Asian Economic and Financial Review
ISSN(e): 2222-6737
ISSN(p): 2305-2147
DOI: 10.55493/5002.v15i6.5459
Vol. 15, No. 6, 979-995.

URL: www.aessweb.com

The impact of emotional and cognitive biases on the investment decisions of Saudi investors: A multigroup analysis approach

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Article History
Received: 18 January 2025
Revised: 3 June 2025
Accepted: 13 June 2025
Published: 8 July 2025

Keywords
Cognitive biases
Emotional biases
Loss aversion
Mental accounting
Regret aversion
Self-control.

JEL Classification:
G0; G11; G40; G41.

ABSTRACT

There is a limited understanding of the impact of emotional and cognitive biases on investment decisions among Saudi investors. This study aimed to investigate the impact of prospect biases on investors' decisions, considering specific characteristics such as gender differences, education levels, investment experience, investment size, and trading frequency. Online questionnaires were distributed to Saudi investors to explore their perceptions of various prospect biases and their investment decisions. The sample included 598 valid responses for data analysis. A partial least squares-structural equation modeling analysis was conducted using SMART PLS. The results indicate that prospect bias significantly influences investment decisions. However, no significant differences were observed based on gender, investment size, or trading frequency. The findings also show a positively significant impact of prospect bias on investors' decisions based on their education and experience, aligning with the objectives of the Financial Sector Development Program under Saudi Vision 2030. Prospect biases are prevalent among Saudi investors with limited education and experience. Understanding these biases can improve financial decision-making, leading to better outcomes for individual investors. Policies should focus on enhancing financial education, promoting best trading practices, and establishing mentorship programs to foster rational investment behavior among investors.

Contribution/ Originality: This study uniquely uses multi-group analysis to quantify how prospect biases affect Saudi investors, focusing on gender, education, experience, and investment size. Unlike previous descriptive studies, this research provides a clear quantitative measure of these biases' impact on investor rationality in the Saudi market.

1. INTRODUCTION

The current research is based on comprehensive analyses provided by Al Rahahleh (2024) and Al Rahahleh (2025) regarding the existence and implications of several behavioural heuristics and prospect biases among investors in the Saudi Exchange (Tadawul). The analysis of Al Rahahleh's research is based on a set of cognitive biases, such as overconfidence, anchoring, availability, representativeness, and the gambler's fallacy, in addition to prospect biases, such as self-control, loss aversion, regret aversion, and mental accounting. Behavioural biases have been widely studied in the financial market and play a key role in investor behaviour (Chowdhury, Mahdzan, & Rahman, 2024; Khan, Mehmood, Khan, & Tangl, 2024; Mahmood, Arshad, Khan, Afzal, & Bashir, 2024; Mohanty, Patnaik, Satpathy, & Sahoo, 2023). Asri and Messaoudi (2024) argued that psychological factors account for various investment biases in decision-making in emerging markets.

Making financial decisions about where and how to invest is a convoluted process determined by emotional, behavioral, and heuristic biases (Ahmed, Rasool, Saleem, Khan, & Kanwal, 2022; Bhatia, Chandani, & Chhateja, 2020). Ullah, Elahi, Ullah, Pinglu, and Subhani (2020) and Dhakal and Lamsal (2023) argued that cognitive biases' primary roles influence investors' decisions in the stock exchange market. Investors' actions are not always rational, particularly when making financial decisions. Irrational behavior resulting from false judgment and misperception affects individuals' investing abilities. According to Ahmed et al. (2022), people who invest in stocks with high profitability and liquidity tend to be psychologically biased in their financial decisions, resulting in unfair judgments that ultimately influence their investment choices. The disposition effect is observed in stock markets, where investors sell winners quickly while holding onto losers for a longer period. These biases negatively impact the decision-making processes of investors and their partners in the stock markets (Al Rahahleh, 2024, 2025).

The Saudi Exchange is the central market in the Gulf Cooperation Council (GCC). It is the third-largest stock market among its emerging market peers, and more than 150 companies are listed on the Saudi Exchange (Saudi Exchange, 2025). Matoussi and Mostafa (2019) suggested certain characteristics of Saudi investors that influence their decisions. In another study focusing on Saudi Arabia's stock market, Alhussain (2020) established that although other factors impacted decision-making, behavioural biases influenced market investors. Alsabban and Alarfaj (2020) also analysed behavioural finance in Saudi Arabia's stock market. They found that overconfidence biases were the primary factors influencing investors' decisions and that the level of overconfidence in Saudi Arabia is lower than in other developing countries. Contrary to these findings, Mahmood et al. (2024) established that risk aversion, disposition, and representative bias do not affect the selection of investment securities.

