780***	-2.1171**	30.8928***
		VR(q)	0.5803	0.2788	0.1609	0.1014	
	Hetero	VR(q)	0.5768	0.2738	0.1542	0.0947	
Non-Crisis	Homo	Z*(q)	-4.2749***	-4.2673***	-3.3630***	-2.8790***	101.2128***
		VR(q)	0.4668	0.2598	0.1226	0.0852	
	Hetero	VR(q)	0.4655	0.2576	0.1202	0.0826	
Crisis	Homo	Z*(q)	-6.1945***	-4.8917***	-3.9287***	-3.3722***	22.9143***
		VR(q)	0.5249	0.2635	0.1457	0.0857	
	Hetero	VR(q)	0.5197	0.2557	0.1356	0.0764	
		Z*(q)	-3.2578***	-2.9445***	-2.4392**	-2.1239**	

Notes: VR(q) is Variance Ratios for the respective lags examined. Z is z-statistics for unbiased variance (Homoscedastic) tests. While Z\* is z-statistics for heteroskedastic robust standard errors (Heteroskedastic) tests. Numbers in the Joint Tests are the Wald Statistics (Chi-Square). The asterisk \*\*\*, \*\*, and \* denotes significant levels of 1%, 5%, and 10% respectively as indicated by *p*-value.

Table 5  
Summary of weak-efficiency tests.

Tests/Conditional	Overall	Economic phases			Market states	
		Pre-Industrialization	Post-Industrialization	Millennium	Non-crisis	Crisis
AR	Autocorrelation present <i>(Predictable)</i>	No autocorrelation <i>(Unpredictable)</i>	Autocorrelation present <i>(Predictable)</i>	No autocorrelation <i>(Unpredictable)</i>	Autocorrelation present <i>(Predictable)</i>	No autocorrelation <i>(Unpredictable)</i>
VR (Hetero)	0.4905 <i>(&lt;0.5)</i>	0.5219 <i>(&gt;0.5)</i>	0.4362 <i>(&lt;0.5)</i>	0.5768 <i>(&gt;0.5)</i>	0.4655 <i>(&lt;0.5)</i>	0.5197 <i>(&gt;0.5)</i>

Notes: The bold-italics values indicate a consistent result of unpredictability (weak-efficiency) of BMKLSE given VR > 0.5.

allocation efficiency, market integration, and information efficiency in financial markets. These forces indirectly have improved the degree of weak market efficiency in Malaysia in particular and in emerging markets in general, despite the fact that it has been evolving to adapt to economic cycles and series of financial crises (see [Abiad, Oomes, & Ueda, 2008](#); [Ben Rejeb & Boughrara, 2013, 2014](#); [Bekaert, Harvey, & Lundblad, 2003](#); [Henry, 2000](#); [Nguyen & Fontaine, 2006](#); [Rizvi & Arshad, 2014, 2016](#)). Most importantly, the Malaysian capital market institutions noted to have improved after the implementation of a Capital Market Master Plan in 1999, which have improvised regulatory framework and corporate governance ([Gimet & Lagoarde-Segot, 2011](#)).

Based on the market states condition, the pattern of stock returns autocorrelation independence is homogeneous in crisis states compared to non-crisis states which indicate the presence weak efficiency. This is also consistent with VR test that shows relatively higher VR value during the crisis compared to non-crisis market states. The insignificant of autocorrelation test in this crisis-sub sample provides evidence of unpredictability pattern of stock returns using its past price information. We caution readers for generalization of our findings due to contradictory opinion drawn from existing studies which argued that the weak market efficiency pattern is deteriorating in Malaysia during the crisis market states (see [Kim & Shamsuddin, 2008](#); [Lim, Brooks, & Kim, 2008](#); [Rizvi & Arshad, 2016](#)). In addition, our finding might also be due to less noisy monthly data used. In the meantime, we provide possible theoretical justification on this finding. The

psychology-based negativity bias hypothesis states that people are more sensitive to negative events compared to positive ones and the effect of negative news is stronger than positive news ([Kanouse, 1984](#)). Based on this hypothesis, we argue that during crisis market states, the negativity biases are homogeneous to all investors and that enhance the predictable pattern of price behaviours. On the other hand, during non-crisis market states, investors' information and opinion divergences are large and weaken the predictable pattern of price behaviour.

#### 4.3. Investor's bounded rationality and predictability of stock returns

This section provides an assessment of bounded rational of investors and asymmetric dynamic behaviour of stock prices. Behavioural finance assumes risk forces comprise of fundamental and behavioural risks, and risk–return relationships are to be asymmetrically dynamic due to bounded-adaptive rational of investors thinking and decisions. To validate this, the asymmetric dynamic behaviour of stock prices in extreme losses and extreme gains of data distributions according to the perspective of prospect theory is examined. This theory postulates that the investor decides based on loss and gains, and experiencing losses are more painful to humans compared to experiencing gains.

Accordingly, the OLS and QR estimations for return autocorrelations with its lag 1 values are estimated and the results are as presented in [Fig. 5](#). The average mean-based

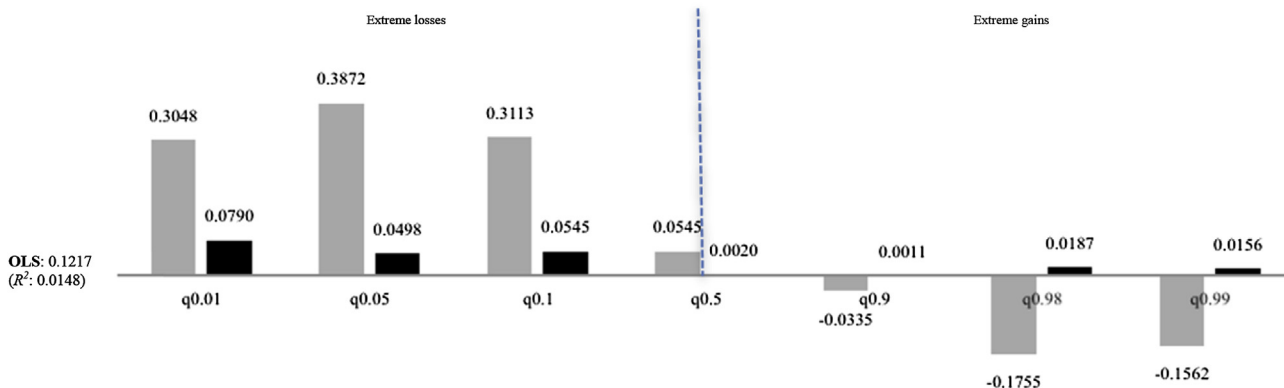


Fig. 5. Stock return autocorrelations using quantile regression approach. Notes: The OLS figures represent the coefficient and R<sup>2</sup>, which is significant at 1% level. The figures in grey and black histograms are the coefficient and R<sup>2</sup> for QR for the respective quantiles (q). Coefficients in q0.01, q0.05, q0.1, q0.98, and q0.99 are significant at 1% level. While coefficients for q0.5 and q0.9 are insignificant.

(OLS) and quantiles-based (QR) estimations yield a different conclusion with regards to the nature of returns autocorrelation. The OLS analysis, which is based on Gaussian assumptions indicated that past returns information is positively related to contemporaneous returns. On the other hand, the alternative non-Gaussian QR analysis revealed that the autocorrelations relationship is asymmetric. The relationships are positive and significant in extreme losses, negative and significant in extreme gains, and insignificant in median points. Also noted that the risk influence to return is stronger in losses compared to gains a situation that is in confirmation to prospect theory theoretical ideas. These findings are in line with recent studies conducted by [Baur, Dimpfl, and Jung \(2012\)](#) and [Zhu, Li, and Zeng \(2015\)](#). Practically, in loss situations, investors are generally panic and scared of further losses. Thus, risk forces are very sensitive to the stock prices. In gains situation, most investors opt to liquidate their investments for profit taking. These provide justification on negative risk–return relationships in the upper quantiles. In prediction comparison (based on  $R^2$ ), OLS underestimate the effect on lower quantiles and overestimate the effect on upper quantiles.

