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SYSTEMATIC RISK FACTORS IN STOCK PRICING MODELING: A NEW THEORETICAL CONCEPTUALIZATION

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Abstract

Stock pricing modeling in both modern- and behavioral finance paradigms are remain divided, still incomplete and have been criticized for some philosophical, theoretical and model limitations. These cause the identification of risk factors in stock pricing modeling to remain puzzling. This analytical conceptual paper aims to address these issues with a new theoretical conceptualization of the risk factors in stock pricing modeling. The proposed stock pricing theoretical framework is derived from triangulation of both social- and natural science perspectives that possibly solve the current paradigm gaps in modern- and behavioral finance.

Keywords*:* *asset pricing, behavioral finance, multifactor stock pricing model, natural science, social science, systematic risk*

INTRODUCTION

Measuring systematic risk is a key problem in stock pricing modeling and remains puzzling in both modern- and behavioral finance research. Identifying the relevant risk factors are crucially important for explaining past stock performance and reliably predicting future returns (Maringer, 2004). Modern asset pricing models, which are based on philosophical assumptions of economic agents' full rationality that will ensure stock market efficiency, have been criticized for failure to account for real investors' and stock market behaviors. On the other hand, behavioral asset pricing model, is offering an alternative theory and evidence of investors' behaviors, financial markets functioning, and stock prices formation in reality. Behavioral finance views those investors and the markets are not fully rational and efficient (Shiller, 1981; Shefrin & Statman, 1985; DeLong, Shleifer, Summers & Waldmann, 1990; DeBondt, 1998; Shleifer, 2000; Baker & Nofsinger, 2002; Ritter, 2003; Statman, 2008; Aggarwal, 2014) which are in contrast to conventional finance philosophy of investors' full rationality and market efficiency assumptions. Due to the element of irrationality in investors' decision making, systematic and significant deviations from market efficiency are expected to persist for long periods of time (Shleifer, 2000). Accordingly, in behavioral finance, fundamental and behavioral factors have been acknowledged as a source of systematic risks in stock prices formation and return determinants. However, behavioral-based models have also been criticized for some theoretical limitations.

The main objective of this paper is to review the systematic risk puzzle in stock returns modeling. Thereafter, this paper proposes alternative perspectives on modeling multifactor systematic risks determinants based on the dual-decision perspective that justifies the incorporation of both fundamental and behavioral systematic risks in stock pricing modeling as

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suggested by Statman (1999) and Thomaidis (2004). This paper is organized as follows; section 2 provides discussion on the stock market investment complexities and prices formation. Section 3, summarize the theoretical relations between risks-prices-returns and the empirical problems. Section 4, offers a new conceptualization of the multifactor systematic risk determinants and stock-pricing model. Final section 5 concludes the paper.

THE STOCK MARKET INVESTMENT

2.1 Stock market complexities

Scholars have classified systems into four types namely ordered, random, complex, (Jacobs & Levy, 1989) and complex dynamic (Mauboussin, 2005). The stock market investment involves both micro and macro environments as illustrated in Figure 1 below.

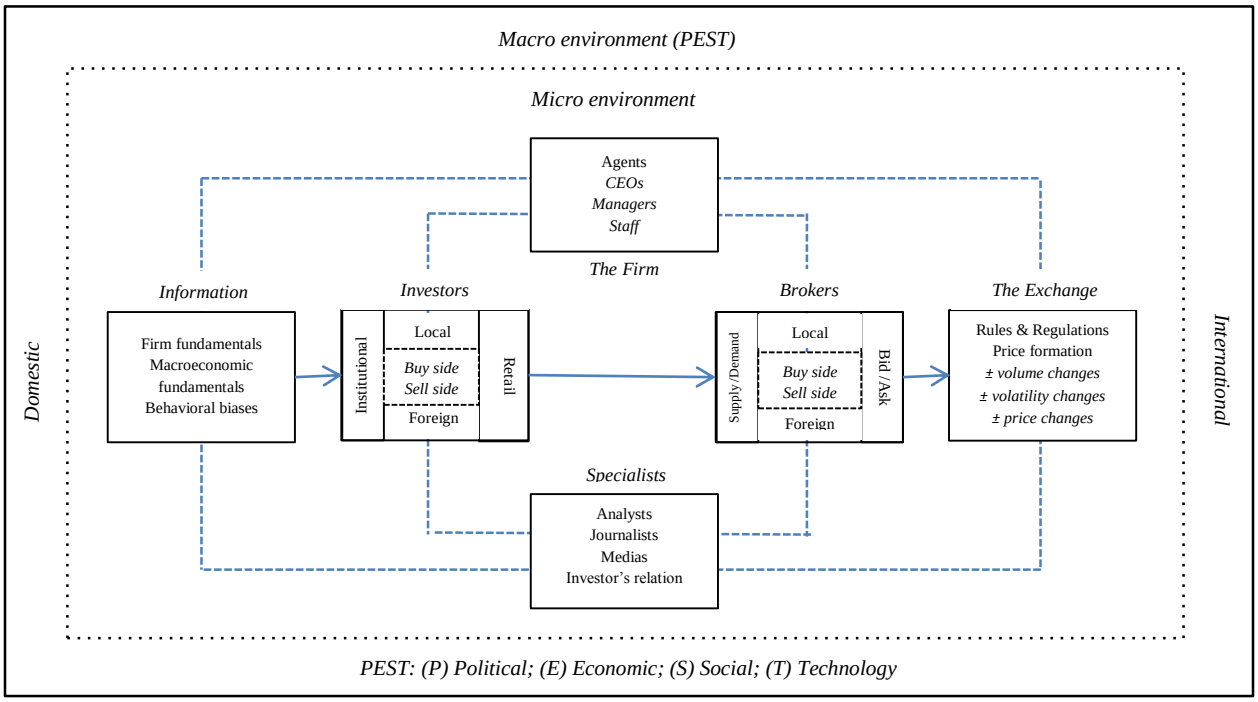

Figure 1: Illustration of stock investment environment

Recently, many believe that the stock market as a complex adaptive system (Mauboussin, 2005) or evolutionary complex collective dynamic (Fenzl & Pelzmann, 2012). In this system, optimal decision-making is impossible due to limitation in human mind and knowledge (Jacobs & Levy, 1989). In addition, investors are comprises of heterogeneous group and their interaction leads to self-organized groups with different investment styles (Mauboussin, 2005). Apart from the human factors, market microstructures studies provides evidenced that market design and trading mechanism have an impact on investors' trading which are translated into volume and prices changes (Madhavan, 2000; Comerton-Forde & Rydge, 2006).