Despite the existing body of research on behavioural finance (Al Rahahleh, 2024, 2025; Alhussain, 2020; Alsabban & Alarfaj, 2020; Matoussi & Mostafa, 2019) there is a limited understanding of the effect of emotional and cognitive biases on stock market investment decisions in the Saudi Arabian context. Investors' emotional and psychological behaviour influences their decisions (Kumar & Chaurasia, 2024). Saudi Arabia is characterized by various social structures, economic conditions, and cultural norms, such as gender, education level, investment experience, investment size, and trading frequency, which influence investor psychology in investing compared to international markets (Alsabban & Alarfaj, 2020; Mansi & Khzindar, 2014). Therefore, one of the leading programs of Saudi Vision 2030 is the Financial Literacy Entity (FLE) under the Financial Sector Development Program (FSDP), which aims to improve the level of financial knowledge and skills among Saudi citizens, who play essential roles in the financial market. This initiative, along with other government-hosted programs, aims to promote prosperity and economic growth (Al Rahahleh, 2022). According to the Saudi Central Bank report published in 2023, the percentage of adults with a basic understanding of financial concepts has increased from 30% to 38% since 2021 (Al Rumaih & Al Hazzani, 2024). Improving financial literacy helps individuals manage their finances effectively, enhance their savings, shape their investment goals, and avoid financial scams (Mian, 2014).

This study aims to enhance the understanding of the impact of prospect biases on investors concerning specific characteristics by applying multigroup analysis (MGA), such as gender differences, education levels, investment experience, investment size, and trading frequency. The study extends recent research focused on investors in Saudi Arabia (Al Rahahleh, 2024, 2025) through a broad comparative analysis to quantify the effects of prospect biases on Saudi investors with specific characteristics and lays a foundation for considering targeted actions to counteract that influence.

The remainder of the paper is structured as follows: The next section includes the theoretical framework and development of hypotheses, and Section 3 covers the methodology. In Section 4, we introduce the data and discuss the empirical results, and Section 5 contains the conclusions.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1. Theoretical Framework

The current research theory is based on the prospect theory developed by Kahneman and Tversky (1979). The theory is an extension of the expected utility theory, which considers human behavior in investment decision-making. In prospect theory, investors are not always rational when making decisions. Furthermore, the expected utility theory assumes that investors are risk-averse, whereas prospect theory presents the concept of loss aversion. As explained by Kahneman and Tversky (1984), risk-averse investors are more likely to avoid losses rather than achieve gains. Investors often evaluate outcomes using subjective indicators, such as market value, purchase price, and the 52-week high (Della Vedova, Grant, & Westerholm, 2023). Moreover, considering loss aversion, investors exhibit risk-seeking behavior when facing losses and risk-averse behavior when facing gains, which are attributed to powerful psychological effects experienced by the investor (Bhanu, 2023). According to portfolio theory, investors would choose a less risky investment when presented with multiple opportunities (Mahmood et al., 2024).

2.2. Hypothesis Development

Prospect theory introduces psychological factors that affect individuals' investment decision-making, such as loss aversion, regret aversion, overconfidence, and mental accounting (Waweru, Munyoki, & Uliana, 2008). Loss-aversion bias induces investors to make irrational decisions due to the fear of potential losses (Hasan & Mustafa, 2023). As a result, investors may avoid investing in portfolios that could be profitable to shield themselves from failure or loss. Ermulyawati, Hariyanto, and Safitri (2023) found a positively significant impact of loss aversion on investment decisions.

The concept of regret-avoidance bias is that investors are more likely to avoid decisions that might lead to painful regret (Aigbovo & Ilaboya, 2019). Addinpujoartanto and Darmawan (2020) found that regret aversion significantly and positively affects investment decisions. On the other hand, Hidayah and Irowati (2021) found inconsistent results and showed that regret aversion has an insignificant effect on investment decisions.

Previous studies on the influence of self-control on decision-making have shown various effects of self-control (Gathergood, 2012; Lucks, 2016). Self-control involves basic behavioral economics that link intertemporal decisions to affect the current situation and future consequences, such as determining savings and investments (Suwono, Giovanni, & Verawati, 2023).

Lastly, mental accounting is one of the psychological biases that can impact an investor's decision-making process. Silva, de Lacerda Moreira, and Bortolon (2023) examined the positive correlation between mental accounting and investment decisions. Mental accounting is a process that deviates from conventional methods and causes investors to be irrational in their investments. Based on the above discussion, we have established the following hypothesis.

H_1: Prospect biases have a significant influence on determining investment decisions.

2.2.1. Demographic Factors Affecting Prospect Biases and Investment Decisions

There is a correlation between an individual's behavioral biases and underlying demographic characteristics, including gender, experience, and educational background in investment decisions (Metawa, Hassan, Metawa, & Safa, 2019). This study emphasizes linking prospect biases with investment decisions and highlights the investors' demographic factors that might affect this relationship.

2.2.2. Gender Differences

Males and females make different decisions related to financial investment in the stock market; these can involve, for example, disposition effects, which are more prevalent in male investors than in their female counterparts (Abideen, Ahmed, Qiu, & Zhao, 2023). Moreover, Mahmood et al. (2024) argued that male investors are more

overconfident compared to their female counterparts, whereas female investors exhibit more herding bias than male investors. Herding bias causes investors to replicate the actions of others and, as a result, reduces the regret associated with their incorrect decisions. Graham, Stendardi Jr, Myers, and Graham (2002) argued that risk-taking capabilities and levels of confidence in men are higher than in women. Pompian and Longo (2004) found that females are more pessimistic and realistic and seek risk-free investments, whereas males are more unrealistic and risk tolerant. Lin (2011) investigated how behavioral biases and investment decisions can have diverse effects on demographic factors such as gender and revealed that the disposition effect is more common in females than in males. Similarly, Kumar and Goyal (2016) found statistical significance among behavioural biases and gender differences, stating that the herding effect is more prevalent in males than in females.