In the next analyses, selected fundamental (i.e.  $KLCI_{t-1}$ , CI, LAI, LEI) and behavioural (i.e. BCS, CSI, VOL) risks influence on aggregate stock market returns are examined in both contemporaneous and future returns perspective. This is to gauge the bounded rational investors as proxies by the influence of both fundamental and behavioural risks in their stock investment decision. The results are as summarized in [Tables 6 and 7](#).

In both contemporaneous and future returns analysis, the OLS and QR analyses provide a different conclusion with regards to the influence and significance of the relationship of risk variables examined. The influences of selected fundamental and behavioural risks are significant, but heterogeneous on the condition of market states and risk states. We draw readers' attention to the emerging patterns in the analysis with justifications from the behavioural finance theoretical lenses.

First, evidence of asymmetry risk–return relationship. Specifically, in OLS analyses, positive risk–return relationships seem to be valid only in the overall (average) sample. Note that the negative relationship between return and volatility indicates a positive relationship ([French, Schwert, & Stambaugh, 1987](#)). However, different patterns appear when market and risk states are taken into account, but with heterogeneous significant influences. On the other hand, the QR provides a heterogeneous predictable pattern of risk influences to return. This result is analogous with to the existing studies employing QR methods.

Second, the risk–return relationships are also noted to obey the prospect theory theoretical postulates. Explicitly, significant risk–return relationship occur in the lower (losers) and upper (winners) quantiles but heterogeneous to condition of market states and the nature of risks. We have performed estimation to all possible quantiles (i.e. 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, and 0.9) plus two extreme quantiles (i.e. 0.02 and 0.98). Overall, significant pattern is observed in lower quantiles up to 0.2 and in upper quantiles started from 0.8. All other

unreported quantiles are qualitatively insignificant. This result can be corroborated to the prospect theory descriptions on human decision making that people decide based on the prospect of losses and gains. Empirical support to this theoretical notion is also provided in a series of Baur's works ([Baur, 2013](#); [Baur et al., 2012](#); [Baur & Schulze, 2010](#)) and others.

Third, the expected higher influence of negativity bias seems to be observed in Malaysian stock market. To highlight, the risk–return relationships in lower and upper quantiles are relatively stronger in the crisis and stronger when negative risk is interacted with crisis. This implies that, negative news in crisis has a strong influence on investor decision and hence, the market returns. These evidences can be corroborated with psychology-based theory of negativity bias hypothesis ([Kanouse, 1984](#)) and regret theory ([Loomes & Sugden, 1982](#)).

Collectively, both analyses provide supports to the validity of bounded and adaptive rationality of investor behaviour and decision that make the stock behaviour to be dynamically heterogeneous. This point to the conclusion that relying on the EMH as the theoretical base in understanding market behaviour and in designing investment strategies as well as market policies could underestimate the true risks and consequently mislead investors, managers, and policy makers.

## 5. Theoretical and practical implications

### 5.1. Theoretical implications

To reemphasize, this research examines the state of Malaysian stock market efficiency based on the theoretical lenses of behavioural finance that believe; investors are boundedly rational, asset price behaviour is dynamic, and that the stock market is bounded and adaptively efficient. The empirical analysis lends support to the behavioural perspectives as summarized below.

Investors behaviour which is read from asset price behaviour that reflect their actions seems to be bounded-adaptive rational. Investors are influenced by both rational (fundamental) and irrational (behavioural) forces and non-linear price formation behaviour. This can be reconciled with inter-related behavioural based theories of decision, namely bounded rational theory ([Simon, 1955](#)), prospect theory ([Kahneman & Tversky, 1979](#)), and regret theory ([Loomes & Sugden, 1982](#)) and adaptive expectation of human behaviour ([Tinbergen, 1939](#)). This is consistent with growing evidence of investors irrationality among retail and institutional investors ([Akerlof & Shiller, 2009](#); [Garling, Kirchner, Lewis, & Raaij, 2009](#)). Due to the bounded-adaptive of investors' behaviour, stock prices show a dynamic behaviour. Dynamic means stock prices trending in non-linear fashion and the risk–return relationships are heterogeneous across specific conditions. This in line with suggestions by some earlier scholars ([Baur, 2013](#); [Baur et al., 2012](#); [Blume & Easley, 1992](#); [Fiegenbaum, 1990](#)). Collectively, the bounded-adaptive of investor and dynamic of asset prices behaviours will form bounded-adaptive market efficiency as postulated in bounded-EMH ([Miller, 1987](#)) and in AMH ([Lo, 2004](#); [2005](#); [2012](#)). The current research

Table 6  
Asymmetric dynamic behaviour of risk–return relationships (Contemporaneous returns).

Data segmentations	Variables/Statistics	OLS	QR					Wald Test
			Lower		Median		Upper	
			0.02	0.20	0.50	0.80	0.98	
<b>Overall</b>	$R_{t-1}$	0.0551	0.4830***	0.2055*	0.0649	−0.0509	−0.1113	
$R_t = a_i + \beta_1 R_{t-1} +$	CI	0.2304	−4.5413***	−0.6367	0.7534**	0.7787	−3.1906***	
$\beta_2 CI_t + \beta_3 LAI_t +$	LAI	0.0902	0.1860	0.1112	−0.1854	0.0522	0.1213	
$\beta_4 LEI_t + \beta_5 BCS_t +$	LEI	0.6079	4.5900***	1.8132***	0.7435*	1.0389**	0.9216***	110.00***
$\beta_6 CSI_t + \beta_7 VOL_t + \varepsilon_t.$	BCS	0.0596**	−0.1138***	0.0153	0.0109	0.0123	0.2746***	
	CSI	0.0521	−0.0355	−0.0294	0.0221	0.0680**	0.2548*	
	VOL	−0.0278***	−0.0560***	−0.0423***	−0.0350***	−0.0098	0.0109	
	Adj. $R^2$	0.0770	0.1565	0.0987	0.0344	0.0391	0.2145	
	JB test	175.0833***						
	BPG test	6.1209***						
	BG-LM test	0.7514						
	VIF Test	1.02–1.28						
<b>Non-crisis</b>	$R_{t-1}$	0.1212	1.0105***	0.0901	0.1310	0.0109	0.0481	
$R_t = a_i + \beta_1$	CI	0.6457	4.2404***	0.4806	0.8208**	1.1726**	−3.2896***	
$R_{t-1} * NC_t +$	LAI	0.3376	0.7278	0.0685	0.0890	0.3455	0.1130	
$\beta_2 CI_t * NC_t +$	LEI	0.5331	0.9493	1.6997***	0.4771	1.0936**	1.0246***	118.41***
$\beta_3 LAI_t * NC_t +$	BCS	0.0588	0.1375	0.0596	0.0183	0.0652	0.2454***	
$\beta_4 LEI_t * NC_t +$	CSI	0.0094	−0.4138***	−0.0822	0.0178	0.0537	0.4449***	
$\beta_5 BCS_t * NC_t +$	VOL	−0.0154*	0.0203*	−0.0209**	−0.0222**	−0.0196***	0.0175	
$\beta_6 CSI_t * NC_t +$	Adj. $R^2$	0.0275	0.1114	0.0465	0.0159	0.0359	0.1555	
$\beta_7 VOL_t * NC_t + \varepsilon_t.$	JB Test	179.4752***						
	BPG Test	2.0972**						
	BG-LM Test	0.9455						
	VIF Test	1.02–1.24						
<b>Crisis</b>	$R_{t-1}$	−0.0082	0.4705***	0.0307	−0.0338	−0.2183	−0.2427	
$R_t = a_i + \beta_1 R_{t-1} *$	CI	−0.5137	−4.3935**	−0.2923	0.0564	−0.6445	1.0523	
$C_t + \beta_2 CI_t * C_t +$	LAI	−0.4917	0.4089	0.0376	−0.2379	−0.3730	−0.7131	
$\beta_3 LAI_t * C_t +$	LEI	1.3834	4.7351***	1.2530	1.3910*	0.7941	−2.0513	160.32***
$\beta_4 LEI_t * C_t$	BCS	0.0593*	−0.1105	0.0241	−0.0177	0.0359	0.1793*	
$+ \beta_5 BCS_t * C_t +$	CSI	0.0713	−0.0132	0.0682	0.0581	0.1157	0.1077	
$\beta_6 CSI_t * C_t +$	VOL	−0.0474***	−0.0596***	−0.0902***	−0.0707	−0.0340	0.0238	
$\beta_7 VOL_t * C_t + \varepsilon_t.$	Adj. $R^2$	0.0679	0.1854	0.0627	0.0159	0.0085	0.1346	
	JB Test	163.9761***						
	BPG Test	6.3108***						
	BG-LM Test	0.8151						
	VIF Test	1.79–3.74						