However, the modern- and behavioral finance paradigm remains divided. The modern finance views the stock market investment as simply static. The modern finance assumes that investors'

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decision and expectations are fully rational which will leads the stock market to be functionally efficient in accordance with the efficient market hypothesis (EMH) of Fama (1965). On the other hand, behavioral finance views the stock market investment as a complex and dynamic system based the following grounds. Investors' decisions are bounded rational as explained by bounded rational theory (Simon, 1955; 1972). This will cause the stock market to be adaptively efficient as conceptualized by Lo (2004; 2005; 2012) in adaptive market hypothesis (AMH). These cause the stock market to be imperfect (DeBondt, 1998). In this regards, the EMH does not accurately reflect the actual markets behavior (Shiller, 2003) and AMH fits the stock market description better (Lim & Brooks, 2011).

2.2 Stock prices formation in stock exchange

Stock prices change through interaction of demand and supply forces by investors (Hopman, 2007; Evans, 2012). The following Figure 2(a) and 2(b) illustrates the hypothetical demand and supply curves for stock (Evans, 2012).

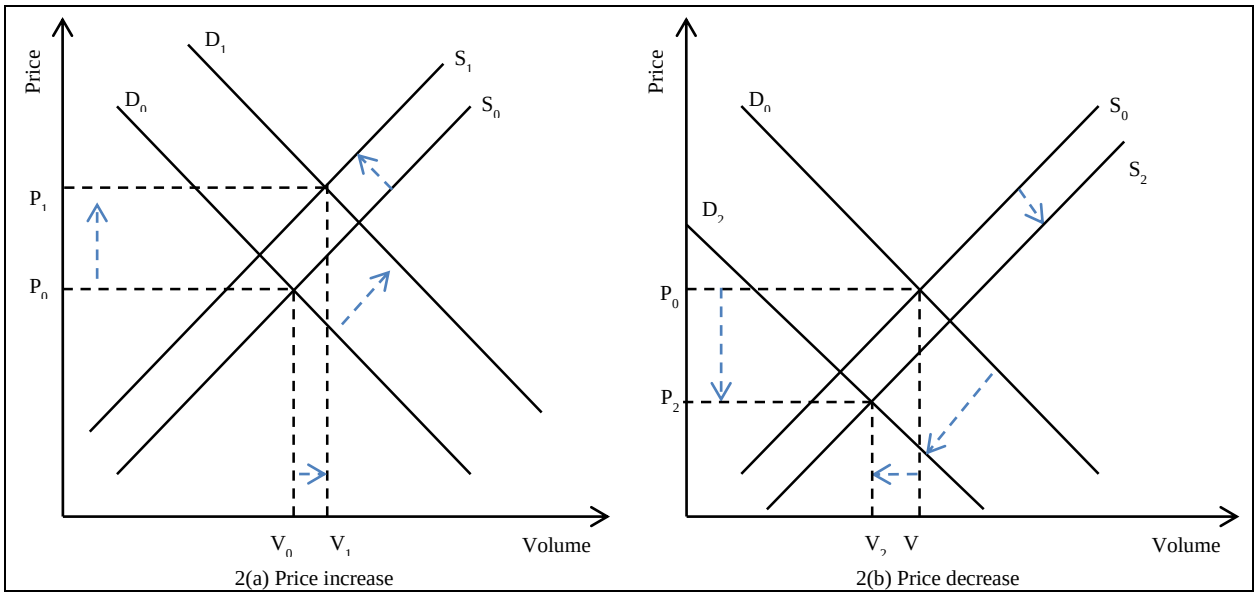

Figure 2: Hypothetical supply and demand curves for stock

The Figure 2(a) illustrates the situation of a stock's price increases. A positive perceived information related to a particular stock, will make that stock more attractive to investors which will increase the demand for that stocks and subsequently increases it prices (Evans, 2012). On the other hand, the Figure 2(b) illustrates the situation of a stock's price decreases. A negative perceived information related to a particular stock, will make that stock less attractive to investors which will cause them to sell that stocks and subsequently decreases it prices (Evans, 2012). Tinbergen (1939) stated that, attractiveness to a particular stock depends on two aspects namely income yields (dividend) and price gain or loss (future price) as they sell it in the future. This is consistent with present valuation model. In this perspective, the formation of share prices is affected by investors' state of expectation on current and future fundamental information that possibly influence the net present value of future stock value (Gantnerova, 2004). This is in accordance with full rational expectation and EMH.

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However, many have challenged and disagreed with full rationality and efficiency assumptions (Muth, 1961) as the representative of aggregate investor and market behavior. Recently, many are in favor of bounded rationality and adaptive efficiency. In this perspective, share prices formation is complex and associated with the following characteristics; First, information that matters to investor is not only fundamental factors but also behavioral factors (i.e. psychological and sociological factors). Second, investor's attitude of buying a share is a mix of an investor (i.e. buying and holding stocks and aiming for both dividend and price appreciation gains in longer term) or speculator (i.e. buy and sell stocks for short-term price appreciation gains only). (Timbergen, 1939). Third, uncertainty perceived differently by individual which cause divergence of opinion, different estimates and preferences about the future of stock investment and expected stock returns (Miller, 1977).

3. RISK, PRICE, AND RETURN THEORETICAL RELATIONS

3.1 Risk and stock prices relation

The conceptual relations between stock prices and risk factors are as illustrated in the following diagram. Theoretically, the firm operating and financial performance will be influenced by various internal and external risk factors because these factors will influence the firm business and its future discount rates as well as future cash flows. Investors' beliefs, expectations and trade decisions will directly induce the common stock price formations.