Li (2021) concluded that males demonstrated greater intelligence than females. Therefore, they tend to be more exposed to mental accounting biases, which lead to irrational decisions. However, Yuliawati, Sari, and Siska (2020) established no significant differences between male and female investors. The findings differed because the male and female participants were novice investors with limited knowledge, experience, and investment. Based on the above discussion, we hypothesize the following.

H_2: Prospect biases are more significant in determining the investment decisions made by male rather than female investors.

2.2.3. Education

Financial literacy means understanding financial concepts and having the ability to make well-informed decisions about using and managing money based on acquired skills. It also involves the knowledge required to access the stock market before deciding on an investment portfolio and aligning with Saudi Vision 2030 goals (Mahmood et al., 2024). Financial literacy is essential in moderating the connection between investment decision-making and behavioural biases. Baker, Kumar, Goyal, and Gaur (2019) and Ramalho and Forte (2019) supported the observation that financial knowledge was necessary to improve investors' literacy levels and help them overcome behavioural biases. Similarly, Khan et al. (2024), Silva, Braz, Amancio, and Tabak (2022), and Kasoga (2021) found that financial literacy reduced heuristics and cognitive biases, significantly influencing investors' behaviour in stock markets. Therefore, a connection exists between investment decisions and financial literacy. Financial-related education is more likely to increase a person's literacy level, influencing decision-making (Nadeem et al., 2020). Therefore, financial education among investors increases their likelihood of participating in the stock market and influences investment decisions among individuals (Baihaqqy, Disman, Nugraha, & Maya, 2020; Rahmawati, Nurhalis, Fairuzzabadi, & Evayani, 2023).

In addition, investor education on financial literacy in the stock market and training are essential factors influencing decision-making (Mahmood & Ahmad, 2020). Investors with high education levels (post-graduate) reported increased tolerance levels of financial risk because they understood how the stock market operated and the potential factors influencing its operations (Chong & Martínez, 2021; Koekemoer, 2019). There is a positive relationship between educational level and investment in the Saudi stock market (Alhussain, 2020).

In contrast, there is evidence of an insignificant impact of education level on behavioural biases (Gonzalez-Igual, Corzo Santamaria, & Rua Vieites, 2021). Based on the above discussion, we built the following hypothesis.

H_3: Prospect biases are more significant in determining the investment decisions made by less-educated investors than by well-educated investors.

2.2.4. Investment Experience

Investment experience acts as a cushion against investment decisions, allowing investors to utilize their history in the stock market. Stock market investment choices and behavioral biases among individuals are influenced by their past experiences. A lack of experience in the stock market affects investors' confidence levels, leading to self-attribution bias that hampers their abilities in the stock market (Li, Wu, Hong, & Tian, 2023; Rahmawati et al., 2023).

Therefore, accumulating investment experience and possessing financial literacy are necessary attributes that can improve investors' performance.

Huang (2019) found that experience influenced investors' financial decisions when investing in risky stock markets. Mushinada and Veluri (2019) discovered that behavioural bias impacted investors' investment choices, and education levels and investment experiences influenced them. Higher investment experience resulted in better financial knowledge that helped the decision-making process, and individuals with limited financial literacy and experience are less inclined to invest in risky stock markets (Arifin & Widjaya, 2020).

However, Jiang, Shrider, Ting, and Wu (2021) mentioned that experience reduced loss aversion among investors. They concluded that the prevalence of a loss-aversion attitude was less common in sophisticated investors, whereas experienced investors were more inclined towards loss-averse behaviour. Feng and Seasholes (2005) concluded that risk aversion was less prevalent in sophisticated investors because experience drives risk-free investment. Therefore, we hypothesise as follows.

H_4: Prospect biases are more significant in determining investment decisions made by inexperienced rather than highly experienced investors.

2.2.5. Investment Size

Ullah et al. (2020) analysed the behaviour of small investors and found that behavioural biases significantly and positively influenced their investment decisions. Chaffai and Medhioub (2014) argued that the investment decisions of small investors relied on their psychological prejudice and market effectiveness. Thus, they concluded that small investors are more sensitive to risk-averse behavior. In addition, mental accounting is more prevalent among small investors because managing information is complicated. Therefore, small investors experience more problems making rational decisions than large ones (Athur, 2014).

H_5: Prospect biases are more significant in determining the investment decisions made by investors with a small investment size than by investors with a large investment size.

2.2.6. Trading Frequency

Previous studies have revealed that investors with behavioral biases trade aggressively, causing an anticipated increase in trading volume and frequency (Deaves, Luders, & Luo, 2003; Gervais & Odean, 2001; Grinblatt & Keloharju, 2009; Scheinkman & Xiong, 2003).