<b>Negative risks</b>	$R_{t-1}$	0.2358	0.0813	0.1315	-0.1650	-0.3207**	-0.6636***	
$R_t = a_i + \beta_1 R_{t-1}^*$	CI	-0.2485	-1.4397	-0.5113	0.9708	-1.2085	-9.1689***	
$Neg_t + \beta_2 CI_t^*$	LAI	0.0254	3.4125	1.2391	-0.3727	0.4140	-7.5109**	
$Neg_t + \beta_3 LAI_t^*$	LEI	0.0653	-0.3491	2.3682	0.5125	-0.1849	1.7419***	177.88***
$Neg_t + \beta_4 LEI_t^*$	BCS	0.0816**	-0.1701**	0.0582	0.0953*	0.0917	0.2707***	
$Neg_t + \beta_5 BCS_t^*$	CSI	0.1029**	0.5892	0.0034	0.0126	0.0665*	0.1505***	
$Neg_t + \beta_6 CSI_t^*$	VOL	-0.0186	-0.0359	-0.0330	-0.0200	-0.0076	0.0021	
$Neg_t + \beta_7 VOL_t^*$	Adj. $R^2$	0.0298	0.1405	0.0299	0.0069	0.0043	0.1570	
$Neg_t + \varepsilon_t$	JB Test	133.3161***						
	BPG Test	1.6238						
	BG-LM Test	0.996						
	VIF Test	1.14–2.48						
<b>Negative risks in crisis</b>	$R_{t-1}$	0.3885*	0.1471	0.4917*	0.4679	0.7110*	0.5428	
$R_t = a_i + \beta_1 R_{t-1}^*$	CI	0.1937	-5.4237**	-1.8898	0.6573	-1.6350	8.9284***	
$Neg_t^* C_t + \beta_2 CI_t^*$	LAI	-0.3016	6.4096	1.0687	-0.9231	-1.6915**	-1.4132**	
$Neg_t^* C_t + \beta_3 LAI_t^*$	LEI	1.5273	14.0119*	4.7912	3.3516	1.4248*	-8.3911***	140.68***
$Neg_t^* C_t + \beta_4 LEI_t^*$	BCS	0.0289	0.0205	0.0636	0.0514	0.0727	0.0789	
$Neg_t^* C_t + \beta_5 BCS_t^*$	CSI	0.0675	1.0410**	0.2843	0.0158	0.0088	-0.1660	
$Neg_t^* C_t + \beta_6 CSI_t^*$	VOL	0.0445	-0.1316	0.0906	0.0200	0.0147	0.1774***	
$Neg_t^* C_t + \beta_7 VOL_t^*$	Adj. $R^2$	0.0614	0.2738	0.0857	0.0162	0.0103	0.0867	
$Neg_t^* C_t + \varepsilon_t$	JB Test	184.3093***						
	BPG Test	3.6556***						
	BG-LM Test	0.6047						
	VIF Test	1.12–2.64						

Notes: OLS is for ordinary least square estimation using robust standard errors Newey–West estimators to correct the residuals for heteroskedasticity and/or autocorrelation problems. The QR is for autoregressive quantile regression estimated using the Huber Sandwich estimators which are valid under independent but non-identical sampling. The asterisks \*\*\*, \*\*, and \* denotes significant level of 1%, 5%, and 10% respectively. The variables acronym reads as follows; Return ( $R_t$ ); Coincident Index ( $CI_t$ ); Lagging Index ( $LAI_t$ ); Leading Index ( $LEI_t$ ); Business Confidence Survey ( $BCS_t$ ); Consumer Sentiment Index ( $CSI_t$ ); Volatility 30 days ( $VOL_t$ ). Dummy variables are; non-crisis period ( $NC_t$ ); crisis period ( $C_t$ ); negative risks ( $Neg_t$ ). Diagnostic statistics; normality (Jarque–Bera test); Heteroscedasticity (Breusch–Pagan–Godfrey test); serial correlation (Breusch–Godfrey LM test), and multicollinearity (centered Variance Inflation Factors test). The Wald test is performed to examine the quantile slope equality 10 different quantiles from  $q0.10$  to  $q0.90$ . For QR, we report only 5 quantiles estimation results representing extreme lower, medium, and extreme upper quantiles inline with our focus and due to space constraints although we have estimated all other quantiles (i.e  $q0.10$  to  $q0.90$ ).

Table 7

Asymmetric dynamic behaviour of risk–return relationships (Future returns).