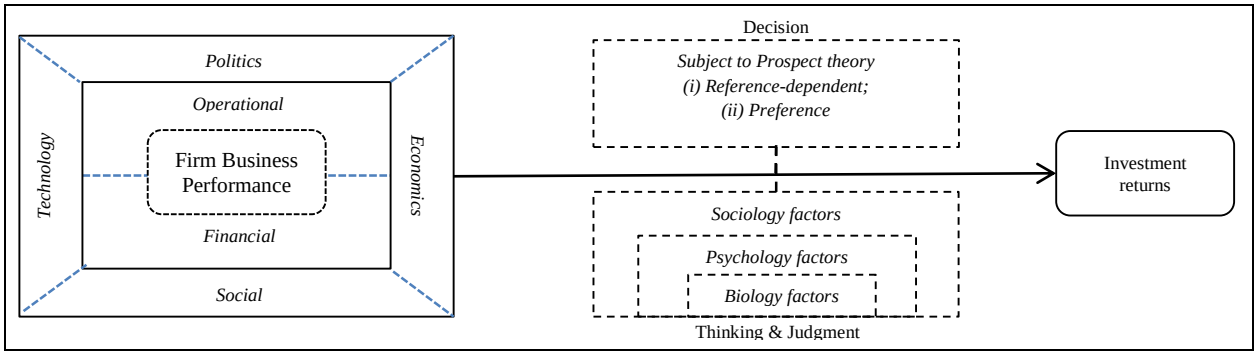

Figure 3: Aggregate investors' behavior

In reference to Huffman and Moll (2013), the linear relations function of common stock return and the total risk factors as illustrated in the following linear regression function.

$$R_i = \alpha_t + \gamma_t(Risk\ Measures_{t-1}) + \varepsilon_i$$

In the modern finance, the risk factors affecting common stock prices are categorized into two namely (i) the systematic components (market risk/nondiversifiable) and unsystematic components (firm-specific risk/diversifiable) (Beja, 1972; Robichek & Cohn, 1974; Dobbins & Witt, 1979; Lakonishok & Shapiro, 1986). The systematic component is assumed to be perfectly correlated among all securities and regarded as the only priced risk in a well-diversified portfolio. While, the unsystematic is unique to specific firm and can be reduced through diversification, hence it does not affect the price. However, evidenced in behavioral finance research revealed that firm-specific risk cannot be totally reduced through portfolio

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diversification (Bennett & Sias, 2006) and the ideas that it does not affect stock value is challenged by many managers (Damodaran 2005). Furthermore, in reality, individual investor does not hold a well-diversified portfolio (Barber & Odean, 2000; 2011) and have been relying on firm fundamental in their evaluation (Arnold & Moizer, 1984; Al-Abdulqader, Hannah & Power, 2007).

3.2 Risk and return relation

There is a disagreement between the two paradigms with regards to the nature of risk-return relationships. The modern finance idealize that the risk and return relationship to be linearly positive as formalized by wealth maximization utility theory (Markowitz, 1952). The idea is based on assumptions of rational, risk averse, holding efficient portfolio, and efficient market (Salvador, Floros & Arago, 2014). On the other hand, behavioral finance postulates that the risk-return relationship can either be positive or negative or upside down (Shefrin, 2007) because investors risk tolerance sometimes risk seeking and other time risk adverse as predicted by prospect theory. This theory postulates that decision under risk and uncertainty is reference-dependent (Tversky & Khaneman, 1991; 1992; Munro & Sugden, 2003). Specifically, higher risk-higher return relation is valid for cases above reference point and higher risk-lower returns for below reference point (see - Fiegenbaum, 1990; Hodoshima, Garza-Gomez & Kunimura, 2000). However, the reference point has not been specified in the prospect theory (Munro & Sugden, 2003) and the effect of reference point is influenced by individual's knowledge and risk propensity (Kwon & Lee, 2009). The popular reference points are; winners and losers stocks (Shefrin & Statman, 1985), average industry return (Fiegenbaum, 1990; Sinha, 1994), average return of firm (Sinha, 1994), market excess return (Hodoshima *et al.*, 2000), declining market and advancing market (Fuller & Goldstein, 2011), and market uncertainty and market sentiment (Bird & Yeung, 2012). These evidences are supporting the non-linear modeling of stock pricing in recent research (Salvador, Floros, & Arago, 2014) as long been argued by Allais (1953, 1988, 1990) that preferences are non-linear (as cited in Levy & Wiener, 2013).

3.3 Multifactor determinant of stock prices

There are various risk measures namely; (i) *market-based* (Beaver, *et al.*, 1970; Rosenberg & McKibben, 1973); (ii) *accounting-based* (Beaver, *et al.*, 1970; Rosenberg & McKibben, 1973); (iii) *macroeconomics-based* (Ross, 1976; Chen *et al.*, 1986); (iv) *firm-specific* (Girard & Omran, 2007); (v) *country-specific risk* (Girard & Omran, 2007); (vi) characteristics-based, (vii) *non-fundamental*; and (viii) *behavioral-based*. The empirical multifactor determinants of stock prices are as summaries in Table 1 below.

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Table 1: Multifactor determinants of stock prices

Fundamental Factors	Studies
Economic Factors	
Gross Domestic Products	Pilinkus (2009); Somoye *et al.* (2009); Singh *et al.* (2011)
Interest Rates	Kandir (2008); Somoye *et al.* (2009); Mayasami *et al.* (2004)
Foreign Exchange Rate	Kandir (2008); Somoye *et al.* (2009); Singh *et al.* (2011)
Inflation	Singh *et al.* (2011)
Industrial Production	Mayasami *et al.* (2004)
Money Supply	Mayasami *et al.* (2004); Pilinkus (2009); Singh *et al.* (2011)
World Market Return	Kandir (2008)
Net Exporter	Pilinkus (2009)
Foreign Direct Investment	Pilinkus (2009)
Oil Prices	Lee *et al.* (1995); Jones & Kaul (1996); Sadorsky (1999); Sari & Soytas (2006); Jalil *et al.* (2009)
Firm Factors	
Net Profit	Collins (1957)
Operating Earnings	Collins (1957)
Dividend/ Dividend Yield	Collins (1957)
Earnings Per Share	Somoye *et al.* (2009);
Net Asset Value Per Share	Uddin (2009)
Book Value Per Share	Collins (1957)
Price Earnings Ratio	Ali (2011)
Leverage	Ait-Shalia, Fan & Li (2013)
Characteristics Factors	Studies
Size (small vs. large firm)	Fama & French (1992; 1993, 1996)
Momentum (high vs. low price/volume)	DeBondt & Chen (2004); Antoniou, Doukas & Subrahmanyam (2013)
Winner-Looser	Shefrin & Statman (1985)
Value-Growth (high vs. low book value)	Fama & French (1992; 1993, 1996); Griffin & Lemmon (2002)
Liquidity	Pastor & Stambaugh (2003); Amihud, Mendelson & Pedersen (2005)
Industry type	King (1966); Meyers (1973); Chen, Chen & Lee (2013)
Non-Fundamental Factors	Studies
Political Risks	Jorg & Christian (2006); Bialkowski (2008) and Wong & Michael (2009); Cheng *et al.* (2011)
Financial Crisis	Jang & Sul (2002); Gong *et al.* (2004)
Infectious Disease	Srinivas & Washer (2004); Chen *et al.* (2007); Cheng *et al.* (2011)
Natural Disaster	Albala-Bertrand (1993); Toya & Skidmore (2007); Cheng *et al.* (2011)
Sport Events	Gabriel *et al.* (2000); Veraros *et al.* (2000); Kasimati & Dawson (2009); Cheng *et al.* (2011)
Wars/Riots/Terrorism	Campbell (1991); Essaddam & Karagianis (2014)
Behavioral Factors	Studies
Sentiment	Baker & Wurgler (2006; 2007); Kumar & Lee (2006); Ho & Huang (2009); Burghardt (2011); Yang *et al.*, (2012).
Emotion	Acket *et al.*, 2003; Kuzmina (2010)
Mood	Nofsinger (2005); Grable & Roszkowski (2008); Shu (2010); Brahmana *et al.* (2012a; 2012b)