Kourtidis, Šević, and Chatzoglou (2011) examined the impact of different behavioral characteristics on investment attributes and trading performance among investors. They concluded that high scores on behavioral biases, such as risk tolerance, were related to increased trading frequency and volume.

Keller and Siegrist (2006) found a significant positive association between risk tolerance and frequent trading behaviour. Furthermore, several existing studies have provided evidence that investors with low risk tolerance are less frequently engaged in trading activities than more risk-tolerant investors (Clark-Murphy & Soutar, 2004; Durand, Newby, & Sanghani, 2008; Tigges, Riegert, Jonitz, Brengelmann, & Engel, 2000). Thus, the sixth hypothesis is as follows.

H_6: Prospect biases are more significant in determining the investment decisions made by investors who trade frequently rather than those who trade infrequently.

3. RESEARCH METHODOLOGY

3.1. Study Design

This study adopts a quantitative approach, as it is considered the most suitable, especially since the aim of the study is to explore the predictors of investment decisions from the perspective of emotional and cognitive biases in the Saudi stock market. Furthermore, although a qualitative approach can provide more detailed results, it may be

challenging to guide for specific tunnel point of view in the context of this study. Therefore, the primary source of data was relied upon through a structured survey designed to provide the basis for analyzing the quantitative data for this study[1].

This study is exploratory in nature, focusing on the characteristics of investors and their emotional and cognitive biases. The exploratory approach helps uncover the phenomenon's characteristics and its underlying relationships, which this study aims to contribute to Bougie and Sekaran (2019). Additionally, it is one of the few studies conducted in Saudi Arabia using advanced analytical techniques with a comprehensive sample. While numerous studies exist in developed countries (Pompian, 2016), this study is among the rare ones in developing economies, particularly in the Middle East and North Africa, according to the researcher.

3.2. Targeted Population

This study targeted investors in the Kingdom of Saudi Arabia to provide results that accurately describe their characteristics. Although Saudi Arabia is part of the literature on developing economies in the Middle East, which are distinguished by their unique cultures, the country's financial status as one of the wealthiest economies necessitates differences in investor characteristics and their susceptibility to cognitive and emotional biases compared to findings derived from countries with low to moderate income levels in developing nations. This highlights the importance of studying this rich context, which aligns with Arab culture.

In general, the sample of investors in this study consists of individual investors, who account for 67% of the trading volume in the Saudi stock market, according to documentation by the Middle East Investor Relations Association (Al Rahahleh, 2025; Middle East Investor Relations Association (MEIRA), 2021). Therefore, this study targets all cities in Saudi Arabia, as these investors trade and invest at both the local and regional levels.

3.3. Sampling and Data Screening

The data collection phase involved distributing an online survey over a period of three months in 2022 to investors in the Saudi stock market. Significant efforts were made to obtain the largest possible sample, resulting in the collection of 626 questionnaires. However, since 28 questionnaires were deemed invalid, only 598 were included in the analysis.

The collected sample was considered sufficient based on previous studies examining similar topics. Additionally, from a statistical analysis perspective, the sample size was deemed appropriate for the analytical techniques used, based on the adequate ratio between the number of survey items and observations, which generally requires a minimum ratio of 1:10 to ensure proper analysis using the SEM approach (Costello & Osborne, 2005).

Data regulatory was evaluated based on the coefficients of the skewness and kurtosis values. As these values were within the ±2.2 range suggested by George (2011), no data regulatory issues were normally distributed. All the data were obtained from responses to the survey instrument; therefore, common method bias was examined as proposed by Podsakoff, MacKenzie, Lee, and Podsakoff (2003). The one-factor analysis indicates that the first factor accounts for only 28% of the variance (below the 50% standard), implying that the remaining factors explain 72%. This suggests that the questionnaire is free from the absence of controlling or dominant factors in the model.

3.4. Variables and Measures

A structured questionnaire was used to collect data from the targeted participants in this study. This questionnaire is considered the most reliable method for this study due to the large size of the target group. It is also a cost-effective means of gathering the sample. Additionally, the electronic approach enhanced accessibility to this

[1] See section 3.3 for more details.

diverse group of individual investors in Saudi Arabia. The questionnaire was developed based on a review of relevant literature; below are the references for each used scale.

- Self-control measured using five items from Pompian (2012) and Pompian (2016).
- Loss aversion measured using six items from Waweru et al. (2008).
- Regret aversion measured using five items from Waweru et al. (2008) and Le Luong and Thi Thu Ha (2011).
- Mental accounting measured using three items from Waweru et al. (2008).
- Investment decisions measured using five items from Al Rahahleh (2025); Rasheed, Rafique, Zahid, and Akhtar (2018) and Scott and Bruce (1995).

All the measures were based on a 5-point Likert-type scale anchored by strongly agree/disagree. Investment trading experts and academic professors verified the validity of the measures, and a language editor translated the survey from English to Arabic.