Data segmentations	Variables/Statistics	OLS	QR					Wald Test
			Lower		Median		Upper	
			0.02	0.20	0.50	0.80	0.98	
<b>Overall</b>	$R_{t-1}$	0.0775	0.3014**	0.2742**	-0.0205	-0.0810	-0.1667***	155.92***
$R_t = a_i + \beta_1 R_{t-1} +$	$CI_{t-1}$	0.5942	1.8845	1.0802*	0.2790	0.2098	-0.3817	
$\beta_2 CI_{t-1} + \beta_3 LAI_{t-1} +$	$LAI_{t-1}$	-0.2217	0.1511	-0.3001	-0.1089	0.1706	-2.0397***	
$\beta_4 LEI_{t-1} +$	$LEI_{t-1}$	-0.5305**	-1.4836***	-0.6447***	-0.3644**	-0.2095	-0.3282	
$\beta_5 BCS_{t-1} +$	$BCS_{t-1}$	0.0476*	0.0488	0.0337	0.0207	0.0304	0.1726***	
$\beta_6 CSI_{t-1} +$	$CSI_{t-1}$	0.0639	0.1782	0.0572	0.0378	0.1212**	0.0200	
$\beta_7 VOL_{t-1} + \varepsilon_t.$	$VOL_{t-1}$	-0.0139	-0.0637	-0.0020	-0.0014	-0.0297**	-0.0478***	
	Adj. $R^2$	0.0268	0.1476	0.0285	-0.0081	0.0200	0.1293	
	JB test	120.9301***						
	BPG test	4.1012***						
	BG-LM test	0.6836						
	VIF Test	1.01–1.30						
<b>Non-crisis</b>	$R_{t-1}$	0.0997	0.7058***	0.2606**	0.0170	-0.0309	-0.1438	
$R_t = a_i + \beta_1 R_{t-1} +$	$CI_{t-1}$	0.7620	2.7839***	0.4334	0.5555	0.1171	3.0398**	
$NC_t + \beta_2 CI_{t-1} * NC_t +$	$LAI_{t-1}$	0.5316*	2.0464***	0.3805	0.4858	0.5813	-1.0361	
$\beta_3 LAI_{t-1} * NC_t +$	$LEI_{t-1}$	-0.1429	-0.0189	-0.3898*	-0.2174	-0.0085	-0.6971**	
$\beta_4 LEI_{t-1} * NC_t +$	$BCS_{t-1}$	0.0463	-0.3143	0.0776	0.0024	0.0696	0.5182***	
$\beta_5 BCS_{t-1} * NC_t +$	$CSI_{t-1}$	0.0412	0.1758	-0.0606	0.0446	0.1223**	0.3137	
$\beta_6 CSI_{t-1} * NC_t +$	$VOL_{t-1}$	-0.0083	0.0499**	0.0032	0.0000	-0.0077	-0.0447***	
$\beta_7 VOL_{t-1} * NC_t + \varepsilon_t.$	Adj. $R^2$	0.0083	0.0932	0.0104	-0.0112	0.0026	0.0871	
	JB Test	153.2325***						
	BPG Test	0.6803						
	BG-LM Test	0.6888						
	VIF Test	1.02 – 1.28						
<b>Crisis</b>	$R_{t-1}$	0.0090	0.0617	0.3578	0.0177	-0.1921	-0.3703	118.41***
$R_t = a_i + \beta_1 R_{t-1} +$	$CI_{t-1}$	0.6408	0.0140	2.1100	0.5660	-0.9388	-0.1829***	
$C_t + \beta_2 CI_{t-1} * C_t +$	$LAI_{t-1}$	-0.2951	-2.8352***	-1.5744*	-0.6737	-0.3333	-0.7525	
$\beta_3 LAI_{t-1} * C_t +$	$LEI_{t-1}$	1.3351	-0.1177	-2.0950**	-0.2729	-0.4646	-2.1597*	
$\beta_4 LEI_{t-1} * C_t +$	$BCS_{t-1}$	0.0546	0.0394	-0.0217	0.0184	0.0604	0.1154**	
$\beta_5 BCS_{t-1} * C_t +$	$CSI_{t-1}$	0.062	0.1518	0.0893	0.0318	0.1079	0.0711	
$\beta_6 CSI_{t-1} * C_t +$	$VOL_{t-1}$	-0.0579***	-0.0212	-0.0123	-0.0205	-0.0302	-0.1368**	
$\beta_7 VOL_{t-1} * C_t + \varepsilon_t.$	Adj. $R^2$	0.0592	0.1477	0.0332	0.0028	0.0182	0.1416	
	JB Test	122.3291***						
	BPG Test	5.6396***						
	BG-LM Test	0.7797						
	VIF Test	1.19–1.52						

<b>Negative risks</b>	$R_{t-1}$	0.2575	0.1935***	0.2035	-0.0833	-0.2617	-0.2967	
$R_t = a_i + \beta_1 R_{t-1}^*$	CI $t-1$	0.7567	3.8129***	0.9670*	0.5530	0.1327	2.8179	
$Neg_t + \beta_2 CI_{t-1}^*$	LAI $t-1$	-0.2733	-1.7155***	0.2963	-0.0565	0.2242	-2.1548	
$Neg_t + \beta_3 LAI_{t-1}^*$	LEI $t-1$	-1.2928***	-0.3860	-0.6006	-0.6371	-1.9227***	-5.3802**	160.32***
$Neg_t + \beta_4 LEI_{t-1}^*$	BCS $t-1$	0.0465	-0.1821***	0.0595	0.0016	0.0749*	0.1501*	
$Neg_t + \beta_5 BCS_{t-1}^*$	CSI $t-1$	0.1301**	0.0578	0.1634	0.0868	0.1517***	0.1021	
$Neg_t + \beta_6 CSI_{t-1}^*$	VOL $t-1$	-0.0264**	-0.1005	-0.0177	-0.0285	-0.0232*	-0.0507***	
$Neg_t + \beta_7 VOL_{t-1}^*$	Adj. $R^2$	0.0558	0.1236	0.0208	-0.0069	0.0379	0.1407	
$Neg_t + \varepsilon_t$	JB Test	113.2680***						
	BPG Test	1.1058						
	BG-LM Test	0.8276						
	VIF Test	1.03–1.12						
<b>Negative risks in crisis</b>	$R_{t-1}$	0.3587	0.3209	0.5788***	0.5705	0.4467	0.8792	
$R_t = a_i + \beta_1 R_{t-1}^*$	CI $t-1$	0.7315	0.4413	0.8483	0.7062	-1.5828	-0.7167	
$Neg_t * C_t + \beta_2 CI_{t-1}^*$	LAI $t-1$	-1.3568	-2.9924*	-3.0933	-0.3367	-0.0735	-1.6255	
$Neg_t * C_t +$	LEI $t-1$	-1.7413*	-3.8173	-1.4347*	-1.5332	-0.3946	-4.5589*	177.88***
$\beta_3 LAI_{t-1} * Neg_t^*$	BCS $t-1$	0.0335	0.8450	0.1829	-0.0033	0.0185	-0.0799	
$C_t + \beta_4 LEI_{t-1} * Neg_t^*$	CSI $t-1$	0.1604*	0.5924***	0.3936***	0.1710***	0.1803	-0.0168	
$C_t + \beta_5 BCS_{t-1}^*$	VOL $t-1$	-0.0568*	-0.0746	-0.0114	-0.0521	-0.0359	-0.0720	
$Neg_t * C_t + \beta_6 CSI_{t-1}^*$	Adj. $R^2$	0.0784	0.2277	0.0753	0.0128	0.0097	0.0889	
$Neg_t * C_t +$	JB Test	121.1061***						
$\beta_7 VOL_{t-1} * Neg_t^*$	BPG Test	2.5410**						
$C_t + \varepsilon_t$	BG-LM Test	0.6235						
	VIF Test	1.12–1.31						

Notes: OLS is for ordinary least square estimation using robust standard errors Newey–West estimators to correct the residuals for heteroskedasticity and/or autocorrelation problems. The QR is for autoregressive quantile regression estimated using the Huber Sandwich estimators which are valid under independent but non-identical sampling. The asterisks \*\*\*, \*\*, and \* denotes significant level of 1%, 5%, and 10% respectively. The variables acronym reads as follows; Return ( $R_t$ ); Coincident Index ( $CI_t$ ); Lagging Index ( $LAI_t$ ); Leading Index ( $LEI_t$ ); Business Confidence Survey ( $BCS_t$ ); Consumer Sentiment Index ( $CSI_t$ ); Volatility 30 days ( $VOL_t$ ). Dummy variables are; non-crisis period ( $NC_t$ ); crisis period ( $C_t$ ); negative risks ( $Neg_t$ ). Diagnostic statistics; normality (Jarque–Bera test); Heteroscedasticity (Breusch–Pagan–Godfrey test); serial correlation (Breusch–Godfrey LM test), and multicollinearity (centered Variance Inflation Factors test). The Wald test is performed to examine the quantile slope equality 10 different quantiles from  $q0.10$  to  $q0.90$ . For QR, we report only 5 quantiles estimation results representing extreme lower, medium, and extreme upper quantiles inline with our focus and due to space constraints although we have estimated all other quantiles (i.e  $q0.10 - q0.90$ ).

provides the theoretical complements to the empirical evidence of adaptive nature of Malaysian stock market efficiency (Lim, 2007, 2008; Lim & Brooks, 2011; Lim et al., 2005).

