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Elucidating rational investment decisions and behavioral biases: Evidence from the Taiwanese stock market

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Financial innovation has witnessed an increasing number of financial products in the financial industry. Various investment activities involving individual investors have also become prevalent in the Taiwanese financial market. Financial managers thus highly prioritize elucidating the investment behaviors of individual investors and then incorporate them in investment decision making. This study examines how rational decision making and behavioral biases are related, as well compares the relative differences of three behavioral biases, that is disposition effect, herding and overconfidence, by various demographic variables. The psychological cognition of investment decision making among investors and the antecedences of behavioral biases are also studied based on a sampling survey of 430 valid respondents from voluntary individual investors in Taiwan. Based on structure equation modeling (SEM), path analysis is performed on how rational decision making and three proposed behavioral biases are related. Analytical results indicate that the structural path model closely fits to the sample data, implying the role of rational decision making in investment behaviors among individuals. However, the irrational investment behavioral biases might arise in various decision-making stages. Our results further demonstrate that male and female investors significantly differ in disposition effect, herding and tendency of overconfidence.

Key words: Rational investment decisions, behavioral finance, disposition effect, herding, overconfidence.

INTRODUCTION

Rational decision theory asserts that decision makers generate various strategies and follow specific logical procedures to resolve problems according to the nature of problem, timing, and decision environment. In other words, a rational decision attempts to reach an optimum decision by categorizing decision making into three types based on the level of rationality. The most rational type, that is pure rationality, allows decision makers to reach optimum decisions and achieve the highest efficiency out of unlimited time, resources and knowledge in order to make decisions. This type assumes the administration dichotomy, in which the former identifies goals for the latter to achieve (Gianakis, 2004). The incremental type is a less rational model in which goals are politically feasible and decisions are made by comparing several immediately available alternatives (Lindblom, 2005). The bounded rationality type is a mixture of the above two types that refers to the achievement of given goals subject to subjective constraints (Simon, 1982, 1991). Shafir and LeBoeuf (2002) suggested that the assumption of rationality is possibly the most common and pivotal assumption underlying theoretical accounts of human behavior in various disciplines. Based on the assumption of rational behaviors among investors, the Efficient Market Hypothesis (EMH) included in conventional financial theory is also established. Fama (1965) suggested that no one can continuously defeat the market to earn the excess profits in an efficiency financial market, where the information has been exposed completely. Additionally, most rational investors can immediately and independently reflect the market information to maximize profits.

In the late 20th Century, however, many financial researchers examined the core arguments of EMH, Capital Asset Pricing Model (CAPM), and anticipation utility theory. For instance, Banz (1981) and Bamber (1987)

found that fluctuating future stock prices has a "scale effect". Cross (1973), French (1980), and Gibbons and Hess (1981) also found the "week effect" on the moving trend of stock prices so that the investors can gain the excess returns by adapting the reverse operation strategy. Kahneman and Tverskey (1979) proposed the prospect theory to explain decision-making behavior under uncertain circumstances. According to the prospect theory, psychological factors of investors will drive their actual decision-making process to deviate from rationality, which is continued to Simon's (1957) argument of bounded rationality. Investors thus often simplify their decision processes and are prone to behavioral heuristics that might make systematic errors and lead to satisfactory investment choices, but does not maximize decisions.

In general, if an investor's decision making process complies with logical path including the procedures of identifying demand, cognitions of financial products, and evaluating alternatives, then such the investment choice will be deemed as a rational investment decision. Additionally, according to the practical observations of individual investors' behaviors, investors usually have the self-perception capability of rationality. Since the investors' declare themselves trading or choosing process as a rational decision-making behavior, why do most of investors still apparently display behavioral biases? In recent decades, most empirical evidence generally views various behavioral biases as common cognitive illusions existing in decision making process among investors. Previous researchers have either identified various investor types or examined how behavioral biases could impact investment returns. However, the relationship linking the antecedents of behavioral biases with each stage of decision-making process has never been examined in literature, especially for a comprehensive survey of pertinent literature on investment behavioral biases. This study thus attempts to re-examine whether the decision behaviors of investors complies with the theoretical model of rational decision making process, and reveals the causal relationships between three proposed behavioral biases and each stage of decision making. Moreover, the influence of various demographic variables on behavioral biases is also discussed.

LITERATURE REVIEW

Rational decision-making theory

A rational decision maker generally makes a decision based on certain logic and systematic decision procedures (Robbins, 2002). With respect to the topic of rational decision-making process, the scholars have provided some well-established models with different decision stages. For example, Mitzberg et al. (1976) described three elementary stages of rational decision-making process: problem identification, i.e . recognizing the nature

nature of a problem and seeking more relevant information; development elements, that is seeking essential information and problem-solving methods; and selection element, that is identifying a problem and evaluating alternative solutions to make an optimal choice. Similarly, Keeney (1998) and Hammond et al. (2002) outlined six procedure criteria to evaluate an effective rational decision; Daft (2003), Osland et al. (2006) and Robbins (2002) suggested eight steps on it; and McMahon (2007) proposed seven effective way to go about the decision making process. Although decision makers vary with respect to their beliefs, opinions, and preferences, rationality deals with the notion that these factors should be coherent (Shafir and LeBoeuf, 2002). This explanation complements the assertion of Eisenhardt and Zbaracki (1992, p. 18) "… *In its most basic form, the rational model of choice follows the everyday assumption that human behavior has some purpose….*" Based on the impli-cations of these theories, they expressed the same ideas in different words. Namely, it could be said that none of these arguments can dominate over the others. Simon (1957, 1982) pioneered the concept of bounded rationality, which asserts that managers make imperfect decisions due to lack of information, inadequate time, and cognitive limitations. Therefore, managers could make better decisions if they could access essential resources. Instead, managers are often forced to make decisions without sufficient information to ensure successful decision making so that the decision is suboptimal yet satisfactory.

Several human behavior-related studies have thoroughly explored consumer behavior topics through rational decision-making theory such as Kotler's (1988) model, consumer decision model asserted by Howard (1989), and EKB model (Engel et al., 1968). In consumer behavioral research, slightly irrational thought has been associated with consumption decision making, e.g. im-pulse purchasing behavior, in which consumers receive temporary rewards from a purchase. Their psychological statuses of post-purchase behavior are often associated with criminal behavior and helplessness; such the consumers are fascinated with purchasing rather than possessing products (Engel et al., 2001). Robbins and Judge (2007) argued that a rational decision ultimately involves a robust and systematic decision-ma-king process and then focuses on maximizing anticipated profits. Similarly, individual investors involved in choosing financial products always undergo a deliberative evalua-tion that appears similar to rational investment decision making.

Behavioral biases-related research

Prospect theory incorporates many distinct perspectives involving conventional finance and initiates a new development in behavioral finance. Asymmetries of risk perception are inherent in the investors' value function that

may causes investors to make investment decisions based on their intuitions and previous investment experiences rather than rational analysis with objective reasons (Kahneman and Tverskey, 1979).