3.5. Analytical Methodology [Smart Partial Least Square]

The measurement and structural model were evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM) through SMART PLS. We selected this software package to test our theoretical framework because SMART PLS is based on a prediction perspective. In fact, PLS-SEM makes it possible to extend theoretical models that are based on established theories (Hair, Risher, Sarstedt, & Ringle, 2019). We applied IBM SPSS (version 27) to complete data screening and preliminary checks, and SMART PLS (version 4) to investigate the measurement and structural models.

In social and behavioral sciences, SEM has emerged as a psychometric method that has gained significant prominence. Its strength lies in its ability to estimate relationships while simultaneously accounting for measurement error (Schamberger, Schuberth, Henseler, & Dijkstra, 2020). In this study, Smart PLS was used, which is a variance-based form of SEM (Hwang & Takane, 2004). In path analysis, causal relationships are hypothesized as associations between variables that reflect theoretical propositions. The estimation of the structural model in PLS combines ordinary least squares regression and principal component analysis. This method includes restrictive assumptions that contribute to its flexibility when dealing with structural models (Jöreskog, 1970). This approach was applied in this study to estimate the influence of cognitive and emotional biases on the decisions of Saudi investors. At the same time, to analyze potential differences in path estimations across demographic subgroups, MGA was used, where certain demographic variables were considered moderating factors in the relationship. Through MGA, comparisons between groups are based on examining differences in variance between the two subgroups. The moderating effect can be determined if significant differences are found in the estimated path coefficients (Hernández-Perlines, 2016).

4. EMPIRICAL RESULTS

4.1. Demographic and Descriptive Statistics of the Sample

Table 1 presents the percentages and frequencies of the demographic makeup of the sample, along with details concerning the respondents' involvement in stock market trading. Various types of information related to the respondents' demographics and trading practices were collected. Regarding gender, the 598 respondents comprised 508 (84.9%) men and 90 (15.1%) women. In terms of age, most respondents were young to middle-aged: 142 (23.7%) were aged 18–25 years; 266 (44.5%) were 26–35 years; 137 (22.9%) were 36–45 years; 44 (7.4%) were 46–55 years; and 9 (1.5%) were older than 55 years.

The sample was diverse in terms of respondents' yearly income: 230 (38.5%) had an income below SAR 20,000; 102 (17.1%) had an income of SAR 20,000–99,999; 74 (12.4%) had an income of SAR 100,000–149,999; 51 (8.5%) had an income of SAR 150,000–199,999; 58 (9.7%) had an income of SAR 200,000–499,999; 8 (1.3%) had an income of SAR 500,000–999,999; 2 (0.3%) had an income of SAR 1,000,000–4,999,999; and 2 (0.3%) an income of more than SAR 5 million; and 71 (11.9%) preferred not to say. Regarding investment capital, 467 (78.1%) of the respondents had

an investment size of SAR 100,000 or below, while 74 (12.4%) had an investment size of SAR 101,000–300,000; 27 (4.5%) had an investment size of SAR 301,000–500,000; 15 (2.5%) had an investment size of SAR 501,000–700,000; 4 (0.7%) had an investment size of SAR 701,000–1,000,000; and 11 (1.8%) had an investment size of more than SAR 1 million.

The observation indicates that 78.1% of respondents had portfolio investments totaling less than SAR 100,000, and 98% had investments totaling less than SAR 1 million, suggesting that retail investors are more common, as defined by the Saudi Stock Exchange (Tadawul) (2023). This finding is consistent with the tendency whereby retail investors continue to represent 67% of the trading volume on the Saudi stock market, as reported by the Middle East Investor Relations Association (MEIRA) (2021).

The respondents varied in terms of the highest level of education they had attained: 177 (29.6%) held a diploma or below; 335 (56.0%) held a bachelor's degree; 85 (14.2%) held a postgraduate degree; and 1 (0.2%) held another certificate.

The sample was diverse in terms of respondents' experience trading on the stock market exchange: 332 (55.5%) respondents, more than half the sample, had been investing for < 1 year; 135 (22.6%) for 1–< 3 years; 57 (9.5%) for 3–< 5 years; 41 (6.9%) for 5–10 years; and 33 (5.5%) for > 10 years. The sample was also diverse regarding the frequency of trading on the stock market exchange: 107 (17.9%) traded daily, 98 (16.4%) weekly, 104 (17.4%) monthly, 67 (11.2%) quarterly, and 38 (6.4%) every 6 months.

Table 1. Demographics of participants in the Saudi exchange.