## 5.2. Practical implications

The founder of AMH together with other behavioural finance scholars have highlighted in their respective works that behavioural finance theoretical perspectives have significant practical implications for investment management. Their ideas are re-emphasized briefly here and advise readers to consult the respective article for details.

*For investors* – Investors need to be educated on the behavioural biases that are part and parcel of normal human being decision making. Behavioural finance theories informed an important contribution to avoidance of serious mistakes in investment analysis and finding profitable investment strategies. As such, institutional investors need to be aware of the growing importance of behavioural finance perspectives. A list of strategies and checklist to overcome behavioural errors are discussed in Kahneman and Riepe (1998), Fromlet (2001), and Baker and Ricciardi (2014).

*For investment management firms* – behavioural risks that distort fair fundamental valuation need to be managed both in risk modelling and fund portfolio management. Some scholars' suggestions are summarized here. On an individual level, fund managers need to recognize their own and others mistakes, to understand the reasons for these mistakes, and to avoid mistakes (Shefrin, 2000). In portfolio management, Shefrin and Statman (2000) develop a behavioural portfolio theory and suggested its implications for optimal portfolio construction that are segregated into multiple mental accounts that resemble both bonds and lottery like features. In investment strategy, an adaptive investment strategy argued to be more efficient in a complex market system that is changing over time due to constant information and technological changes (Mauboussin, 2002; Nawrocki & Viole, 2014). In line with this intuition, several authors have proposed a possible adaptive investment approaches as follows. Livanas (2007) provides interesting ideas on the construction of optimal portfolio. To simplify, the author suggests that the value of portfolio gains should be higher than the value of portfolio losses to hedge on the risk of investors asymmetric risk tolerance. In Zhu (2013), the author develops a distribution-based framework for return prediction and portfolio selection. Howard (2014) introduces some thought on behavioural portfolio management strategies from asset allocation to stock selection, and market selection. Last but not least, Ma (2015), a practitioner, introduces three different ways to develop investment strategies with the ability of adapting to economic regimes, market returns, or market volatility changes. Equally important, there is a need to enhance awareness and action on corporate governance to address behavioural biases in investment institutions (Suto & Toshino, 2005).

*For regulators and policymakers* – There is an urgent need to incorporate policy concerns to mitigate behavioural risks in financial market governance. The needs to regulate

these behavioural risks have been discussed in details by some scholars (see Cunningham, 2002; Daniel, Hirshleifer, & Teoh, 2002; Li, 2008) but still have been largely neglected so far. These scholars suggested some important issues for policy consideration including; the need to educate investors on behavioural risks, the need to promote the efficiency of the markets by minimizing the effect of behavioural risks, and the need to incorporate mechanisms to protect investors from excessive behavioural risks in the current corporate governance framework. In this regards, the study of Klapper and Love (2004) for 14 emerging markets provide evidence to support that better corporate governance is highly correlated with better operating performance and fair market valuation.

## 6. Conclusion

This paper aims to provide the behavioural finance perspectives on the nature of Malaysian stock market efficiency. Drawing from theoretical and empirical evidence from the current research, it is important to view the nature of market efficiency as prescribed by AMH. This efficiency theoretical framework offers the following advantages. First, this framework theoretically connects investors bounded and adaptive rationality which will collectively determine price formation, then induced a degree of market stability and finally creates the bounded and adaptive market efficiency. Second, will also be consistent with consideration of multi-factor fundamental and behavioural risks that possibly influenced the stock price formation. Third, the theoretical framework will be compatible with various methods that aim to recognize many stylized properties in financial prices. More importantly, the consistency of the philosophical, theoretical and methods are essential in scientific research inquiry and for a fair view of financial market reality. To mitigate excessive behavioural risks that will ensure reasonable fundamental valuation in the stock market and stable efficiency of financial markets, behavioural risks need to be curbed right from the investor behaviour, fund management practice, and market regulations. Going forward, joining Verheyden et al. (2015) calling, we suggest that future research is geared towards further examination and development of the theory of adaptive markets and its implications for investor education, investment portfolio management, and financial market regulation and governance.