Disposition effect

As a common behavioral bias among investors, the disposition effect has generally been regarded as a direct implication of the prospect theory. Shefrin and Statman (1985) indicated that although investors become risk averse when they enjoy making gains, when losses occur, they become loss averse. Investors are thus eager to sell stocks of value and willing to hold stocks that have lost value. Statman et al. (2006) indicated that this bias is based on a mental accounting framework. Most of the considerable evidence supports the existence of the disposition effect (Barber et al., 2007; Grinblatt and Keloharju, 2000; Odean, 1998; Shapira and Venezia, 2001; Weber and Camerer, 1998). However, many derivative analyses of disposition effect have been well-developed with respect to a variety of positions for market investment or investors in the last two decades, there still have no thorough discussions with respect to the antecedents of disposition effect.

Bremer and Kato (1996) investigated the Japanese stock market based on monthly trading volume data from 1975 to 1990, indicating that the abnormal turnover rate of the stocks in value is significantly increased but not for the stocks that have lost value; existence of the disposition effect is thus verified. Goetzmann and Peles (1997) found the speed of cash inflow towards a better performing mutual fund is faster than that of cash outflow from a worse performing mutual fund. This phenomenon is owing to that investors are unwilling to suffer losses. While analyzing trading records from 10,000 accounts of individual investors, Odean (1998) explored the disposition effect over a 5 year period (except for December) because of tax regime reasons. Locke and Mann (2005) demonstrated the disposition effect by focusing on the trading volume of institutional investors, indicating strong evidence of loss aversion in the futures market. Grinblatt and Keloharju (2000) also identified the disposition effect in the Finnish market. Luo and Lu (2007) made a similar observation that displays the disposition effect in Chinese "B share" for the behavior of institutional investors from 1996-2003. Based on the trading records of individual accounts, Shu et al. (2005) compared the Taiwan and US stock markets in terms of the disposition effect. According to their results, the selling proportion of winning stocks is 2.5 times higher than that of losing stocks for Taiwanese investors; mean-while, that for US investors is 1.5 times higher. They thus inferred that the disposition effect of Taiwanese individual investors is stronger than that of US individual investors. A similar finding was demonstrated after the next decade

in Taiwan. For instance, Barber et al. (2007) found that 84% of Taiwanese stock market investors sell the stocks during gains faster than during losses. Therefore, even the individual investors and institutional investors display the disposition effect.

As for the disposition effect on returns, Benartzi and Thaler (1995) conducted a follow up study on winning stocks sold by investors with the disposition effect. According to their results, the rate of returns of such stocks the following year were higher for 3.4% than losing stocks, in which investors are persistently holding on and waiting for a rebound. This finding implies that the disposition effect may lead to a decline in the whole rate of returns. According to the argument of Kahneman and Tverskey (1979), since asymmetries of risk perception are inherent in the investors' value function; it would be reasonable if investors could more deliberately evaluate the entire investment program by following the stages of rational decision-making process, then the negative impacts of disposition effect would be theoretically mitigated.

Herding

Herding behavior originates from psychology research. Sherif (1966) referred to herding as a behavior that blindly follows the decisions of the majority rather than relying on rational thinking. Related behavior effects on stock price moments may influence the investor risk and return characteristics (Tan et al., 2008). Similar to research on the disposition effect, numerous empirical studies have focused on identifying herding behavior among financial managers or different markets. For instance, Scharfstein and Stein (1990) examined the herding behaviors of professional managers, indicating that financial managers may follow the investment choices of other managers because they will not bear all losses once the investment fails. The managers are thus apt to suppress their own beliefs, and their investment decisions are more likely to rely on collective actions. Grinblatt and Titman (1994) designed herding indicators to elucidate significant herding behavior in mutual fund market. Christie and Huang (1995) designed a cross-sectional standard deviation method to detect herding behavior, suggesting that investment decision making of market participants depends on overall market conditions. By such an approach, the extreme returns of investors must be defined. However, identifying the extreme returns is rather difficult if the market history is relatively short, that is why Demirer and Kutan (2006) found no evidence of herding behavior in Chinese equity markets. According to Devenow and Welch (1996), financial managers may adopt similar investment strategies and, therefore, lead to the herding behavior to protect their own reputation. Iihara et al. (2003) found that the herding behaviors induced from foreigner and institutional

investors more heavily influence stock prices than that of individual investors in the Japanese Stock Market. Sias (2004) attributed herding formation for mutual fund managers to reputational herding, information cascade, investigative herding, fads, and herding characteristics. Summarizing above-mentioned viewpoints, herding behavior seems independent of personal decision-making process but relevant to market environment and atmosphere.

Overconfidence

Many investors are prone to rely on insufficient information that they hold and, simultaneously, ignore reversal information in the market so that it can lead to suboptimal results (Shefrin and Statman, 1994). Financial economists have attempted to explain why overconfidence prevails among investors. Especially when the return rate of an investment target cannot be accurately predicted by experts whom consider themselves competent, investment experts over rely on financial theoretical models and appear more overconfident than novices (Griffin and Tversky, 1992). Daniel et al. (1998) indicated that overconfident investors overestimate their private information and neglect available information. Consequently, the asymmetric response of overconfident investors induces the short-horizon momentum and long-horizon reversal in returns. Gervais and Odean (2001) developed a forecasting model in which overconfident investors attribute investing gains to their competence in order to select winning stocks, while accumulating wealth causes them to more aggressively trade according to their investment experiences. Tourani-Rad and Kirkby (2005) examined optimistic and overconfident investors in New Zealand who believe they have investment ability and knowledge to understand the latest market trends or select the next hot stocks. Statman et al. (2006) found that the market turnover rate is significantly positive related to the market return of a prior term. This finding implies that overconfident investors attribute high returns in bull markets to their trading skills, leading to a high subsequent trading volume. Similarly, Huang and Goo (2008) observed that external factors such as an optimistic investment atmosphere that affects investors' mood and leads to greater optimism, capable of withstanding higher risk and likely leading to overconfidence.

Furthermore, Menkhoff et al. (2006) found that if the mutual fund managers are overconfident, then their herding behavior will be insignificant. In a series of evaluations involving overconfident trading behavior, related evidence suggests that individual investors appear overconfident about their perceived information and ability (e.g., Barber and Odean, 2000a, 2000b, 2002; Benartzi and Thaler, 1995; Odean, 1998, 1999). Consequently, such investors tend to underestimate risk and trade more in higher risk securities, leading to investment performances that are often lower than the market

average. Generalizing the above-mentioned viewpoints, one may conclude that if the investors have definitely indentified themselves investment demand or have well-evaluated the feasible alternatives, then they will be likely to form an optimistic investment attitude leading to overconfidence.