Characteristic	Subgroup	*n* (%)
Gender	Male	508 (84.9%)
	Female	90 (15.1%)
Age	18–25 years	142 (23.7%)
	26–35 years	266 (44.5%)
	36–45 years	137 (22.9%)
	46–55 years	44 (7.4%)
	More than 55 years	9 (1.5%)
Yearly income in Saudi Riyal	Less than or 19.999	230 (38.5%)
	20,000–99,999	102 (17.1%)
	100,000–149,999	74 (12.4%)
	150,000–199,999	51 (8.5%)
	200,000–499,999	58 (9.7%)
	500,000–99,999	8 (1.3%)
	1,000,000–4,999,999	2 (0.3%)
	More than 5 million	2 (0.3%)
	Prefer not to say	71 (11.9%)
Investment capital in Saudi Riyal	100,000 or below	467 (78.1%)
	101,000–300,000	74 (12.4%)
	301,000–500,000	27 (4.5%)
	501,000–700,000	15 (2.5%)
	701,000–1,000,000	4 (0.7%)
	More than 1 million	11 (1.8%)
Education level	Diploma or less	177 (29.6%)
	Bachelor	335 (56.0%)
	Postgraduate	85 (14.2%)
	Other	1 (0.2%)
Experience trading in stock market exchange	< 1 year	332 (55.5%)
	1–< 3 years	135 (22.6%)
	3–< 5 years	57 (9.5%)
	5–< 10 years	41 (6.9%)
	> 10 years	33 (5.5%)
Frequency of trading in stock market exchange	Daily	107 (17.9%)
	Weekly	98 (16.4%)
	Monthly	104 (17.4%)
	Quarterly	67 (11.2%)
	Every 6 months	38 (6.4%)
	Yearly	184 (30.8%)

4.2. Measures and Validation

4.2.1. Descriptive Analysis

In interpreting the average values, the scale applied was suggested by Bougie and Sekaran (2019), consistent with earlier relevant research (Al Rahahleh, 2022; Al Rahhaleh, Al-Khyal, Daghran Alahmari, & Al-Hanawi, 2023), which includes the following categorizations.

- Mean values ranging from 3.67 to 5.00 indicate a high level of agreement.
- Mean values ranging from 2.34 to 3.669 indicate a moderate level of agreement.
- Mean values ranging from 1 to 2.339 indicate a low level of agreement.

The results presented in Table 2 provide a descriptive analysis along with Pearson correlations and mean values. The average values range between 3.44 and 3.67, which is above the midpoint of the Likert scale. Therefore, the assessments favor the proposed factors, indicating that biases have a moderate influence on the respondents. Neither of the SD values is >1, indicating homogeneity in the assessments among the respondents.

Based on the Pearson correlations, we concluded that various indicators, prospect biases components, are free of high collinearity. In fact, neither of the correlations between the components is > 0.90 (Pallant, 2020). However, we found support for a link between prospect biases and irrational investment decisions: all of the correlations are positive and significant at the 0.01 probability level.

Table 2. Descriptive analysis including mean, standard deviation, minimum, and maximum.

No.	Construct	Mean	SD	Min.	Max.	1	2	3	4	5
1	Self-control	3.66	0.64	1.00	5.00	1				
2	Loss aversion	3.44	0.76	1.00	5.00	0.408**	1			
3	Regret aversion	3.67	0.67	1.00	5.00	0.626**	0.469**	1		
4	Mental accounting	3.62	0.79	1.00	5.00	0.485**	0.381**	0.493**	1	
5	Investment decisions	3.61	0.76	1.00	5.00	0.569**	0.278**	0.470**	0.414**	1

Note: ** Correlation is significant at the 0.01 level.

4.2.2. Reliability and Validity of the Measurement Instrument

A demonstration of the measures' strength was based on discriminant and convergent validity (Hair, Black, Babin, Anderson, & Anderson, 2018). Factor loading (FL), average variance extracted (AVE), Cronbach's alpha, and composite reliability (CR) values were collected to examine convergent validity. Established criteria were adopted to confirm the validity and reliability of the measures: FL should be > 0.5 with a preference for a value > 0.7; Cronbach's alpha should be > 0.6 with a preference for a value > 0.7; CR should be > 0.7; and AVE should be > 0.5 (Fornell & Larcker, 1981; Hair, Hult, Ringle, & Sarstedt, 2022). After applying these thresholds, the following items were dropped (LA6, SC4, and RA1), resulting in the retention of the indicators meeting the criteria. Table 3 presents the FL, Cronbach's alpha, CR, and AVE for the revised measures. All the stated criteria were met, which supports the model's reliability and convergent validity.

For the discriminant validity check, three criteria were adopted (Al Rahhaleh et al., 2023) as presented in Tables 4, 5, and 6. Table 4 shows that the HTMT coefficients were < 1, and the majority were < 0.85, which indicated adequate discriminant validity (Henseler, Ringle, & Sarstedt, 2015). For discriminant validity, the square root of AVE at the diagonal of Table 4 was > the inter-scale correlations, as proposed by the Fornell and Larcker (1981) approach (Table 5). Finally, we found support for discriminant validity through the cross-loadings method: the FL values of each measure's items were greater than its FL in the other measures, which supported the correlation of items to their proposed measure (Table 6).

Table 3. Reliability and validity of the measurements: FL, Cronbach's α, CR, and AVE.