3.4 Priced risks in asset pricing modeling

Asset pricing modeling is based on the determination of risks that explain required rates of return (Girard & Omran, 2007). Theoretically, the value of a firm's stock is a function of the perceived stream of benefits, associated risk, and the price of bearing risk (Groth & Nixon, 2007). Accordingly, the hypothetical stock valuation model is as illustrated in the following Figure 1.

$$\boldsymbol{Stock\ Value} = \sum_{\boldsymbol{t=1}}^{\boldsymbol{n}} \frac{(\boldsymbol{Perceived\ expected\ benefits})}{(\boldsymbol{1+R})^{\boldsymbol{t}}}$$

Development of asset pricing models in finance can be divided into two schools of thought, namely the modern finance-based asset pricing models and behavioral finance-based asset pricing models. Both have different perspectives on investor decision rationality, market functioning efficiency and the priced risks in stock investment. These assumptions limit each paradigm perspective on asset pricing modeling (Ball, 1994).

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The modern finance models are build upon the assumptions that the (i) investors are rational, (ii) markets are efficient, (iii) investors should design their portfolio according to portfolio theory, and (iv) Expected return are function of market risk alone. In Modern Portfolio Theory (Markowitz, 1995) and CAPM (Sharpe, 1964) perspective, the total risk can be decomposed into systematic risk and unsystematic risk. Systematic risk is the variability of stock's return associated with changes in return on the market as a whole. This risk is non-diversifiable. As such, it is considered to be the only priced risk in CAPM. While, the unsystematic risk is the variability of stock's returns due to other factors not explained by general market movements. These risks can be avoidable through diversification. Thus, they are not considered to be the priced risk factors in stock pricing modeling. The CAPM represents the single systematic risk through beta ($\boldsymbol{\beta_j}$) as in the following equation. Where; $\boldsymbol{R_j}$ is the required rate of return for stock *j*; $\boldsymbol{R_f}$ is the risk-free rate of return; $\boldsymbol{\beta_j}$ is the beta or systematic risk of stock *j*; $\boldsymbol{R_m}$ is the expected return for the market. This market model is not based on any assumption of investment behavior but simply posits a linear relation between stock and market returns (Bradfield, 2003). The $\boldsymbol{\beta_j}$ is basically measures the sensitivities of asset returns to underlying source of risk (Campbell & May, 1993) and is derived from; $\boldsymbol{\beta_j} = \frac{\boldsymbol{Cov\,(R_j, R_m)}}{\boldsymbol{Var\,(R_m)}}$.

$$R_t = R_f + \beta_j(Rm_t - Rf_t)$$

The Arbitrage Pricing Theory (APT) of Ross (1976) provides an alternative multifactor model for stock pricing. The APT valuation model posits a multi-linear relationship between the returns of an asset and the returns of a set of multiple unknown economic factors. The APT starts with the premise that arbitrage opportunities should not be present in efficient financial markets. This assumption is much less restrictive than those required to derive the CAPM. The APT assuming that there are *n* macroeconomic factors (non-diversifiable risk factors), which cause asset returns to systematically deviate from their expected values. The theory does not specify how large the number *n* is, nor does it identify the factors. There may be other, firm-specific reasons for returns to differ from their expected values, but these firm-specific deviations are not related across stocks and could be diversified away. Based on these assumptions, Ross shows that, in order to prevent arbitrage, an asset's expected return must be a linear function of its sensitivity to the *n* common factors as follows. Where, R_t is the expected return and R_f is the risk free rates. Each β_{jk} coefficient represents the sensitivity of asset *j* to risk factor *k*, and λ_k represents the risk premium for factor *k*.

$$R_t = R_f + \beta_{j1}\,\lambda_1 + \beta_{j2}\,\lambda_2 + \ldots + \beta_{jn}\,\lambda_n$$

Fama has first provided an alternative valuation combining risk-based and characteristics-based risk factors and French (1993, 1996) through their three factors asset-pricing model as stated below. Where; SMB_t (small minus big) – is the difference between returns on diversifies portfolio of small and big stocks. While, HML_t (high minus low) – is the difference between the returns on diversified portfolio of high and low B/M stocks. Inclusion of these two variables in the model is to minimize the error effects on the model.

$$R_t = \alpha_i + \beta_{im}[E(Rm_t) - Rf_t] + \beta_{is}E(SMB_t) + \beta_{ih}E(HML_t)$$

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Fama and French (1993) argue that the higher average returns on small stocks and high B/M stocks reflects unidentified state variables that produce undiversifiable risks (covariances) in returns that are not captured by the market return and are price separately from market betas. In support for these claims, they show that the returns on the stocks of small firms co-vary more with one another than with returns on the stocks of large firms. Additionally, return on value stocks (high B/M) co-vary more with one another than with returns on growth stocks (low B/M). Meanwhile, stock with high ratio of book value to market price (B/M) are typically firm that have fallen on bed times, while low B/M is associated with growth firms.

Behavioral finance paradigm has been offering an alternative behavioral finance-based asset pricing models. The fundamental assumptions of behavioral finance are (i) investors are normal or not perfectly rational, (ii) markets are not perfectly efficient (iii) investors design portfolios according to the rules of behavioral portfolio theory, and (iv) expected returns follow behavioral asset pricing theory (Statman, 2008). However, most of the behavioral-based models are merely an extension of the above three modern asset pricing models with modification and inclusion of behavioral factors namely sentiment, emotion, mood, and heuristics factors represented through various proxies. Summary of these models are as summarized in the following Table 2.