Personal characteristics of investors and behavioral biases

To elucidate the relationship of personal characteristics and behavioral biases of investors has received considerable interest recently, in which the differences in investment patterns are attributed to personal characteristics. For instance, Goetzmann and Massa (2002) indicated that investors with a higher income, stronger specialty, and trading experience would mitigate the disposition effect. By using a sample of individual investors, Dhar and Zhu (2006) found that groups of older, higher specialty and high wage earners appear to have a relatively lower disposition effect. Da Costa et al. (2008)'s findings emphasized that males have stronger disposition effect than females. Referring to the relationship between demographics and overconfidence, the empirical studies seem consistently believe that males are more overconfidence than females (Acker and Duck, 2008; Barber and Odean, 2000b; Bengtsson et al., 2005; Bhandari and Deaves, 2006; Kuo et al., 2005). For example, Barber and Odean (2000b) examined the trading histories of 60,000 discount brokerage investors, revealing that the returns of males are lower than that of females owing to a higher turnover rate and too much trading.

Kuo et al. (2005) thoroughly surveyed Taiwanese individual stock investors with respect to gender role in investment, indicating that females are psychologically less confident and pessimistic than males that the finding is consistent with Barber and Odean (2001). Bhandari and Deaves (2006) found that the degree of overconfidence varies, depending on gender, education level, income, and investment knowledge, which is especially significant for males and highly educated investors. With respect to the relationship between demographics and herding bias, Eagly and Carli (1981) identified females are more prone to herding than males. Menkhoff et al. (2006) found that the people without college degree are more apt to herding, but there is no significant evidence in gender. In sum, most studies have verified that the personal characteristics of investors profoundly impact various behavioral biases with the exception of Wong et al. (2006).

The connection of investors' rationality and behavioral biases

Based on the bounded-rationality framework, individual investors are regarded as attempting to make rational

decision, but they often lack important information on the definition of the problem, the relevant criteria, and so on. In general, the judgment of people is bounded in their rationality, so they will forego the best solution in favor of acceptable or reasonable one that is so-called the decision makers' *satisfice* (March and Simon, 1958). Afterward, Tversky and Kahneman (1974) provided critical information about specific systematic biases that affect judgment. More specifically, previous studies found that investors would rely on a number of simplifying strategies (that is, heuristics) or rules of thumb in making decisions. In practice, heuristics are helpful in investment decision, but it may sometimes lead to critical errors and biases. Although the concepts of bounded rationality and *satisficing* are important in showing that judgment deviates from rationality and help investors identify situations that they may be acting on the basis of limited information, they do not explore how judgment will be biased, neither help diagnose the specific relationship between investors' biases and judgment (Bazerman, 2002). Further to generalize Thaler's (2000) arguments, investors have bounded willpower so they give greater weight to current concerns than to future concerns that will lead to a variety of ways in which their temporary motivations are inconsistent with long-term interests.

Therefore, despite the investment decisions complying with each stage of rational decision-making process, the behavioral biases would still exist in the mind of investors. In other words, one may infer that other important exogenous variables such as demand identification, public information searching, and personal investment experience would also affect the formation of behavioral biases.

METHODOLOGY AND DATA

Instrument

Most studies use secondary data to perform a longitudinal analysis and construct specific indicators to identify behavioral biases of investment. However, owing to that behavior finance explores psychological attitudes of investors towards investment decisions primary data can accurately reflect the inner motivation of investors. Thus, in contrast with previous studies, which focus on detecting behavioral biases and the impacts of behavioral biases, this study performs a cross-section analysis via Structure Equation Modeling (SEM) that constructs a comprehensive path to link each stage of the rational decision-making process with three proposed behavioral biases. The causal processes are represented by a series of structural equations that can be modeled graphically to facilitate the conceptualization of a theoretical framework (Byrne, 2001). Using SEM allows us to evaluate simultaneously the factor loadings and error variance of the measurements and to test the significance of the relationships between the latent variables of interest. According to Hayduk's (1987) suggestion, the SEM should be simplified as much as possible in order to reduce the under-identification and improve the goodness of fit of a structural model.

Based on the principle of parsimonious, Mitzberg et al. (1976)'s theory is a more concise model for conceptualizing the rational decision making procedures in the hypothesized model. The questionnaire is divided into three parts. The first part involves determining the rational decision-making process, including three stages modified from Mintzberg et al. (1976) (that is identifying the problem, seeking information, and evaluating the alternatives). Each stage in the rational decision-making process is regarded as a latent variable measured by 2-3 observed variables and totally constructed 10 items of questionnaires. The second part involves evaluating three proposed behavioral biases, that is disposition effect, herding, and overconfidence. The measures involving these behavioral biases are well defined in the behavioral finance and psychology literature, as well as based on the theoretical work of Devenow and Welch (1996), Scharfstein and Stein (1990), Shefrin and Statman (1985, 1994), Sias (2004), and Statman et al. (2006). Each behavioral bias is treated as a latent variable and measured by 2-4 observed items and totally developed 16 items of question- naires. Each item in these two parts adopts six-point Likert-type scales to measure the psychological agreement of respondents. Categories for the scale ranged from strongly disagree (1) to strongly agree (6). Table 1 lists the measures with the reworded items. The third part is demographics of the investors, including gender, age, occupation and annual income. The self-report ques- tionnaire designed by this paper is utilized to collect the subjective information from individual investors. However, it is likely to lead the common method variance (CMV). To detect whether the data has been affected by CMV, the *post hoc* remedy, Harman's one-factor test, is adopted to examine the value of CMV by incorporating all observed variables to conduct an un-rotated factor analysis (Podsakoff and Organ, 1986). In the designated questionnaire, there are five factors with eigenvalue greater than 1 extracted from 18 items of observed variables in which the percentage of cumu- lative explained variance is 61.04% and the explained variance of the first principle component is only 26.39%. It implies that the CMV has little effect on the survey data.

The reliability, validity and internal quality of constructed models

For the both considerations of measurement reliability and goodness of fit of the model, the final measurement scales for each latent variable are determined that satisfy the following criterion: (a) eliminate items with communalities (item-total) lower than 0.3 (Yavas, 1998); (b) eliminate items with square multiple correlation (SMC) lower than 0.2; (c) eliminate items with standardized factor loadings higher than 0.95; (d) suggest the modification index (MI) provided by LISREL8.71 package (Jöreskog and Sörbom, 1993). Additionally, there are two steps to test the reliability and validity of measures: First, we have executed a pre-test by using 216 con- venience samples collected from the security companies to test the internal consistent reliability shown as the Cronbach's α values calculated by SPSS12.0 for Windows. Second, we conduct a confirmatory factor analysis (CFA) using 430 confirmatory samples to evaluate the construct validity of questionnaires. From the results of CFA, all the factor loadings of observed variables on latent variables are significant (Table 1) and show a good model-fit. The measures of rational decision making process ($\chi^2_{(14)} = 23.46$, p= 0.053, GFI=.99, CFI=.99, NNFI=.94, RMSEA=.04, SRMR=0.027); the measures of herding ($\chi^2_{(2)} = 1.64$, $p = 0.44$, GFI=1.00, CFI=1.00, NNFI=1.00, RMSEA=.0, SRMR=0.011); the measures of overconfidence ($\chi^2_{(2)} = 7.72$, $p = 0.021$, GFI=0.99, CFI=0.99, NNFI=0.97, RMSEA=.082, SRMR=0.026). The corresponding composite reliability (ρ_c) for each latent variable is also calculated by the indicator of $\rho_c = \frac{(\sum \lambda_i)^2}{[(\sum \lambda_i)^2 + \sum \theta_i)]}$,

Where:

Table 1. The internal quality of measures for latent variables.