Factor	Code	FL	*t*-value
Self-control	SC1	0.716**	20.712
Cronbach's α (0.715)	SC2	0.761**	29.925
CR (0.820)	SC3	0.777**	36.666
AVE (0.533)	SC5	0.659**	17.989
Loss aversion	LA1	0.710**	17.978
Cronbach's α (0.761)	LA2	0.767**	22.711
CR (0.838)	LA3	0.711**	18.012
AVE (0.510)	LA4	0.680**	14.480
	LA5	0.699**	17.142
Regret aversion	RA2	0.707**	20.428
Cronbach's α (0.669)	RA3	0.691**	17.105
CR (0.801)	RA4	0.693**	20.442
AVE (0.502)	RA5	0.741**	24.236
Mental accounting	MA1	0.778**	24.498
Cronbach's α (0.642)	MA2	0.679**	14.863
CR (0.804)	MA3	0.818**	32.710
AVE (0.579)			
Investment decisions	ID1	0.735**	24.947
Cronbach's α (0.813)	ID2	0.771**	32.869
CR (0.863)	ID3	0.802**	42.529
AVE (0.559)	ID4	0.718**	29.105
	ID5	0.709**	25.413

Note: **P < 0.001.

Table 4. Discriminant validity through HTMT.

Construct	Investment decisions	Loss aversion	Mental accounting	Regret aversion	Self-control
Investment decisions	1				
Loss aversion	0.341	1			
Mental accounting	0.585	0.521	1		
Regret aversion	0.615	0.593	0.700	1	
Self-control	0.744	0.490	0.688	0.888	1

Table 5. Discriminant validity through Fornell & Larcker (n = 598).

Construct	Investment decisions	Loss aversion	Mental accounting	Regret aversion	Self-control
Investment decisions	0.748				
Loss aversion	0.274	0.714			
Mental accounting	0.425	0.370	0.761		
Regret aversion	0.472	0.418	0.452	0.708	
Self-control	0.580	0.360	0.470	0.612	0.730

Table 6. Discriminant validity through cross-loadings (n = 598).

Items	Investment decisions	Loss aversion	Mental accounting	Regret aversion	Self-control
ID1	0.735	0.206	0.268	0.251	0.337
ID2	0.771	0.155	0.342	0.445	0.525
ID3	0.802	0.160	0.347	0.317	0.486
ID4	0.718	0.292	0.333	0.435	0.446
ID5	0.709	0.210	0.279	0.254	0.318
LA1	0.165	0.710	0.306	0.311	0.278
LA2	0.182	0.767	0.216	0.263	0.261
LA3	0.168	0.711	0.171	0.255	0.267
LA4	0.224	0.680	0.324	0.285	0.217
LA5	0.218	0.699	0.278	0.360	0.269
MA1	0.343	0.269	0.778	0.346	0.404

Items	Investment decisions	Loss aversion	Mental accounting	Regret aversion	Self-control
MA2	0.288	0.250	0.679	0.356	0.279
MA3	0.336	0.322	0.818	0.334	0.380
RA2	0.331	0.425	0.293	0.707	0.394
RA3	0.310	0.271	0.349	0.691	0.476
RA4	0.369	0.103	0.299	0.693	0.442
RA5	0.320	0.408	0.344	0.741	0.423
SC1	0.418	0.378	0.366	0.448	0.716
SC2	0.440	0.251	0.360	0.494	0.761
SC3	0.467	0.252	0.402	0.452	0.777
SC5	0.361	0.164	0.225	0.388	0.659

4.3. PLS-SEM Results

4.3.1. Structural Model Testing

The structural model was analyzed by applying PLS modeling. First, a structural model was implemented to estimate the impact of prospect biases on investment decisions. Then, MGA was considered a valid approach for examining differences based on subgroups (Lin, Li, Califf, & Featherman, 2013) to determine any statistically significant differences in the relationship between prospect biases and investment decisions based on variables such as gender, education, trading experience on the stock market, investment size, and trading frequency.

Structural model testing for the direct influence of prospect biases on investment decisions applied at the beginning of the analytical process (Figure 1), which showed that the model has a coefficient of variation (R^2) = 32.2%; therefore, we found support for the explanatory power of the model. Further, the coefficient of influence was 0.568, which was significant at $P < .05$ and $T > 1.96$. Therefore, we can conclude that for every 1% increase in prospect biases, the irrationality of investment decisions increases by 56.8%, which supports H1. Based on these results, it can be concluded that prospect bias significantly influences investment decisions, in line with Hair et al. (2022).