Table 2: Behavioral Finance-Based Asset Pricing Models

Model	*Author(s)*
Static Asset Pricing Model with Incomplete Information	Merton (1987)
Dynamic model incorporating noise traders	Blume & Easley (1992)
Behavioral Asset Pricing Model (BAPM)	Sherfin & Statman (1994)
Overreaction/underreaction	Sherfin & Statman (1994); Daniel *et al.*, (1998); Odean (1998)
Overconfidence-CAPM	Daniel, *et al.*, (2001)
Behavioral SDF-Based Asset Pricing Model	Sherfin (2008)
Behavioral Beta	Hachicha & Bouri (2008)
FFPW Model	Ho & Hung (2009)
Sentiment-CAPM	Kumar & Lee (2006); Yang, Xie & Yan (2012)
Behavioral Approach to Arbitrage Pricing Model	Hassan (2010)

In Statman (2008), he conceptualise that the risk factors could be decomposed into risk-based and characteristics-based factors. This will collectively represents two components or risks that is utilitarian and expressive risk factors (Statman, 2004). The basic idea is based on the fact that people decide based on perception on perception on information and what they care, like and what they can afford to pay.

3.5 Systematic risk puzzle: Key theoretical issues

Defining and measuring systematic risks in stock pricing modeling remain puzzle in finance research. The key theoretical issues are as summarized below.

Problems 1: Philosophical, methodological and theoretical limitations – There is a competing ideas on the nature of finance philosophy i.e. natural vs. social science (Ryan, Scapens & Theobald, 2002; De Scheemaekere, 2009). Scholars in natural science paradigm believe that there are natural laws governing the universe (Phillips, 2000) and approach finance problems using theories from the domain of natural science (Ardalan, 2003). This view is adopted by modern finance and evolutionary finance. For example, modern finance used the mathematical theory of Brownian motion. While evolutionary finance using theories from biology, physics and

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neuroscience to model the dynamism and complexity of the finance problems. On the other hand, scholars in social science paradigm believed that the universe is governed by unique personal, social, and historical conditions (Phillips, 2000). Behavioral scholars reunify modern finance theory with psychology and sociology (Ardalan, 2003) in understanding the complexity of agent and market behaviors.

Problem 3: What are the nature of investor rationality and market efficiency? – Scholars have long pointed that assumption of full rational expectation does not describe the way agents think, learn and process information (Muth, 1961) and the EMH offers limited insights on the stock market reality (Merton, 1987). Nonetheless, modern finance scholars argued that the effect of irrationality is temporary and will disappear off-setted by the arbitrageurs' activity (Fama, 1998). In contrast, behavioral scholars argued that irrationality is systematically existed to the large segment of the population in which incapable of making perfectly rational decision due to various psychological, sociological factors (Yang & Lester, 2008) as well as biological factors (Murphy, 2012; Cronqvist & Siegel, 2014). Perspectives from neuroscience also support for collaborative rational and irrational elements in human decisions. This bounded rational behavior will cause market instability and inefficiency to persist consistently in the market so long normal people is trading in the market (Slezak, 2003) becouse the constant of human nature that will regularly produce fads, euphoria and gloom (Sanford, 1994) in financial markets.

Problem 2: What are the risk factors? - Generally, it is still not clear how risks are determined and measured in stock market investment (Girard & Omran, 2007). The currently used beta as a measure of systematic risk in CAPM is questionable (Olsen, 2009), narrowly defined risk (Damodaran, 2005), invalid as measure of systematic risks (Leland, 1999) and rarely used by professional investors (Arnold & Moizer, 1984). Due to these, the rational-based models do not seem to offer perfect insight into asset pricing anomalies (Baker and Wurgler, 2007). In this respect, there is a need to take into account multifactor source of risk (Nwogugu, 2005; Olsen, 2009) and to include cognitive biases (Thaler, 1985; 1999). Collectively, the risk factors should include utilitarian and expressive factors (Statman, 1999; 2004; Shefrin, 2007) or logic and feeling/affect factors (Solvic *et al.*, 2004). Behavioral asset pricing models have incorporated these but there are still criticisms. There is no grounded theory that explains the origin of the behavioral anomalies in the market (Coval & Shumway, 2005; Burnham, 2013), which cause the theoretical gaps between investor behavior and asset price dynamics (Goetzmann & Massa, 2008). In addition, the systematic behavioral risk still remains disputable. Some of the pointed gaps including lack of unified theory of investor sentiment (Baker & Wurgler, 2007; Burghardt, 2011), little attention given to emotion (Acket *et al.*, 2003; Lucey & Dowling, 2005), and confusion in the use of behavioral factors namely "sentiment", "feelings", "emotion", "mood" and "affect" (Stets, 2003; Lucey & Dowling, 2005).

A NEW THEORETICAL CONCEPTUALIZATION

Interdisciplinary Research: Combining social and natural sciences perspectives

The economic system is increasingly complex in today contemporary world settings (Lewis & Kelemen, 2002) and there is a need to learn from multiparadigm thought and experiences (Parsons, 1938) for theorizing works. The current financial theory is limited in the context of

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broader social criteria. There is a need to recognize even broader environments in an open system framework for finance theory to remain relevant (Weston, 1974). In the same spirits, Shu (2010) argued that there is a need to combine modern and behavioral finance perspectives to form a single framework that accounts for complexity of investors' behavior. In this regards, this research proposed an interdisciplinary research perspective to better understand the complexity and dynamism in stock investment. The interdisciplinary research emerges from the process of combining and integrating various discipline creating new research perspectives that surpass the possibilities of a single paradigm (Zaman & Goschin, 2010) and support an innovative and more successful integrated research (Healy, 2003; Miller *et al.*, 2008).

The modern efinance's full rationality assumption of economic agents behaviors is widely rejected by many scholars. Wolozin (2002) argues that there is a need to understand how human mind works in which human thinking is not only bounded rational (Simon, 1955) but also evolvely adaptive (Haselton *et al.*, 2005). In an attempt to understand the investor and market behaviors, this research propose a reunification of interdisciplinary perspectives of behavioral finance, neuroscience, psychology, sociology, and evolutionary science.

Neurofinance has integrated neuroscience into finance that aims to understand how human brain works. Understanding the mechanism of the brain is necessary in understanding the bounded rationality of human thinking, behaviors and actions (Rubinstein, 2008). In neural science perspective, the human behavior is collectively governed by and interaction between controlled and automatic processes, and between cognitive and affective systems (Carmerer, Loewenstein & Prelec, 2005). This gives a logic justification on how "*affect*" (i.e. sentiment, emotion and mood) influence investors' decision-making.