Latent variable	Item	Standard factor loading	SMC	Cronbach's α	Composite reliability ρ_c
Demand identification	Investing financial product can help me to develop interest and to find fulfillment.	0.61*	0.36		
	Investment is a better way to increase my wealth.	0.65*	0.45	0.55	0.67
	I invest financial products because it can keep the value of the property.	0.66*	0.43		
Searching information	In order to understand financial goods, I think to exchange the information with relatives and friends is important.	0.46*	0.23		
	I often collect and refer to the investment information from newspapers, magazines or relevant public resources.	0.80*	0.58	0.60	0.62
	The past investing experience can provide me with the important information.	0.41*	0.35		
Evaluating alternatives	Before choosing financial product, it is necessary for me to consider the future growth for the related industry.	0.78*	0.60		
	When I invest, I would pay much attention to relative transaction costs.	0.59*	0.35	0.71	0.64
Disposition effect	I often actively dispose gains from my portfolio.	0.82*	0.68		
	I am often reluctant to realize losses.	0.73*	0.52	0.68	0.75
Herding	I would invest in the financial products by following my friend's recommendation.	0.55*	0.31		
	I would bid the securities whose prices have risen for a period.	0.57*	0.33	0.80	0.73
	I would bid the same financial products as my friends.	0.76*	0.56		
	I would follow the market information to trade.	0.71*	0.51		
Over-confidence	I am sure that I can make the correct investment decision.	0.67*	0.46		
	I believe I can master the future trend for my investment.	0.77*	0.59		
	I think market trend is often consistent with my perspectives.	0.59*	0.35	0.67	0.76
	I always refer the investing profit to my successful investment strategy.	0.62*	0.39		

*$|t| > 2.58$

λ_i denotes the standardized factor loadings on latent variables, θ_i denotes the measurement errors of observed variables. The value of ρ_c that is higher than 0.6 may be represented as good construct reliability (Bagozzi and Yi, 1988). The final measure items and the reliabilities of each item (that is the value of SMC) and compo-site concept (that is, latent variables) are summarized in Table 1. To sum up, the constructed models have a good internal quality be-cause of the acceptable reliability and validity on the measurement.

Data collection

In the formal survey work, based on the suggestion of Griselli et al. (1981), the recommended sample size should be ten times that of the measurement items or upwards. Schumacker and Lomax (1996) also suggested a proper sample size ranged between 200 and 500 for using structure equation modeling (SEM). For the purpose of this study, the formal survey is conducted of general individual investors.

Based on the privacy concerns of individual investors, the screening interview method is adopted to ask for the willingness of investors and whether they have any investment experience in Taiwan stock market before completing the questionnaires. Consi-dering the special structure of investors in Taiwan stock market, there is accounted for more than 80% of individual investors to total investors, the convenience sampling method is utilized to totally investigate 450 voluntary individual investors attending at securities companies located in Taipei during Dec. 2009 to Jan. 2010. After deducting the invalid and incomplete questionnaires, 430 valid res-pondents have been collected, so the valid response rate is 96%.

Structure equation model

The study uses SEM to simultaneously estimate and test how latent variables and their measurements are related. Based on previous literature, two hypothetical structure equation models are proposed and analyzed with the LISREL 8.70 statistics package, respectively. Model 1, consisting of a measurement model and structure model, is developed to explore how the three stages of rational decision-making process and the three behavioral biases are related. The structure equation of Model 1 is:

$$\eta_i = \beta_{ij}\eta_j + \gamma_{ij}\xi_j + \varsigma_i, \ i, \ j = 1, \ 2, \ 3, \ \dots, \qquad (1)$$

where ξ_j denotes exogenous latent variables, that is demand identifi-cation; η_i denotes endogenous latent variables, that is searching information, evaluating alternatives, disposition effect, herding, and overconfidence; γ_{ij} denotes the regression coefficient of ξ_j on η_i; β_{ij} denotes the regression coefficient of η_j on η_i; and ς_i denotes the error variance of structure equation. The measurement equation of Model 1 is:

$$X_i = \lambda_{xij}\xi_j + \delta_i, \qquad (2)$$

$$Y_i = \lambda_{yij}\eta_j + \varepsilon_i, \qquad (3)$$

where; λ_{xij} denotes the regression coefficient of X_i on ξ_j; λ_{yij} denotes the regression coefficient of Y_i on $\eta_{i,j}$; δ_i, ε_i denote measurement errors of exogenous (ξ_j) and endogenous (η_i) latent variables, respectively.

Similarly, Model 2 is constructed to examine how demographic variables of investors differ in various behavioral biases. This model evaluates how well the observed exogenous variable, that is gender, age, occupation, and annual income, predict the endogenous latent variables, that is disposition effect, herding, and overconfidence. The structure equation of Model 2 is:

$$\eta_i = \beta_{ij}\eta_j + \gamma_{ij}X_i + \varsigma_i \ \ i, \ j = 1, \ 2, \ 3 \dots \dots \qquad (4)$$

and the measurement equation of Model 2 is only for Y_i, shown as follows:

$$Y_i = \lambda_{yij}\eta_j + \varepsilon_i. \qquad (5)$$

By using maximum likelihood estimation, the fitness indices of the structure models are assessed by goodness of fit index (GFI), comparative fit index (CFI), and non-normed fit index (NNFI), where the values greater than 0.90 are regarded as acceptable. A situation in which the value of the root mean square error of approximation (RMSEA) is 0.05 or lower implies that it is a close fit. Additionally, values up to 0.08 are recognized as a reasonable error of approxi-mation (Browne and Mels, 1990). In addition, according to the principle of parsimony, Critical N (CN) should be greater than 200 (Hoelter, 1983), parsimony normed fit index (PNFI) should be higher than 0.5, and Normed chi-square (χ^2/df) should be lower than 3.

RESULTS

Table 2 summarizes the descriptive statistics for various measurements. The sample is composed of 266 males (61.86%) and 164 females (38.14%), with 9.9% under 25 years old, 50.2% between 25 to 35 years old, 26.7% between 36 to 45 years old, 8.8% between 46 to 55 years old, and 4.4% over 55 years old. Approximately 53.4% of the sample is finance-related occupations. Of the sample 46.4% are lower annual income (under US$16,000), 43.0% are middle annual income (between US$16,000 to US$29,000), and 10.6% are higher annual income (over US$900,000). The absolute values of skewness and kurtosis for each latent variables are lower than 3 and 10, respectively. It means that all of these measurements could be regarded as approximate normal distribution (Kline, 1998) and the Maximum Likelihood method is suitable to be used to estimate the parameters in the model.

