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Article

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Impact of investors' demographic, behavior, attitudes and knowledge and skills on their risk tolerance levels in Bangladesh's emerging capital market

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Abstract

Purpose – This paper examines the impact of socio-economic and behavioral factors on determining the risk tolerance level of investors in the Bangladeshi stock market.

Design/methodology/approach – To measure the effects of socioeconomic factors, investment behavior, attitude and knowledge, a chi-square test analysis, a Bayesian ordinal regression model (with convergence and posterior predictive checks) and a forest plot of regression coefficients were used.

Findings – The findings reveal that investment attitudes, level of investment, education and risk attitudes are significant predictors of risk tolerance, with positive effects indicated by posterior estimates of 0.72, 1.00, 0.70 and 0.54, respectively, as shown by 95% credible intervals excluding zero. The regressions show a marginal negative relationship between income and risk tolerance, but marital status had no significant effect on risk tolerance. Gender is another factor, with males having a higher risk-taking tendency compared with females. Individuals with such attitudes typically fall into the category of moderate risk tolerance, which suggests a connection between their values, attitude toward long-term operations or active trading and moderate risk inclination.

Practical implications – Practically, the paper can be used to further the actions of behavioral finance, as it outlines the subject of psychological and behavioral forces in risk-taking activities. This justifies the claim that significantly more effort within the field of financial promotion should be devoted to educating investors and modeling their attitudes rather than focusing solely on the significance of such a demographic variable.

Originality/value – The study's originality lies in its multidimensional approach, advanced methodology and counterintuitive findings, challenging traditional risk tolerance models.

Keywords Risk tolerance, Bayesian ordinal regression, Investment behavior, Investor psychology, Behavioral finance

Paper type Research article

1. Introduction

Bangladesh's capital market has its own structural and behavioral features that distinguish it from other emerging economies. The country's structural dependency on the ready-made garment (RMG) sector, which constitutes more than 85% of export earnings (Basher, 2023), results in one-of-its-kind sensitivity to global demand shocks (Raihan and Khan, 2020; Abtahee *et al.*, 2023). Bangladesh currently has the third-largest capital market in South Asia, although it remains relatively underdeveloped due to limited available financial products and a lack of long-term investments (Islam and Jahan, 2012). Circuit breakers stabilize the market, despite the uneven growth observed (Basher *et al.*, 2007), in contrast to other diversified Asian peers, such as Thailand and Vietnam (Faiz and Maitra, 2020). The Bangladeshi stock market, dominated by the Dhaka Stock Exchange (DSE), is performing well behind its Indian and Brazilian peers in terms of stock trading volume, listings and investor participation (Khan and Billah, 2023). Ineffective corporate governance generates instability and inefficiency in the

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market (Rashid, 2011). It also has a negative export image, which hinders international development (Fregidou-Malama *et al.*, 2023).

Behaviorally, investors' emotive inclination causes them to make emotional judgments and their risk tolerance is low due to concerns about political and societal uncertainty (Hossain and Siddiqua, 2024; Ahmed *et al.*, 2022). Loss aversion and media influence increased due to COVID-19 (Muzareba *et al.*, 2023). People tend to make risky investments despite adhering to financial principles due to the influence of psychology (Miazee *et al.*, 2014). Family background, income, age and education level (Muktadir-al-Mukit, 2022) as well as Shariah-based preference differences (Chowdhury and Salema, 2023) further distinguish investors' attitudes, contributing to financial illiteracy and leading to impulsive decision-making (Khan and Tan, 2020). Many investors do not follow financial theory; instead, they make decisions based on emotions and act impulsively (Hossain and Siddiqua, 2024; Ghosh, 2023). Financial literacy supports informed and regulated investment decisions (Akter and Alam, 2020). In comparison to developed economies, the financial environment in Bangladesh is also developing; however, poor governance and a low level of financial literacy make informed decisions difficult (Ahmad *et al.*, 2012). Enhanced financial literacy promotes wise risk-taking, risk dispersion and market stability and intensive training can improve the confidence levels of long-term investors. Strengthening these areas is critical for sustainable growth (Basher *et al.*, 2007). Primarily, the risk tolerance of retail investors in Bangladesh influences their preferences, which can be understood by considering demographics, financial knowledge and behavioral biases (Owusu *et al.*, 2023).