Psychology theorizes the self and social behaviors dynamism. Social psychology scientifically explore how individuals think, influence, and relate to one another (Myers, 2007). Psychology also highlighted that cultural heterogeneity factor plays a role in influencing individual behaviors. Specifically, Western cultures are more to individualism and cultures native to Asia are more to collectivism (Myers, 2007). This help in explaining the intensity of herding and sentiment behaviors in Asia stock markets. Psychologists also argued that trading behavior, performance and stock preference of different group of investors are different due to individual psychological differences (Bae *et al.*, 2011), environmental factors and traits on perception (Mayoral & Vallelado, 2012), and investor's attention and anchoring (Jianfeng, 2012).

The sociology perspectives also play some role in finance. According to Shiller, (2002), investment in stock market is influenced by social movements where investors are connected to the mass through investment discussion with others, reading reports and news. These biases are termed as social cognition in which decisions are influenced by an understanding, intentions, emotions and beliefs of others (Frith & Singer, 2008). Trading strategy influenced by the mass is known as herding (Baddeley, 2010). In today economic setting, globalization has promoted capital market integration and interdependence (Carruthers & Kim, 2011). Taking all these into account, sociologists argued that social influences in the economy affect the formation of value or price (Zafirovski, 2000).

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Synthesis of Interdisciplinary Theories[58]

The theoretical framework for this research is drawn from interdisciplinary theories namely, the cognitive-affective theory of mind (from *neuroscience*), the two-system view of bounded rationality (from *cognitive psychology*), the dual system model of preference under risk (from *behavioral decision science*), and the Activating events-Beliefs-Consequences theory of causation known as ABC model (from *psychology*). Collectively, these theories are in complementary in building the theoretical framework of this research. William Forbes and William, N. Goetzmann and Massimo Massa express a motivational opinion for this current approach; *"…the only difference between behavioral and traditional approaches to finance lies in the explicit recognition of the need to ground theoretical innovations of financial decision making in an understanding of how decisions are actually made…"* (Frobes, 2009, p. 1) and *"an important challenge to behavioral finance is to find a direct link between individual investor behavior and asset price dynamics"* (Goetzmann & Massa, 2008, p. 103)

Some scholars argued that investors' expectations about the future value of the asset and preferences determines the asset prices formation (Franke, Stapleton, & Subrahmanyam, 1998; Luders & Peisl, 2001). In addition, the psychology and experimental finance research evidences that systematic biases arise form people's beliefs, expectations and preferences (Tversky & Kahneman, 1974, 1981, 1986, 1991; 1992; Luders & Peisl, 2001; Baker and Nofsinger, 2002; Khaneman, 2003; Kuhen & Knutson, 2011). However, this has been neglected in modern finance and the current perspective of behavioral finance is theoretically limited. This research reunify this two perspectives together and closing the gap of rationality-irrationality in investors' decision-making. The following illustration aims to justify these theoretical syntheses.

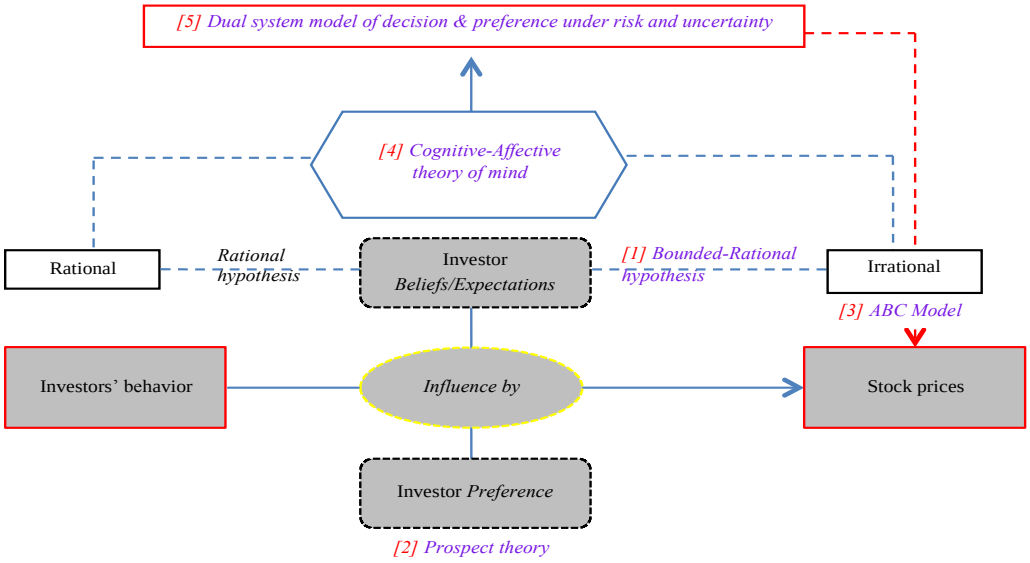

Figure 4: Synthesis of interdisciplinary theories

Cognitive-Affective Theory of Mind

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Human being is constructing the economic activities and that complexity of economics is connected human mind and body (Fast, Hertel & Clark, 2014). This perspective motivates our stating point to understand how human mind works that shape their action and behavior. The theory of mind (TOM) was originally proposed by two primatologists, Premack & Woodruff (1978). This cognitive-affective theory of mind (TOM) provides us the basis for understanding the neural bases of the human mind. TOM recognizes that human thinking is processed by two system of our brain namely cognitive and affective. TOM postulates that the ability to recognize, manipulate and behave with respect to socially relevant information requires neural systems that process perception of social signals and connect such perception to motivation, emotion, and adaptive behavior (Poletti, Enrici & Adenzato, 2012; Brune & Brune-Cohrs, 2006). As such, we review the human behaviors components and definitions in the perspective of neural science, cognitive psychology, sociology, and behavioral decision science to get a clear picture. Understanding the cognitive and affective neural function of human brain gives the foundation in analyzing human thinking and interpreting the human behavior. This also enables us to clarify and accept the concept of bounded rationality of human decision making due to the nature of human brain functioning. This also justifies the significant importance of both affect and cognitive biases to be taken into account in modeling of human decision-making.