Figures 1 and 2 show the estimations of parameters for these two models, respectively. In the Model 1 depicted in Figure 1, the measures of the model is represented by the latent variables, which is indicated in ovals (e.g., demand identification, and disposition effect); in addition, the observed items associated with the questionnaire are used for evaluating the latent variables by the rectangles consecutively labeled X_1, X_2, ..., Y_1, Y_2. The measure-ment accuracy for each latent variable can be evaluated by the factor loadings and error variances for the observed

Table 2. Descriptive statistics for items on the questionnaire.

Item	Mean	SD	Percentage (%)	Skewness	Kurtosis
Demand identification	4.26	0.99		0.13	-0.48
Searching information	4.49	0.90		-0.34	-0.33
Evaluating alternatives	4.80	0.96		-0.63	0.38
Disposition effect	2.98	1.22		0.25	-0.39
Herding	3.37	0.93		0.21	0.27
Overconfidence	3.85	0.84		0.34	0.26
Gender					
Male			61.86		
Female			38.14		
Age					
<25			9.9		
25-35			50.2		
36-45			26.7		
46-55			8.8		
>55			4.4		
Occupation					
Finance-related			53.4		
Others			46.6		
Annual income (thousand NT$)					
<500			46.4		
500-900			43.0		
>900			10.6		

observed items in this model. For instance, there is an error variance of 0.62 on item X_1 for demand identi-fication. This finding implies that 38% of the variance is explained by the latent variable, demand identification, whereas the remaining 62% variance is explained by other factors. Similarly, the explanations of the other items may be drawn from an analogy. For testing the validity of the hypothetical model, most fit indices refer to the ability of hypothetical theory model to closely corres-pond to the actual data (GFI=.93, CFI=.96, NNFI=.94, RMSEA=.058, 90% CI for RMSEA=.049 − .066, p-value for a test of close fit=.069 > .05)) with the exception of the χ^2 statistic (χ^2 (121)= 292.75, p<0.00). However, by the index of normed chi-square (χ^2/df = 2.4 < 3), CN=234.07 > 200, and PNFI=.75 > .5, Model 1 can still be regarded as a reliable model.

According to Figure 1, all factor loadings, that is lambda coefficients, for the observed variables are greater 0.4 that is considered meaningful. However, the structural component is represented by the path between latent va-riables. Additionally, all of the relationships between the stages of rational decision making and behavioral biases are not statistically significant. According to estimates of

the structure parameters (that is the standardized path coefficients γ_{ij}= 0.57, p<0.05; β_{ij}= 0.82, p<0.05), if the de-mand identification increases by one standard deviation, the searching information increases by a standard deviation of .57. Additionally, if the searching information increases by one standard deviation, the evaluating alternatives increase by a standard deviation of .82. This finding implies that demand identification of an investor significantly influences the second decision-making stage, searching information, and influences indirectly the final stage of evaluating alternatives. Thus, this finding implies that decision making among investors is asso-ciated rationality. Moreover, considering the relation-ship between the stages of decision-making process and the behavioral biases, analysis results indicate that both the stages of demand identification and evaluating alterna-tives can accurately predict the degree of overconfidence γ_{ij} = 0.60, p<0.05; β_{ij}=0.35, p<0.05). Evaluating the alternatives negatively impacts the disposition effect (β_{ij}=-0.42, p<0.05). According to the *post hoc* modification index of SEM, overconfidence demonstrates a signifi-cantly negative impact on disposition effect (β_{ij}=-0.42, p<0.05). However, the stages of a decision-making
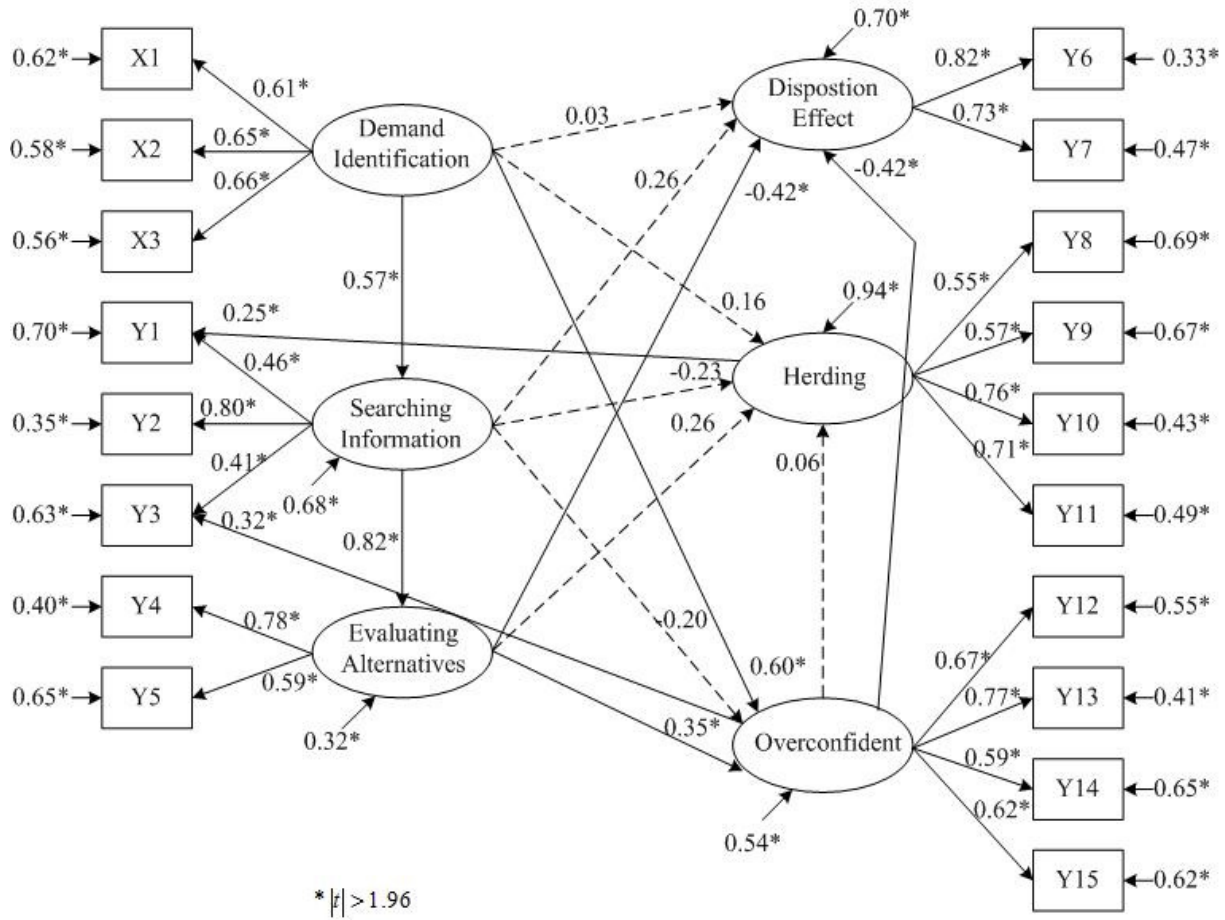
Figure 1. The relationship of rational decision-making process and behavioral biases.

process and herding behavior are not significantly related to each other.