However, despite this distinctiveness, several research gaps are evident. In theory, current models do not account for the interactions between structural constraints, such as RMG reliance and governance constraints in Bangladesh and behavioral biases, including overconfidence (Barber and Odean, 2001) or herding (Rashid, 2011). Methodologically, the vast majority of studies use self-report data (Hossain and Siddiqua, 2024), which limits the possibilities for more advanced statistical analysis and may not accurately capture real risk-taking behavior. There are still grey areas in terms of how Shariah-compliance requirements change the conventional risk calculus and how familial networks exacerbate the tendency to deviate. Most importantly, while financial literacy is deemed to be important (Akter and Alam, 2020), evidence-based interventions remain untested for low-education investors in Bangladesh and post-2011 crash reforms (Sarbabidya and Saha, 2018) lack a behavioral foundation.

This study fills this gap by investigating risk preferences through the unique cultural, structural and behavioral lens of Bangladesh. The paper proceeds by: (1) examining the interface of demographics, financial literacy and behavioral influences (Heo *et al.*, 2021) in this unique context; (2) using Bayesian logistic regression to address methodological shortcomings and (3) suggesting relevant strategic interventions such as financial literacy programming and behavioral nudges (Basher *et al.*, 2007), etc. The incorporation of structural breaks into behavioral analysis offers innovative implications for policymakers and other service providers in Bangladesh's developing capital market (Bhattacharya and Dutta, 2019; Balaz, 2021).

To ensure long-term stability and resilience, strategic diversification policies are necessary, as this reliance remains supportive of positive economic development, albeit accompanied by associated vulnerabilities due to variations in global demand and competitive forces. Compared to other emerging markets, Bangladesh and other emerging economies exhibit low start-up experiences, a fear of failure and limited creativity (Pervez *et al.*, 2024). Significant investments should be made to empower the youth and address skill shortages, as they are a valuable asset (Akter and Alam, 2020). Bangladesh must adapt to tariff rationalization, reaffirm its investment environment, ease economic complexity and nurture human capital to diversify its economy (Basher, 2023; Ginting *et al.*, 2025). It is important to handle these issues to ensure sustainable economic development and reduce inequality in Bangladesh.

As a consequence, this paper reviews the effects of demographics, behaviors, attitudes, experience, knowledge and risk tolerance on retail investors in Bangladesh's capital market, considering the diverse population and evolving market regulations. This paper begins by highlighting the structural and behavioral distinctions in Bangladesh's market, reviews the literature, identifies gaps and outlines objectives. The methodology covers research design, sampling, data collection, variable measurement and Bayesian logistic regression for risk tolerance analysis. The findings part includes Chi-square tests, Bayesian ordinal logistic regression, forest plots and diagnostic tests. Key findings, theoretical contributions and policy recommendations are discussed, followed by conclusions and future research directions.

2. Literature review and hypothesis development

When studying risk tolerance in emerging capital markets, particularly as retail investors gain prominence, it is essential to examine the factors that drive risk tolerance. The literature encompasses studies on various aspects, including demographic, behavioral, attitudinal and cognitive factors, which contribute to a deeper understanding of risk strategies in investor behavior, with a specific focus on portfolio risk. The literature review covered in this study investigates the relationship between these characteristics and risk tolerance, laying the groundwork for the current study's investigation.

2.1 Demographic factors and risk tolerance

Research shows that men are generally more risk-tolerant than women (Ghosh, 2022; Koekemoer, 2019), with studies noting a greater risk-taking attitude among men (Bhattacharya and Dutta, 2019; Bashir *et al.*, 2014). Men often overestimate their risk tolerance, while women tend to underestimate theirs (Grable and Roszkowski, 2007), contributing to approximately 10% of the gender wealth gap (Neelakantan, 2010). Women's lower risk appetite affects asset allocation decisions (Faff *et al.*, 2011; Woods *et al.*, 2020), prompting calls for gender-balanced investment committees or behavioral adjustments in financial regulations (Woods *et al.*, 2020). Nonetheless, there is some debate about the relationship between gender and investment behavior, while some studies reveal that there are no significant gender differences (Farzana *et al.*, 2012; Sadiq and Ishaq, 2014). As a consequence, the hypothesis was developed regarding this in the following manner.

- H1. Gender is statistically significantly associated with risk tolerance, with men showing higher risk tolerance than women.

A younger investor is generally risk-tolerant compared to an older one, as their risk appetite tends to decrease with age, driven by the desire to maintain capital and gain more experience (Kabra *et al.*, 2010). Nevertheless, the results of studies on the relationship between an individual and society are contradictory, with some pointing to the negative nature of this relationship (Anbar and Eker, 2010). In contrast, others establish a more nuanced, non-linear pattern, such as a J-curve risk profile (Cardak and Martin, 2023). Although there is a tendency for a decrease in risk tolerance with age in terms of self-report, in experimental settings (i.e. the willingness to take a risk related to performing a specific action), an opposite tendency is sometimes observed (Wang *et al.*, 2022, 2023). In addition, risk-taking is influenced by framing effects and older people are more sensitive to loss framing (Schulman *et al.*, 2022). Such differences point to a flaw in age-based risk preference measurement, which can be connected with measurement method faults, task conditions and context framing. The following hypothesis may be developed.