The affective and cognitive mechanisms of decision making under risk has been increasingly supported by neuroscience scholars (see – Evants, 2003; Martino, *et al.* 2013; Shimp, *et al*. 2014; Ogawa, *et al.* 2014). This dual perspective of decision theory has also been recently applied in behavioral finance, economics and business research in recent years (see – Parayitam & Dooley, 2009; Hensman & Sadler-Smith, 2011; Basel & Bruhl, 2013; Alos-Ferrer & Strack, 2014; Brocas & Carrillo, 2014; Hytonen, *et al*., 2014). However, there are still theoretical limitations in connecting the dual decision-making and stock pricing modeling.

Bounded Rationality Theory

Bounded rationality theory developed by Simon (1955; 1972) is use to support that investors' decision making is not fully rational but is bounded rational. Bounded rationality asserts that because of human cognitive and emotional element decisions are normally goal oriented and adaptive (Jones, 1999). This is because as a normal human being, investor's thinking is influenced by both the logic thinking (i.e. cognitive part of the brain) and the illogic thinking (i.e. affective part of the brain). The existence of these underlying cognitive systems was postulated from observation and analysis of behavior, which is used to explain behavior (Kenning & Plassmann, 2005).

The two dimensions of human neural functioning comprises of affective (operating System 1) and cognitive (operating System 2) (Kahneman, 2003; Solvic, Finucane, Peters, & MacGregor, 2004; Carmerer, Loewenstein, & Prelec, 2005). In an atempt to maps the bounded rationality of human decision making which was coined earlier by Herbert A. Simon (1955; 1979), Kahneman (2003) conceptualize the intuition and reasoning of the neural which is intuition (affective) and reasoning (cognitive) as illustrated above. System 1 (affective) is where the emotion, sentiment, mood and other affect states are located. Affective decision making involved intuition and this intuition will be influenced by perception. This intuitive thoughts comes to mind spontaneously.

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Meanwhile System 2 (cognitive) deliberates logic thought and also monitors System 2 activities (Kahneman, 2003).

Prospect Theory

The use of expected utility theory as a descriptive model of decision making under risk in modern economic and finance perspective has been criticised first by Kahneman & Tversky (1979). The model assumption of economic agent's full rationality behavior in real practice does not hold (Gazioglu & Cahskan, 2011) becouse most of the time people preferences systematically violates the assumption of expected utility theory (Kahneman & Tversky, 1979). Accordingly, Kahneman & Tversky suggested prospect theory as an alternative model of decision making under risk and uncertainty (Kahneman & Tversky, 1979; Tversky & Kahneman,1986). Prospect theory distinguishes two phases in individual choice process namely framing and valuation. In the framing stage the individual constructs a representation of the acts, contingency and outcomes relevant to the decision. While, in the evaluation stage, individual assess each of the prospects available and chooses decision accordingly (Tversky & Kahneman, 1992). According to prospect theory, the choice value function has the following characteristics; (i) defined on deviation from the reference point, generally concave for gains (risk aversion) and convex for losses (risk seeking), steeper for losses than for gains (loss aversion), and (ii) having a nonlinear transformation of the probability scale (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). Along the way, the first version of this model has been noted to have few drawbacks. The model was developed based on assumption of small number of outcomes and was based on individual probabilities, which has limited applicability. Accordingly, in 1992, Tversky and Kahneman published a modified version of this theory known as "cumulative prospect theory" (Tversky & Kahneman, 1992). The extended version has taken into account uncertainty and risk prospects with any number of outcomes and incorporate the cumulative functional of individual probabilities.

Empirical validation of the applicability of this theory in relation to asset prices has been conducted by many scholars (see - Thaler & Johnson, 1990; Barberies, Huang & Santos, 2001; Hung & Wang, 2005; Barberis & Huang, 2008; Arkes, Hirshleifer, Jiang & Lim, 2008; Kliger & Kudryavtsev, 2008; Gazioglu & Cahskan, 2011; Li & Yang, 2013; Yao & Li, 2013). Collectively, all of these research confirmed to the assumption and predictibility of prospect theory hypotheses. Prospect theory is the most successful behavioral model of decision under risk and now widely viewed as the best available description of how people evaluate risk in uncertain environment (Trepel, Fox & Poldrack, 2005; Barberis, 2013). The consistency of propsect theory with human brain in investment setting have also been validated by neiroscience scholars (see – Trepel, Fox & Poldrack, 2005; Mohr, *et al.* 2010)

ABC Model[59]

The theory of mind discussed previously does not provide justification for irrationality thinking of causes and effects. Irrational thinking to psychologists is a thinking that *"creates extreme emotions that persists and which distress and immobilize…miss interpretation of what is happening and it is not supported by the available evidence…it contains illogical ways of evaluation oneself, others, and the world"* (Froggatt, 2006, p. 12). As such, this research adopts

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the theory of causation from cognitive psychology known as ABC model as an underlying theory to understand the cause and effects of behavioral anomalies expressed by investors and its impact to stock market. Similar approach has been employed by Brahmana, Hooy & Ahmad (2012a) and Brahmana, Hooy & Ahmad (2012b) in explaining the psychological factors on irrational financial decision-making. This is the first finance scholar to use this psychoanalytic approach in behavioral finance research. The ABC model is an established psychoanalytic fundamental framework in understanding the biological basis of human irrationality. This model is founded by a clinical psychologist, Dr. Albert Ellis in 1950s (Ellis, 1976). According to this model, the root cause of human behavior irrationality (both by affective and cognitive) can be understood logically by this theory of causation (i.e. the ABC model). According to this model, the C-*behavioral consequences* (in this case behavioral anomalies, can be positive or negative) arise from B-*core beliefs* or belief system (affect and cognitive, rational and irrational) that were triggered by various A-*activating events* (Ellis, 1976;1991; Froggatt, 2006; Li & Lee, 2011; Vaida & Ormenisan, 2013).

A Dual System Model of Preferences under Risk

The vast majority of existing models of decision making including expected utility theory, bounded rationality, prospect theory and their variants assumes a single system of human thought (Mukherjee, 2010). Expected utility, which requires rationality on the part of investors thinking and actions, describes only the logic cognitive (System 2) thought. On the other hand, Prospect theory by focusing on explaining the irrationality thinking and behaviors focuses only on affective cognitive system (System 1). Thus, human behaviors are only partly explained by the existing models and empirical evidence rationalization is limited to the specific model assumption. Thus, to acknowledge both the cognitive and affective states of mind in modeling the asset pricing risk factors, the dual processing theory of mind is needed. The dual processing theory is currently widely accepted as a dominant explanation and characterization of human decision making. There is various theory of dual decision-making available, however this research chooses to adopt the Mukherjee's dual model of preferences under risk Mukherjee (2010)[60] for its suitability in this study. This research is the first to apply this model with some modification in modeling the investors' behavior (i.e. cognitive and affective components of decision making) as well as their influences on share prices formation. In reference to the Figure above, the affective cognitive system (System 1) will take into account the influence of affective biases (i.e. sentiment, emotion, mood) on investors' decision-making. Meanwhile, the logic cognitive system (System 2) involved both logic calculation (cognitive logic) as well as heuristic biases (cognitive biases).