Figure 2 presents the hypothesized Model 2 for predicting the behavioral biases. Similar to Model 1, all goodness-of-it indices indicate that Model 2 have a good model fit on data except for the χ^2 value (χ^2 (62) = 117.49, p<0.00). However, when we use the normed chi-square index ((χ^2/df = 1.90 <3) and involve other fit indices (that is GFI=.96, CFI=.96, NNFI=.94, RMSEA=.046, 90% CI for RMSEA=.033 − .058, p-value for test of close fit =.07 >.05, CN=321.83 > 200, and PNFI=.63 > .5), Model 2 is also regarded as an acceptable model. From the estimation value of path coefficients, gender appears to play the most important role in explaining the difference of behavioral biases. Analysis results indicate that female investors appear to have a stronger disposition effect and herding behavior than those of males. In contrast, male investors have greater overconfidence than females. Additionally, age has a significantly negative impact on herding, implying that younger investors tend to exhibit more herding behavior in investment. However, all behavioral biases do not statistically differ in terms of occupation category and annual income.

CONCLUSION

Despite numerous attentions paid to behavioral biases and decision-making behaviors, few studies have integrated these two distinct dimensions simultaneously. In contrast from previous research, by using the primary data, this study uniquely explores how rational decision making and behavioral biases are related. The main findings and implications of this study are summarized in the following two parts.

The relationship between rational decision-making process and behavioral biases

The evidence from the first hypothesized model allows us to verify the statistical significant relation between each stage of the rational decision-making process. This finding implies that individual investors follow the rational decision-making process to select financial products. Namely, before investing in financial products, individual investors initially identify their investment demand, such as recognizing that investing in financial products may retain or increase their value, even able to achieve their
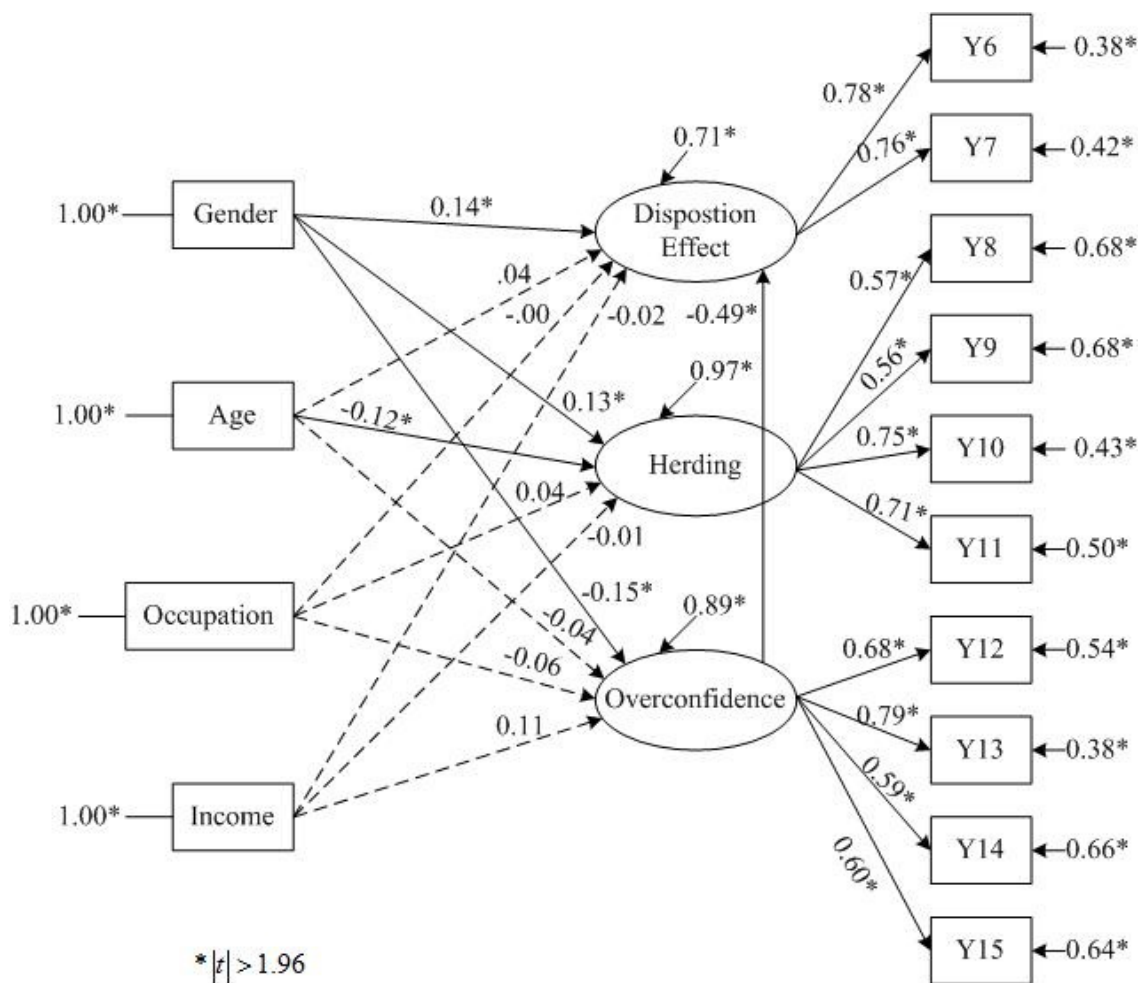
Figure 2. The effects of demographic variables on behavioral biases.

financial goals and, then, start searching for external (e.g., the recommendation of kith and kin) and internal information (e.g., previous investment experience) and, finally, evaluating the alternatives or establishing the critical criteria for investment.

In the three stages of rational decision making, both stages of demand identification and evaluating alternatives significantly and positively contribute to overconfidence. This finding may be owing to that once investors have identified investment motivation and demand, they may form an attitude towards risk and regard risk-taking as inevitable. Most investors self-righteously understand how return and risk are related, subsequently strengthening, the investor's belief and leading to overconfidence. However, after demand identification, investors may continue to search for information and evaluate alternatives based on their limited recognition or previously successful investment experience owing to bounded rationality. Therefore, a more comprehensive evaluation of alternatives also directly strengthens the investor's faith, further facilitating investor's tendency of overconfidence.