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## References

- Abiad, A., Oomes, N., & Ueda, K. (2008). The quality effect: does financial liberalization improve the allocation of capital? *Journal of Development Economics*, 87(2), 270–282.
- Ackert, L. F., & Deaves, R. (2010). *Behavioral finance: Psychology, decision-making, and markets*. Mason, USA: South-Western Cengage Learning.
- Ahmad, Z., & Hussain, S. (2001). KLSE long run overreaction and the Chinese new year effect. *Journal of Business Finance and Accounting*, 28(1), 63–105.
- Akerlof, G. A., & Shiller, R. J. (2009). *Animal spirits: How human psychology drives the economy, and why it matters for global capitalism*. US: Princeton University Press.
- Ali, F. (1997). *Effective stock market investment in Malaysia*. Kuala Lumpur, Malaysia: Berita Publishing Sdn Bhd.
- Ali, R., Ahmad, Z., & Anusakumar, S. V. (2011). Stock market overreaction and trading volume: evidence from Malaysia. *Asian Academy of Management Journal of Accounting and Finance*, 7(2), 103–119.
- Ali, N., Nassir, A. M., Hassan, T., & Abidin, S. Z. (2010). Short run stock overreaction: evidence from Bursa Malaysia. *International Journal of Economics and Management*, 4(2), 319–333.
- Ali, N., Nassir, A. M., Hassan, T., & Abidin, S. Z. (2011). Stock overreaction behavior in Bursa Malaysia: does the length of the formation period matter? *British Journal of Economics, Finance and Management Sciences*, 2(2), 42–56.
- Ang, J. B., & McKibbin, W. J. (2007). Financial liberalization, financial sector development and growth: evidence from Malaysia. *Journal of Development Economics*, 84, 215–233.
- Arief, S. (1975). *Share price determination and share price behavior in developing economies: The case of Malaysia and Singapore*. Jakarta, Indonesia: Sritua Arief Associates.
- Arrow, K. J. (1958). Utilities, attitudes, choices: a review note. *Econometrica*, 1–23.
- Auer, B. R., & Rottmann, H. (2014). Is there a Friday the 13th effect in emerging Asian stock markets? *Journal of Behavioral and Experimental Finance*, 1, 17–26.
- Bai, J., & Ng, S. (2005). Tests for skewness, kurtosis, and normality for time series data. *Journal of Business & Economic Statistics*, 23(1), 49–60.
- Baker, H. K., & Ricciardi, V. (2014). How biases affect investor behavior. *The European Financial Review*, 7–10.
- Barberis, N. C. (2013). Thirty years of prospect theory in economics: a review and assessment. *Journal of Economic Perspectives*, 27(1), 173–196.
- Barberis, N., Huang, M., & Santos, T. (2001). Prospect theory and asset prices. *The Quarterly Journal of Economics*, 116(1), 1–53.
- Barnes, P. (1986). Thin trading and stock market efficiency: the case of the Kuala Lumpur stock exchange. *Journal of Business Finance & Accounting*, 13(4), 609–617.
- Bauman, W. (1989). Investment research analysis in an emerging market: Singapore and Malaysia. *Financial Analysts Journal*, 60–67.
- Baur, D. G. (2013). The structure and degree of dependence: a quantile regression approach. *Journal of Banking & Finance*, 37, 786–798.
- Baur, D. G., Dimpfl, T., & Jung, R. C. (2012). Stock return autocorrelations revisited: a quantile regression approach. *Journal of Empirical Finance*, 19, 254–265.
- Baur, D. G., & Schulze, N. (2010). The risk of beta – investor learning and prospect theory. In *Finance and Corporate Governance Conference 2010 Paper*. Available at SSRN <http://ssrn.com/abstract=1536754>.
- Bekaert, G., Harvey, C. R., & Lundblad, C. T. (2003). Equity market liberalization in emerging markets. *Journal of Financial Research*, 26(3), 275–299.
- Ben Rejeb, A., & Boughrara, A. (2013). Financial liberalization and stock markets efficiency: new evidence from emerging economies. *Emerging Markets Review*, 17, 186–208.
- Ben Rejeb, A., & Boughrara, A. (2014). Financial liberalization and emerging stock markets efficiency: an empirical analysis of structural changes. *Macroeconomics and Finance in Emerging Market Economies*, 7, 230–245.
- Bialkowski, J., Etebari, A., & Wisniewski, T. P. (2012). Fast profits: investor sentiment and stock returns during Ramadan. *Journal of Banking & Finance*, 36, 835–845.
- Blume, L., & Easley, D. (1992). Evolution and market behavior. *Journal of Economic Theory*, 58(1), 9–40.
- Bogan, V. (2008). Stock market participation and the internet. *Journal of Financial and Quantitative Analysis*, 43(1), 191–212.
- Brahmana, R., Hooy, C. W., & Ahmad, Z. (2012). The role of heard behavior in determining the investor's Monday irrationality. *Asian Academy of Management Journal of Accounting and Finance*, 8(2), 1–20.
- Brocas, I., & Carrillo, J. D. (2000). The value of information when preferences are dynamically inconsistent. *European Economic Review*, 44, 1104–1115.
- Butler, C., Dhillon, H. S., & Thiagarajah, L. (1991). *Guide to the Malaysian capital market*. Kuala Lumpur, Malaysia: Pelanduk Publications (M) Sdn. Bhd.
- Cajueiro, D. O., & Tabak, B. M. (2004). The Hurst exponent over time: testing the assertion that emerging markets are becoming more efficient. *Physica A*, 336, 521–537.
- Campbell, J. Y., & Shiller, R. J. (1987). Cointegration and tests of present value models. *The Journal of Political Economy*, 95(5), 1062–1088.
- Cao, S. N., Deng, J., & Li, H. (2010). Prospect theory and risk appetite: an application to traders' strategies in the financial market. *Journal of Economic Interaction and Coordination*, 5(2), 249–259.
- Carmerer, C. F., Lowenstein, G., & Prelec, D. (2004). Neuroeconomics: why economics needs brains. *Scandinavian Journal of Economics*, 106(3), 555–579.
- Chan, K., McQueen, G., & Thorley, S. (1998). Are there rational speculative bubbles in Asian stock markets? *Pacific-Basin Finance Journal*, 6, 125–151.
- Chen, J., Huang, C., Wang, M. L., & Cheng, J. C. (2010). Information effects during the U.S. subprime crisis: evidence from the Asia-Pacific region. *Emerging Markets Finance and Trade*, 46(1), 75–86.
- Chittedi, K. R. (2014). Financial development and instability: a theoretical perspective. *Journal of Stocks and Forex Trading*, 3(3), 1–5.
- Chong, C. Y. (2011). Effect of Subprime crisis on U.S. stock market return and volatility. *Global Economy and Finance Journal*, 4(1), 102–111.
- Chun, W. W., & Ming, L. M. (2009). Investor behavior and decision-making style: a Malaysian perspective. *Banker's Journal Malaysia*, 133, 3–13.
- Conlisk, J. (1996). Bounded rationality and market fluctuations. *Journal of Economic Behavior and Organization*, 29, 233–250.
- Cunningham, L. A. (2002). Behavioral finance and investor governance. *Washington and Lee Law Review*, 59(3), 767–837.
- Daniel, K., Hirshleifer, D., & Teoh, S. H. (2002). Investor psychology in capital markets: evidence and policy implications. *Journal of Monetary Economics*, 49, 139–209.
- Dowd, K., & Blake, D. (2006). After VaR: the theory, estimation, and insurance applications of quantile-based risk measures. *The Journal of Risk and Insurance*, 73(2), 193–229.
- Drakos, K. (2010). Terrorism activity, investor sentiment, and stock returns. *Review of Financial Economics*, 19, 128–135.
- Drew, M. E., & Veeraraghavan, M. (2002). A closer look at the size and value premium in emerging markets: evidence from the Kuala Lumpur stock exchange. *Asian Economic Journal*, 16(4), 337–351.
- Durand, R. B., Koh, S., & Tan, P. L. (2013). The price of sin in the Pacific-Basin. *Pacific-Basin Finance Journal*, 21, 899–913.
- Fama, E. F. (1965). The behavior of stock-market prices. *Journal of Business*, 38(1), 34–105.
- Fama, E. F. (1970). Efficient capital markets: a review of theory and empirical work. *Journal of Finance*, 25, 383–417.
- Fiengenbaum, A. (1990). Prospect theory and the risk-return association: an empirical examination in 85 industries. *Journal of Behaviour and Organization*, 14(1990), 187–203.
- French, K. R., Schwert, G. W., & Stambaugh, R. F. (1987). Expected stock returns and volatility. *Journal of Financial Economics*, 19(1), 3–29.
- Fromlet, H. (2001). Behavioral finance – theory and practical application. *Business Economics*, 63–69.