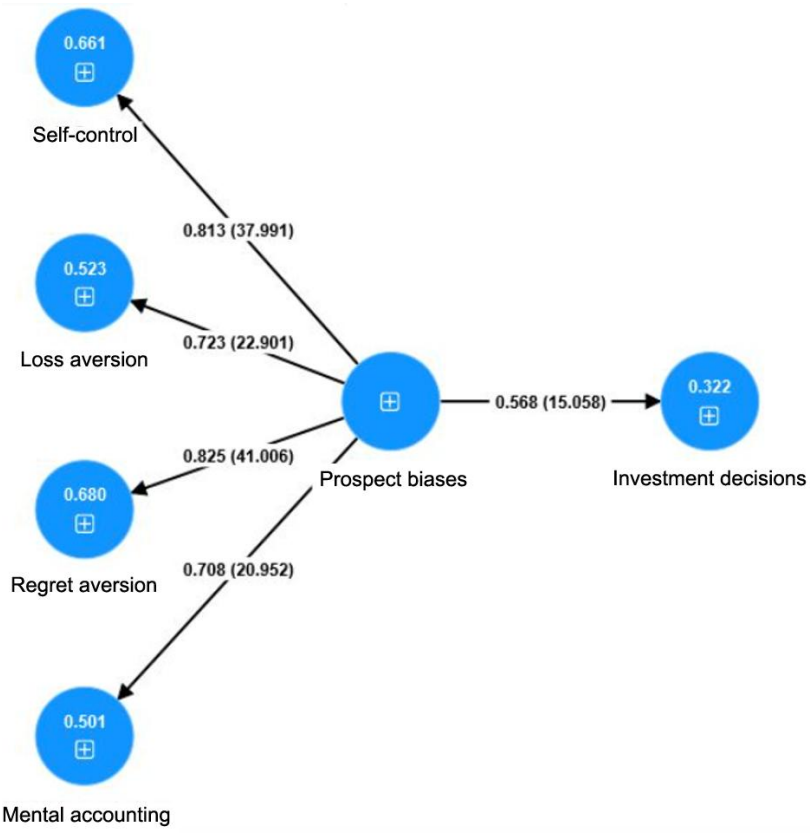

Figure 1. Structural model testing for the influence of prospect biases on investment decisions.

The paper employed an MGA to examine significant differences in the path estimates between two groups (i.e., for gender results, with a difference of 0.083 found). However, the difference was nonsignificant, as $P > .05$; therefore, the second hypothesis was not supported. Based on these results, there is no significant difference in prospect biases between males and females; these findings are consistent with Yuliawati et al. (2020).

H3 was supported by and aligned with Mahmood and Ahmad (2020) as the difference in prospect biases based on education was significant: 0.162 with $P < .05$. The influence coefficient was higher for investors with a diploma or lower (0.672) compared to those with education above the diploma level (0.510). Therefore, the results indicate that the level of education influences prospect biases in investment decisions and aligns with the goal of the FSDP in Saudi Arabia.

Regarding the investment experience of trading on the stock market exchange, there was a statistically significant difference in prospect biases based on the investment experience level ($P < .05$). H4 was supported by a significant difference (0.222) between investors with less than 1 year of experience and an influence coefficient of 0.655, and investors with more than 1 year of experience, with an influence coefficient of 0.433. More experienced investors were associated with lower prospect biases than less experienced ones. These results are consistent with several studies, such as Huang (2019) and Li et al. (2023).

Finally, neither H5 nor H6 was supported, and the results are inconsistent with Kourtidis et al. (2011) and Ullah et al. (2020). The differences based on investment size and frequent trading were insignificant, with respective coefficients of 0.460 and -0.072. These results indicate that investment size and trading frequency do not influence the extent of prospect biases in making investment decisions. Table 7 presents the hypothesis testing results.

Table 7. Hypotheses Testing Results.

H	Path	Beta		Supported	
H1	Prospect biases → Investment decisions	0.568*		Yes	
H	Sub-group variable	Group 1	Group 2	Difference	Supported
H2	Gender	Male (508)	Female (90)	0.083	No
		0.591*	0.508*		
H3	Education	Diploma or < (177)	> Diploma (421)	0.162*	Yes
		0.672*	0.510*		
H4	Investment experience	< 1 year (332)	> 1 year (266)	0.222*	Yes
		0.655*	0.433*		
H5	Investment size	< 100.000 (467)	> 100.000 (131)	0.460	No
		0.700*	0.627*		
H6	Trading frequency	Frequent trading (309)	Infrequent trading (289)	−0.072	No
		0.527*	0.600*		

Note: *P < 0.05.

5. CONCLUSIONS

This research investigates the impact of emotional and cognitive biases on investment decisions in Saudi Arabia. Based on a sample of 598 Saudi investors with responses to a survey instrument analysis using PLS-SEM, we found strong support for an association between prospect biases and investment decisions. To provide a deep understanding of prospect biases that influence investment decisions, we used an MGA comparison strategy to determine which groups of investors, based on distinct characteristics, are most influenced by prospect biases in the general and specific types of prospect bias. The findings show that less-educated investors are more likely to make biased decisions, which emphasizes the importance of the financial education courses provided by the Capital Market Authority (CMA) to satisfy one of the main indicators in the Financial Literacy and Education (FLE) under the Financial Sector Development Program (FSDP). Furthermore, because less experienced investors showed a higher likelihood of making biased decisions, the Saudi Exchange (Tadawul) offers a practice trading platform where new investors can gain experience without risking real money and help recognize and manage their behavioral biases in the real world.

Therefore, the CMA should develop mentorship programs that pair experienced investors with newcomers to share practical knowledge and experiences. Establishing a behavioral finance research center is important to consistently examine the impact of cultural and social factors on investment behavior in Saudi Arabia. In conclusion, implementing these policies could help create a more resilient and informed investor base, ultimately contributing to greater economic stability and growth in the broader context.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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