Furthermore, only the stage of evaluating alternatives directly and simultaneously contributes to both overconfidence and disposition effect. Meanwhile, evaluating alternatives negatively affects indirectly the disposition effect through a positively influence on overconfidence. The fact that disposition effect is a *post hoc* investment behavioral bias suggests that if overconfident investors may convince themselves and insist on previous evaluation and judgment on investment decisions. Furthermore, since the overconfident investors overestimates their private information (Daniel et al., 1998) or attribute investing gains to their competence and further leads to more aggressive trade based on their investment experiences (Gervais and Odean, 2001), their attitude towards risk is consistent, regardless of whether their assets are in value or in lose. Therefore, a higher overconfidence implies a lower disposition effect. In other words, a situation in which the investors evaluate investment alternatives more comprehensively implies a decline in the disposition bias. Similarly, a situation in which the

investor's overconfidence arises from stronger self-confident evaluation weakens the investor's disposition effect. Additionally, all three stages are not significantly related to herding behavior. This finding suggests that herding behavior seems independent of personal decision-making process but relevant to market environment and atmosphere. Thus, further research is worthy to identify how the other exogenous factors beyond the stages of rational decision-making process or other behavioral biases could influence the formation of herding behavior.

In summing up the above evidence from the first model, we confer with a similar argument of Simon (1982, 1991), who suggested that the existence of psychological anticipation tendency is the foundation of bounded rational behavior. Although allocating and selecting financial assets are of priority concern in financial activity, such activity frequently accompanies the psychological tendency that generates psychological factors in the decision-making process, ultimately leading to an irrational and uncertain financial decision.

The influence of demographic variables on investors' behavioral biases

In the second hypothesized model, our evidence strongly supports the relationship between behavioral biases and investor's personal characteristics. Gender largely explains the difference in behavioral biases. As for the disposition effect, females display a greater disposition effect than males do. Such a result contradicts the findings of Da Costa et al. (2008). As for overconfidence, our results are consistent with previous studies (Barber and Odean, 2000b, 2001; Bhandari and Deaves, 2006; Kuo et al., 2005). As for herding, our results indicate that female investors tend to blindly follow other investors doing the same investment decisions than their male counterparts do. Such a finding resembles Eagle and Carli (1981). Particularly, the result further demonstrates that younger investors are more prone to herding than older ones. However, there is no significant evidence in investor's category of occupation and level of annual income.

In conclusion, this paper constructs two proper structural models and uses primary survey data to reveal investors' behaviors between rational decision making process and behavioral biases. Despite the many complex antecedents that may incur behavioral biases that this study did not examine, empirical evidence of this study significantly contributes to efforts to link the rational decision process with irrational behaviors of investors. This study also verifies that the individual investors may simultaneously possess complex rational and irrational thinking logics in their investment behavior. We recommend that future studies add various psychological variables and collect more valid respondents for various investors' structure to more thoroughly explore the antecedents of behavioral biases, or survey data in

different research periods to confirm the validity of the hypothetical model.

REFERENCES

Acker D, Duck NW (2008). Cross-cultural overconfidence and biased self-attribution. J. Soc. Econ. 37: 1815-1824.
Bagozzi RP, Yi Y (1988). On the evaluation of structural equation models. J. Acad. Mark. Sci. 16: 74-94.
Bamber LS (1987). Unexpected earnings, firm size, and trading volume around quarterly earnings announcements. Account. Rev., 62: 510-532.
Banz RW (1981). The relationship between return and market value of common stocks. J. Financ. Econ., 99: 3-18.
Barber BM, Lee YT, Liu Y J, Odean T (2007). Is the aggregate investor reluctant to realise Losses? Evidence from Taiwan. Eur. Financ. Manage., 13(3): 423-447.
Barber BM, Odean T (2000a). Too many cooks spoil the profits: Investment club performance. Financ. Anal. J., 56(1): 17-25.
Barber BM, Odean T (2000b). Trading is hazardous to your wealth: The common stock investment performance of individual investors. J. Financ., 55(2): 773-806.
Barber BM, Odean T (2001). Boys will be boys: Gender, overconfidence, and common stock investment. Q. J. Econ., 116(1): 261-292.
Barber BM, Odean T (2002). Online investors: Do the slow die first. Rev. Financ. Stud., 15(2): 455-487.
Bazerman MH (2002). Judgment in Managerial Decision Making (5th ed.). New York: John wiley and Sons.
Benartzi S, Thaler RH (1995). Myopic loss aversion and the equity premium puzzle. Q. J. Econ., 110(1): 73-92.
Bengtsson C, Persson M, Willenhag P (2005). Gender and overconfidence. Econ. Lett., 86: 199-203.
Bhandari G, Deaves R (2006). The demographics of overconfidence. J. Behav. Financ., 7(1): 5-11.
Bremer M, Kato K (1996). Trading volume for winners and losers on the Tokyo stock exchange. J. Financ. Quant. Anal., 31(1): 127-143.
Browne MW, Mels G (1990). RAMONA User's Guide, Columbus: Department of Psychology, Ohio State University.
Byrne BM (2001). Structural Equation Modeling with AMOS - Basic Concepts, Applications, and Programming. Mahwah, New Jersey: Lawrence Erlbaum Associates.
Christie WG, Huang RD (1995). Following the pied piper: do individual returns herd around the market? Financ. Anal. J., 51(4): 31-37.
Cross F (1973). The behavior of stock prices on Fridays and Mondays. Financ. Anal. J., 29(6): 67-69.
Da Costa N, Mineto C, Da Silva S (2008). Disposition effect and gender. Appl. Econ. Lett., 15(6): 411-416.
Daft RL (2003). Organization Theory and Design (8th ed.). Cincinnati: South-Western.
Daniel K, Hirshleifer D, Subahmanyam A (1998). Investor psychology and security market under- and overreactions. J. Financ., 53(6): 1839-1886.
Demirer R, Kutan AM (2006). Does herding behavior exist in Chinese stock markets? J. Int. Financ. Mark. Inst. Money. 16(2): 123-142.
Devenow A, Welch I (1996). Rational herding in financial economics. Eur. Econ. Rev., 40(3-5): 603-615.
Dhar R, Zhu N (2006). Up close and personal: Investor sophistication and the disposition effect. Manage. Sci., 52(5): 726-740.
Eagly AH, Carli LL (1981). Sex of researchers and sex-typed communications as determinants of sex differences in influenceability: A meta-analysis of social influence studies. Psychol. Bull., 90(1): 1-20.
Eisenhardt KM, Zbaracki MJ (1992). Strategic decision making. Strat. Manage. J., 13(0): 17–37.
Engel JF, Kollat DT, Blackwell RD (1968). Consumer behavior. New York Holt: Rinehart and Winston, Inc.
Engel JF, Miniard PW, Blackwell RT (2001). Consumer Behavior (9th ed.). New York: The Dryden Press.
Fama EF (1965). The behavior of stock market prices. J. Bus., 38: 34-105.

French K (1980). Stock returns and the weekend effect. J. Financ. Econ., 8(1): 55-69.

Gervais S, Odean T (2001). Learning to be overconfident. Rev. Financ. Stud.,14: 1-27.

Gianakis GA (2004) Decision Making and Managerial Capacity in the Public Sector. In: Holzer, M., Lee, Public Productivity Handbook, New York, Marvel Dekker Inc, P.43.