Extended Behavioral Multifactor Theoretical Framework

The research theoretical framework is as illustrated below. Development of this theoretical framework is justified by interdisciplinary theories as discussed before and validated by empirical evidence related to this study. In constructing the determinant of stock price determinants, we take into account both the cognitive and affective thinking of human mind as discussed in the theory of mind in previous section. To recap, investors' decision will be influenced by cognitive logic, cognitive biases and affective biases. The investors' decision function is represented as follow;

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$$Investors' Decision = f\ (Cognitive_{Logic} + Cognitive_{Biases} + Affective_{Biases})$$

Following Huffman and Moll (2013) and Baker and Wurgler (2006), the model function of stock returns and risk measures are as in the following equation. Where, γ_t is a coefficient represents the sensitivity of asset *j* to risk factor *k.*

$$R_{it} = \alpha_t + \gamma_t(Risk\ Measure_{it-1}) + \varepsilon_{it}$$

Based on the research framework, the risk measures can be extended to incorporate both fundamental factor (FF) and behavioral factors (BF). FF represents cognitive logic thinking factors. While BF accounts for cognitive and affective biases factors. The basic behavioral multifactor stock pricing model equation can be written as follow;

$$R_{it} = \sigma_t + \gamma_t\ (FF_{it-1} + BF_{it-1}) + \ \varepsilon_{it}$$

Accordingly, the conceptual framework for extension of the behavioral multifactor stock pricing model is as illustrated in the following Figure 5.

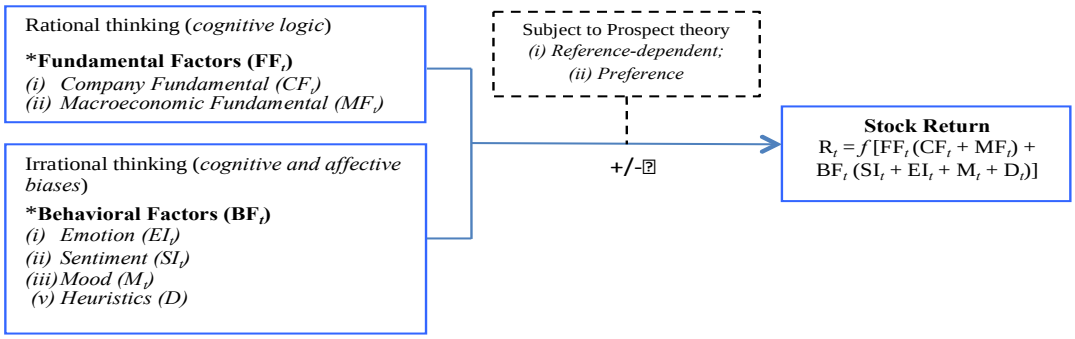

Figure 5: The multifactor risk stock pricing model theoretical framework

In reference to the above framework, both rational and irrational source of information contribute to investor decisions thus they are considered to be the determinants of stock demand and supply and thus influence prices formation. Positive (negative) fundamental and behavioral factors will have a positive (negative) effect on stock demand and share prices changes. In this perspective, investor thinking, perception, and action will be influenced by reference-dependence and preference. Reference dependence means investor treat outcomes as losses or gains from subjective reference and individual weight probabilities in a non-linear manner (Ricciardi, 2008). Various reference points used by investors are as discussed previously in page 5.

Preference is related to investor perception on the degree of riskiness of investment (badness or goodness) based on certain characteristics of stocks and their preference as well as attention for affordability and less risky stocks (Shefrin & Statman, 1995; Statman *et al.*, 2008; Shefrin, 2007). Main preferences characteristics include among others preference for, small size firm stock, value stocks (Fama & French, 1992; Shefrin & Statman, 1995), glamour stocks i.e. glamour brands (Billett *et al.*, 2014), admired firms stock (Statman, 2008), and good company stock e.g. ethical and socially responsible firms (Statman *et al.*, 2008; Shefrin, 2007). These characteristics triggered a positive affect (Shefrin, 2007) and perceived to be lower risk with high

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return expectation (Statman *et al*., 2008). In addition, attentions to momentum (DeBondt & Chen, 2004; Antoniou, Doukas & Subrahmanyam, 2013), winner-losers (Shefrin & Statman, 1985), and liquidity (Pastor & Stambaugh, 2003; Amihud, Mendelson & Pedersen, 2005) factor also play roles in demand-supply, price formation and return determination.

CONCLUSION

This research provides an alternative theoretical perspective on, and an extension of, behavioral multifactor stock pricing model. Theoretically, the findings would significantly contribute to bridge the current gaps in behavioral assets pricing theory in the following area; First, the rationale linkages between investors' behaviors and stock pricing formation are theoretically synthesized using five interdisciplinary theories (i.e. bounded rational hypothesis, prospect theory, ABC model, cognitive-affective theory of mind, and dual system model of decision). This addresses the research gaps coined by some of the scholars (Coval & Shumway, 2005; Goetzmann & Massa, 2008; Burghardt, 2011; Burnham, 2013) that justifies the origin, causes, and effects of investors' irrationality and provide scientific justification for the importance of investors' behavior as risk factors in stock pricing model. In addition, reunification of these five theories collectively justifies the dynamism of investors and market behaviors. Second, to the best of our knowledge, this research is the first to utilize the dual decision making under uncertainty in combining both the rational (fundamentals) and irrational (behavioral) factors in stock pricing modeling. Third, this study contributes to the extension of behavioral multifactor model for share prices determinants different from the existing available model. This model incorporates both fundamental (i.e. firm and macroeconomic fundamentals) and behavioral factors (i.e. investors' sentiment, emotion, mood and heuristics) as risk factors, which reflect both rational and irrational elements of investors' decision making. Nonetheless, validity of this framework is subject to empirical testing as in the words of Blumer (1954) that *"the theory is of value in empirical science only to the extent to which it connects fruitfully with the empirical world"* (p. 4).

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