- Garling, T., Kirchler, E., Lewis, A., & Raaij, F. V. (2009). Psychology, financial decision making, and financial crises. *Psychological Science in the Public Interest*, 10(1), 1–47.
- George, R. L. (1991). *A guide to Asian stock markets* (2nd ed.). Hong Kong: Logman Group (Far East) Ltd.
- Ghazani, M. M., & Araghi, M. K. (2014). Evaluation of the adaptive market hypothesis as an evolutionary perspective on market efficiency: evidence from the Tehran stock exchange. *Research in International Business and Finance*, 32, 50–59.
- Gimet, C., & Lagoarde-Segot, T. (2011). Global crisis and financial destabilization in ASEAN countries: a microstructural perspective. *Journal of the Asia Pacific Economy*, 16(3), 294–312.
- Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *The American Economic Review*, 70(3), 393–408.
- Hameed, A., & Ting, S. (2000). Trading volume and short-horizon contrarian profits: evidence from the Malaysian market. *Pacific-Basin Finance Journal*, 8, 67–84.
- Henry, P. B. (2000). Stock market liberalization, economic reform, and emerging market equity prices. *The Journal of Finance*, 55(2), 529–564.
- Hiremath, G. S., & Kumari, J. (2014). Stock returns predictability and the adaptive market hypothesis in emerging markets: evidence from India. *SpringerPlus*, 3(1), 428.
- Hollifield, B. (2002). Comment on: stock volatility in the new millennium: how wacky is Nasdaq? *Journal of Monetary Economics*, 49, 27–30.
- Hoque, H. A. A. B., Kim, J. H., & Pyun, C. S. (2007). A comparison of variance ratio tests of random walk: a case of Asian emerging stock markets. *International Review of Economics and Finance*, 16, 488–502.
- Howard, C. T. (2014). Behavioral portfolio management. *Journal of Behavioral Finance & Economics*, 4(1), 39–61.
- Jasic, T., & Wood, D. (2006). Testing for efficiency and non-linearity in market and natural time series. *Journal of Applied Statistics*, 33(2), 113–138.
- Jerrett, J. E. (2010). Efficient market hypothesis and daily variation in small Pacific-basin stock markets. *Management Research Review*, 33(12), 1128–1139.
- Jiang, J., Ma, K., & Cai, X. (2007). Non-linear characteristics and long-range correlations in Asian stock markets. *Physica A*, 378, 399–407.
- Kahneman, D., & Riepe, M. W. (1998). Aspects of investor psychology. *Journal of Portfolio Management*, 52–65.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, 263–291.
- Kanouse, D. E. (1984). Explaining negativity biases in evaluation and choice behavior: theory and research. *Advances in Consumer Research*, 11(1), 703–708.
- Kean, N. S. (1986). *Stock market investment in Malaysia and Singapore*. Kuala Lumpur, Malaysia: Berita Publishing Sdn. Bhd.
- Khan, S., & Park, K. W. (2009). Contagion in stock markets: the Asian financial crisis revisited. *Journal of Asian Economics*, 20, 561–569.
- Kim, A. K., & Nofsinger, R. J. (2008). Behavioral finance in Asia. *Pacific-Basin Finance Journal*, 16, 1–7.
- Kim, J. H., & Shamsuddin, A. (2008). Are Asian stock markets efficient? Evidence from new multiple variance ratio tests. *Journal of Empirical Finance*, 15, 518–532.
- Kim, J. H., Shamsuddin, A., & Lim, K. P. (2011). Stock return predictability and the adaptive markets hypothesis: evidence from century-long U.S. data. *Journal of Empirical Finance*, 18, 868–879.
- Kim, E. H., & Singal, V. (2000). The fear of globalizing capital markets. *Emerging Markets Review*, 1, 183–198.
- Klapper, L. F., & Love, I. (2004). Corporate governance, investor protection, and performance in emerging markets. *Journal of Corporate Finance*, 10(5), 703–728.
- Koenker, R., & Bassett, G., Jr. (1978). Regression quantiles. *Econometrica*, 46(1), 33–50.
- Koenker, R., & Hallock, K. (2001). Quantile regression: an introduction. *Journal of Economic Perspectives*, 15(4), 43–56.
- Kristoufek, L., & Vosvrda, M. (2013). Measuring capital market efficiency: global and local correlation structure. *Physica A*, 392, 184–193.
- Lai, M. M., Tan, S. H., & Chong, L. L. (2013). The behavior of institutional and retail investors in Bursa Malaysia during the bulls and bears. *Journal of Behavioral Finance*, 14, 104–115.
- Laurence, M. M. (1986). Weak-form efficiency in the Kuala Lumpur and Singapore stock markets. *Journal of Banking and Finance*, 10, 431–445.
- Leger, L., & Leone, V. (2008). Changes in the risk structure of stock returns: consumer confidence and the dotcom bubble. *Review of Financial Economics*, 17, 228–244.
- LeRoy, S. F. (1989). Efficient capital markets and martingales. *Journal of Economic Literature*, 27, 1583–1621.
- Li, G. (2008). China's stock market: inefficiencies and institutional implications. *China & World Economy*, 16(6), 81–96.
- Lim, K. P. (2007). Ranking market efficiency for stock markets: a nonlinear perspective. *Physica A*, 376, 445–454.
- Lim, K. P. (2008). Sectoral efficiency of the Malaysian stock market and the impact of the Asian financial crisis. *Studies in Economics and Finance*, 25(3), 196–208.
- Lim, K. P., & Brooks, R. (2011). The evolution of stock market efficiency over time: a survey of the empirical literature. *Journal of Economic Surveys*, 25(1), 69–108.
- Lim, K. P., Brooks, R. D., & Kim, J. H. (2008). Financial crisis and stock market efficiency: empirical evidence from Asian countries. *International Review of Financial Analysis*, 17(3), 571–591.
- Lim, K. P., & Hinich, M. J. (2005). Non-linear market behavior: events detection in the Malaysian stock market. *Economics Bulletin*, 7(6), 1–5.
- Lim, K. P., & Kim, J. H. (2011). Trade openness and the informational efficiency of emerging stock markets. *Economic Modelling*, 28, 2228–2238.
- Lim, K. P., Liew, V. K. S., & Wong, H. T. (2005). Weak-form efficient market hypothesis versus behavioral finance: a different perspective drawn from the Malaysian stock market. *International Journal of Management Studies*, 12(1), 1–27.
- Livanas, J. (2007). Behavioral finance implications in portfolio construction. *Journal of Investment Strategy*, 2(1), 45–49.
- Lo, A. W. (2004). The adaptive market hypothesis. *Journal of Portfolio Management*, 15–29.
- Lo, A. W. (2005). Reconciling efficient market hypothesis with behavioral finance: the adaptive market hypothesis. *Journal of Investment Consulting*, 7(2), 21–44.
- Lo, A. W. (2012). Adaptive markets and the new world order. *Financial Analysts Journal*, 68(2), 18–29.
- Lo, A. W., & MacKinlay, A. C. (1988). Stock market prices do not follow random walks: evidence from a sample specification test. *The Review of Financial Studies*, 1(1), 41–66.
- Loomes, G., & Sugden, R. (1982). Regret theory: an alternative theory of rational choice under uncertainty. *Economic Journal*, 92, 805–824.
- Ma, H. (2015). Adaptive investment approach. *Alternative Investment Analyst Review*, 3(4), 8–25.
- Mauboussin, M. J. (2002). Revisiting market efficiency: the stock market as a complex adaptive system. *Journal of Applied Corporate Finance*, 14(4), 8–16.
- Meier, C. (2014). Adaptive market efficiency: review of recent empirical evidence on persistence of stock market anomalies. *Review of Integrative Business & Economics Research*, 3(2), 268–280.
- Miller, E. M. (1987). Bounded efficient markets: a new wrinkle to the EMH. *Journal of Portfolio Management*, 13(4), 4–13.
- Ming, L. M., Guru, B. K., & Nor, F. M. (2007). An examination of the random walk model and technical trading rules in the Malaysian stock market. *Malaysian Accounting Review*, 6(2), 99–121.
- Mitchell, H., & Joseph, S. (2010). Changes in Malaysia: capital controls, prime ministers and political connections. *Pacific-Basin Finance Journal*, 18, 460–476.
- Mohamad, S., & Nassir, A. M. (1997). A survey methods used by Malaysian brokerage firm investment analysts to appraise investments in ordinary shares. *Pertanika Journal of Social Science and Humanities*, 5(2), 125–137.
- Muhammad, N. N. (2009). Investment decision making style: are Malaysian investors rational decision makers? *Interdisciplinary Journal of Contemporary Research in Business*, 1(3), 96–108.