Gibbons M, Hess P (1981). Day of the week effects and asset returns. J. Bus., 54(4): 579-596.

Goetzmann WN, Peles N (1997). Cognitive dissonance and mutual fund investors. J. Financ. Res., 20(2): 145-158.

Goetzmann WN, Massa M (2002). Daily momentum and contrarian behavior of index fund investors. J. Financ. Quant. Anal., 37(3): 375-389.

Griffin D, Tversky A (1992). The weighing of evidence and the determinants of confidence. Cognit. Psychol., 24(3): 411-435.

Grinblatt M, Keloharju M (2000). The investment behavior and performance of various investor types: A study of Finland's unique data set. J. Financ. Econ., 55: 43-67.

Grinblatt M, Titman S (1994). A study of monthly mutual fund returns and performance evaluation techniques. J. Financ. Quant. Anal., 29(3): 419-444.

Griselli EE, Campbell, JP, Zedeck S (1981). Measurement Theory for the Behavioral Sciences. San Francisco: W. H. Freeman.

Hammond JS, Keeney RL, Raiffa H (2002). Smart Choices: A Practical Guide to Making Better Life Decisions. Boston Mass: Harvard Business School Press.

Hayduk L A (1987). Structural Equation Modeling with LISREL: Essentials and Advances. Baltimore, MD: John Hopkins University Press.

Hoelter JW (1983). The analysis of covariance structures: Goodness-of-fit indices. Sociol. Meth. Res., 11(3): 325-344.

Howard JA (1989). Consumer Behavior in Marketing Strategy. New Jersey: Prentice-Hall.

Huang CL, Goo YJ (2008). Are happy investors likely to be overconfident? Emerg. Mark. Financ. Trade., 44(4): 33-39.

Iihara Y, Kato HK, Tokunaga T (2003). Investors herding on the Tokyo stock exchange. Int. Rev. Financ., 2: 71-98.

Jöreskog KC, Sörbom D (1993). LISREL VIII: Reference guide. Scientific Software International Inc., Chicago.

Kahneman D, Tversky A (1979). Prospect theory: An analysis of decision under risk. Econometrica. 47(2): 263-291.

Keeney H (1998). Smart Choice. Harvard Business School Press.

Kline RB (1998). Principles and Practice of Structuarl Equation Modeling. New York: Guilford Press.

Kotler P (1998). Marketing management: Analysis, planning, implementation, and control (9th ed.). New Jersey: Prentice- Hall.

Kuo MH, Kuo NF, Chiu YC, Fan PH (2005). Gender and investment behavior: On Taiwanese individual investors. J. Financ. Stud., 13(2): 1-28.

Lindblom CE (2005). The science of muddling through, In: Richard, J., Stillman, II, Public Administration: Concepts and Cases, Boston, Houghton Mifflin Co.

Locke PR, Mann SC (2005). Professional trader discipline and trade disposition. J. Financ. Econ., 76: 401-444.

Luo H, Lu L (2007). Holding periods, illiquidity and disposition effect in the Chinese stock markets. Appl. Financ. Econ., 17: 1265–1274.

March JG, Simon HA (1958). Organizations. New York: Wiley.

McMahon M (2007). Career Coach: Decision Making. Pulse: United Kingdom.

Menkhoff L, Schmidt U, Brozynski T (2006). The impact of experience on risk taking, overconfidence, and herding of fund managers: Complementary survey evidence. Eur. Econ. Rev., 50: 1753-1766.

Mintzberg H, Raisinghani O, Theoret A (1976). The structure of unstructured decision processes. Adm.. Sci. Q., 21: 246-275.

Odean T (1998). Are investors reluctant to realize their losses? J. Financ., 53(5): 1775-1798.

Odean T (1999). Do investors trade too much? Am. Econ. Rev., 89: 1279-1298.

Osland JS, Kolb DA, Rubin IM, Turner ME (2006). Organizational Behavior: An Experiential Approach (8th ed.). New Jersey: Prentice- Hall.

Podsakoff PM, Organ DW (1986). Self-reports in organizational research: Problems and prospects. J. Manage., 12(4): 531-544.

Robbins SP (2002). Management. New Jersey: Pearson Prentice-Hall.

Robbins SP, Judge TA (2007). Organization Behavior (12th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Scharfstein DS, Stein JC (1990). Herd behavior and investment. Am. Econ. Rev. 80(3): 465-479.

Schumacker RE, Lomax RG (1996). A Beginner's Guide to Structural Equation Modeling. Mahwah, NJ: Lawrence Erlbaum Associates.

Shafir E, LeBoeuf RA (2002). Rationality. Annu. Rev. Psychol. 53(1): 491–517.

Shapira Z, Venezia I (2001). Patterns of behavior of professionally managed and independent investors. J. Bank. Financ., 25: 1573-1587.

Shefrin H, Statman M (1985). The disposition to sell winners too early and ride losers too long: Theory and evidence. J. Financ., 40(3): 777-790.

Shefrin H, Statman M (1994). Behavioral capital asset pricing theory. J. Financ. Quant. Anal., 29(3): 323-349.

Sherif M (1966). The psychology of social norms. New York: Harper and Brothers.

Shu PG, Yeh YH, Chiu SB, Chen HC (2005). Are Taiwanese individual investors reluctant to realize their losses? Pac. Basin Financ. J., 13(2): 201-223.

Sias WR (2004). Institutional herding. Rev. Financ. Stud., 17(1): 165-206.

Simon HA (1957). A behavioral model of rational choice, in models of man, social and rational: Mathematical essays on rational human behavior in a social setting. New York: Wiley.

Simon HA (1982). Models of Bounded Rationality. 1(2): The MIT Press.

Simon HA (1991). Bounded Rational and Organizational Learning. Organ. Sci., 2(1): 125-134.

Statman M, Thorley S, Vorkink K (2006). Investor overconfidence and trading volume. Rev. Financ. Stud. 19(4): 1531-1565.

Tan L, Chiang TC, Mason JR, Nelling E (2008). Herding behavior in Chinese stock markets: An examination of A and B shares. Pac. Basin Financ., J. 16: 61-77.

Thaler R (2000). From homo economics to homo sapiens. J. Econ. Perspect., 14(1): 133-141.Tourani-Rad A, Kirkby S (2005). Investigation of investors' overconfidence, familiarity and socialization. Account Financ., 45: 283-300.

Tversky A, Kahneman D (1974). Judgment under uncertainty: Heuristics and biases. Sci., 185: 1124-1131.

Weber M, Camerer C (1998). The disposition effect in securities trading: An experimental analysis. J. Econ. Behav. Organ., 33(2): 167-184.

Wong AS, Carducci BJ, White AJ (2006). Asset disposition effect: The impact of price pattern and selected personal characteristics. J. Asset. Manage., 7: 291-300.

Yavas U (1998). The base of power in international channels. Int. Market. Rev., 15(2): 140-150.