- Muller, F. M., Righi, M. B., & Ceretta, P. S. (2015). IBOVESPA market efficiency analysis: a quantile autoregressive model approach. *Revista de Administracao e Contabilidade de Unisinos*, 12(2), 122–134.
- Nasir, A. M., & Mohamad, S. (1993). *The efficiency of the Kuala Lumpur stock exchange: A collection of empirical findings*. Selangor, Malaysia: Penerbit Universiti Pertanian Malaysia.
- Nassir, M. L. (1983). *A study of market efficiency and risk return relationship in the Malaysian capital market* (Ph.D. Dissertation). Belgium: Katholieke University of Leuven.
- Nassir, A. M. (2002). *Is the KLSE efficient? Efficient market hypothesis vs behavioral finance*. Universiti Putra Malaysia.
- Nawrocki, D., & Violo, F. (2014). Behavioral finance in financial market theory, utility theory, portfolio theory and the necessary statistic: a review. *Journal of Behavioral and Experimental Finance*, 2, 10–17.
- Nguyen, D. K., & Fontaine, P. (2006). Stock market liberalization and informational efficiency in emerging markets: new consideration and tests. *Bankers, Markets & Investors*, 84, 6–17.
- Ocampo, J. A., & Stiglitz, J. E. (2008). *Capital market liberalization and development*. Oxford, New York: Oxford University Press.
- Pandey, I. (2002). Seasonality in the Malaysian stock market. *Journal of Financial Management and Analysis*, 15(2), 37–44.
- Quiggin, J. (1982). A theory of anticipated utility. *Journal of Economic Behavior and Organization*, 3, 323–343.
- Ramiah, V. (2012). The impact of international terrorist attacks on the risk and return of Malaysian equity portfolio. *Review of Pacific Basin Financial Markets and Policies*, 15(4), 1–26.
- Ratner, M. (1996). Investigating the behavior and characteristics of the Madrid stock exchange. *Journal of Banking & Finance*, 20(1), 135–149.
- Richards, A. (2005). Big fish in small ponds: the trading behavior and price impact of foreign investors in Asian emerging markets. *Journal of Financial and Quantitative Analysis*, 40(1), 1–27.
- Rizvi, S. A. R., & Arshad, S. (2014). Investigating the efficiency of East Asian stock markets through booms and busts. *Pacific Science Review*, 16, 275–279.
- Rizvi, S. A. R., & Arshad, S. (2016). How Does crisis affect efficiency? An empirical study of East Asian markets. *Borsa İstanbul Review*, 16(1), 1–8.
- Rizvi, S. A. R., Dewandaru, G., Bacha, O. I., & Masih, M. (2014). An analysis of stock market efficiency: developed vs Islamic stock markets using MF-DFA. *Physica A*, 407, 86–99.
- Rosenberg, B., Reid, K., & Lanstein, R. (1985). Persuasive evidence of market inefficiency. *Journal of Portfolio Management*, 11(3), 9–16.
- Sanderson, S. M. (1998). New approaches to strategy: new ways of thinking for the millennium. *Management Decision*, 36(1), 9–13.
- Sanford, C. S. (1994). Financial markets in 2020. *Economic Review-Federal Reserve Bank of Kansas City*, 79(1), 19–28.
- Saw, S. H., & Tan, K. C. (1989). Test of random walk hypothesis in the Malaysian stock market. *Securities Industry Review*, 15, 45–50.
- Schwert, G. W. (2002). Stock volatility in the new millennium: how wacky is Nasdaq? *Journal of Monetary Economics*, 49, 3–26.
- Shefrin, H. (2000). *Beyond greed and fear: Understanding behavioral finance and the psychology of investing*. United States: Harvard Business School Press.
- Shefrin, H. (2007). *Behavioral corporate finance: Decisions that create value*. New York, the United States of America: McGraw-Hill/Irwin.
- Shefrin, H., & Statman, M. (2000). Behavioral portfolio theory. *Journal of Financial and Quantitative Analysis*, 35(2), 127–151.
- Shiller, R. J. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? *The American Economic Review*, 71(3), 421–436.
- Shiller, R. J. (1999). Human behavior and the efficiency of the financial system. In J. B. Taylor, & M. Woodford (Eds.), *Handbook of macroeconomics* (vol. 1, pp. 1305–1340).
- Shiller, R. J. (2003). From efficient markets theory to behavioral finance. *Journal of Economic Perspectives*, 17(1), 83–104.
- Shimp, K. G., Mitchell, M. R., Beas, B. S., Bizon, J. L., & Setlow, B. (2015). Affective and cognitive mechanisms of risky decision making. *Neurobiology of Learning and Memory*, 117, 60–70.
- Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 69(1), 99–118.
- Slezak, S. L. (2003). On the impossibility of weak-form efficient markets. *Journal of Financial and Quantitative Analysis*, 38(3), 523–554.
- Soufian, M., Forbes, W., & Hudson, R. (2014). Adapting financial rationality: is a new paradigm emerging? *Critical Perspectives on Accounting*, 25, 724–742.
- Statman, M. (2008). Countries and culture in behavioral finance. *CFA Institute Conference Proceedings Quarterly*, 25(3), 38–44.
- Stigler, G. J. (1967). Imperfections in the capital market. *Journal of Political Economy*, 75(3), 287–292.
- Suarez-Garcia, P., & Gomez-Ullate, D. (2014). Multifractality and long memory of financial index. *Physica A*, 394, 226–234.
- Summers, L. H. (1986). Does the stock market rationally reflect fundamental values. *Journal of Finance*, 41(3), 591–601.
- Suto, M., & Toshino, M. (2005). Behavioural biases of Japanese institutional investors: fund management and corporate governance. *Corporate Governance: An International Review*, 13(4), 466–477.
- Tan, P. P., Chin, C. W., & Galagedera, D. U. A. (2014). A wavelet-based evaluation of time-varying long memory of equity markets: a paradigm in crisis. *Physica A*, 410, 345–358.
- Tinbergen, J. (1939). The dynamics of share-price formation. *Review of Economic Statistics*, 21(4), 153–160.
- Todea, A., Ulici, M., & Silaghi, S. (2009). Adaptive markets hypothesis: evidence from Asia-Pacific financial markets. *The Review of Finance and Banking*, 1(1), 007–013.
- Toh, G. G., & Ahmad, Z. (2010). Do Malaysian investors' judgement exhibit reference dependence? *Asian Academy of Management Journal of Accounting and Finance*, 6(1), 109–133.
- Urquhart, A., & Hudson, R. (2013). Efficient or adaptive markets? Evidence from major stock markets using very long run historic data. *International Review of Financial Analysis*, 28, 130–142.
- Verheyden, T., De Moore, L., & den Bossche, F. V. (2015). Towards a new framework on efficient markets. *Research in International Business and Finance*, 34, 294–308.
- Westerhoff, F. (2003). Speculative behavior and asset price dynamics. *Nonlinear Dynamics, Psychology, and Life Sciences*, 7(3), 245–262.
- Wong, P., Neoh, S., Lee, K., & Thong, T. (1990). Seasonality in the Malaysian stock market. *Asia Pacific Journal of Management*, 7(2), 43–62.
- Yeong, N., Ho, C. M., Dollery, B., & Kogid, M. (2010). A test of the present value model of stock prices under rational and adaptive expectations using Bursa Malaysia data from 1983 to 2003. *Applied Econometrics Letters*, 17, 1835–1839.
- Yong, O. (1994). *Behavior of the Malaysian stock market* (2nd ed.). Selangor, Malaysia: Penerbit Universiti Kebangsaan Malaysia.
- Zalewska-Mitura, A., & Hall, S. G. (1999). Examining the first stages of market performance: a test for evolving market efficiency. *Economics Letters*, 64, 1–12.
- Zhu, M. (2013). Return distribution predictability and its implications for portfolio selection. *International Review of Economics and Finance*, 27, 209–223.
- Zhu, H. M., Li, Z., & Zeng, Z. (2015). Revisiting the asymmetric dynamic dependence of stock returns: evidence from a quantile autoregression model. *International Review of Financial Analysis*, 40, 142–153.
- Zunino, L., Tabak, B. M., Figliola, A., Perez, D. G., Garavaglia, M., & Rosso, O. A. (2008). A multifractal approach for stock market inefficiency. *Physica A*, 387, 6558–6566.