- H2. There is a significant relationship between age and risk tolerance, implying that young investors are more ready to take chances than older ones.

Studies demonstrate that financial risk tolerance (FRT) varies significantly by marital status and gender, with single men being the most risk-tolerant, followed by married men, single

women and married women (Yao and Hanna, 2005). The married are more risk-averse, as individuals have higher financial obligations (Chen and Tsai, 2010; Sultana and Pardhasaradhi, 2011). Single status also extends to the management of US companies, while single CEOs exhibit more aggressive investment behavior (Roussanov and Savor, 2014). However, some research fails to identify a significant association between marital status and risk attitude (Bhattacharya and Dutta, 2019; Sutejo *et al.*, 2018), demonstrating that other factors shape individuals' risk preferences. The above discussion supports the following hypothesis.

- H3. Married people are more risk-averse, so marital status and risk tolerance have a noteworthy relationship.

Education levels are positively associated with risk tolerance in finance, as more educated individuals tend to have greater access to financial knowledge and a higher willingness to take risks (Koekemoer, 2019). The same dependence can be observed for the guiding role of parents (Heenkenda and Chandrakumara, 2016), economic conditions (Heenkenda and Chandrakumara, 2016) and gender differences. However, financial literacy serves as an alternative mediator (Lodhi, 2014). The extent of higher education leads to an improvement in financial literacy and cognitive aptitudes, making one more tolerant of risk (Anindya and Hasnawati, 2024; Tharayil, 2024). The following hypothesis is proposed:

- H4. Education level is favorable to risk tolerance, as more educated investors are more likely to accept measured risks.

Research indicates that income is strongly correlated with FRT, as individuals with higher incomes tend to be more risk-seeking (Koekemoer, 2019; Wright, 2017). This holds true to patterns in retirement, with wealthier retirees holding riskier portfolios. President of Country A, Krustev has stated that risk preference is income elastic, that an increase of £1,000 in income will increase risk preference 1% (Wright, 2017); the rich can take a hit and they are not hit by short versus long-term costs (Reddy and Mahapatra, 2017). However, researchers have shown that the effect of income is marginal compared to financial literacy and experience (Bashir *et al.*, 2014). Empirically, income is heavily related to FRT, as confirmed.

- H5. Income is significantly related to risk tolerance; however, income alone might not significantly influence risk-taking behavior.

Occupation is found to have a positive impact on FRT. Risk tolerance: professionals and self-employed individuals tend to be more risk-accepting, frequently engaging in higher-risk or more speculative investments (Shtudiner, 2018; Bhattacharya *et al.*, 2022), as well as occupations with higher income risk (Bonin *et al.*, 2007). Other educated and wealthy professionals are also found to have a higher risk tolerance (Bhattacharya and Dutta, 2019). However, findings vary by demographic, with occupation affecting male investors more than female investors (Thanki *et al.*, 2022) and showing no significant correlation among Indonesian millennials (Suherman *et al.*, 2023). Workplace risk exposure links occupational choice to risk tolerance (Galizzi and Tempesti, 2015). These results suggest that occupation shape risk attitudes, leading to the following hypothesis.

- H6. Occupation affects risk tolerance; higher-ranking professionals tend to exhibit greater risk tolerance.

2.2 Investors' behavior, attitudes, knowledge and skills and risk tolerance

2.2.1 *Investors' behavior and risk tolerance.* Studies have also shown that portfolio size has a positive impact on risk tolerance since the larger the investor, the more easily they can absorb a loss (Grable and Roszkowski, 2007). In contrast, smaller portfolios carry higher idiosyncratic risk due to under-diversification (Goetzmann and Kumar, 2008). Wealthy individuals are more inclined to hold riskier assets, such as shares, while poorer investors prefer lower-risk options,

such as bonds (Riley and Chow, 1992). The source of the money for an investment also makes a difference – windfall gains, such as bonuses or an inheritance, may have been used to justify risky decisions through mental accounting (Chen *et al.*, 2007; Haisley *et al.*, 2008).

Risk tolerance is further affected by investment experience; however, the findings are inconsistent. Some studies indicate a positive relationship (Yuliani and Nurwulandari, 2023), while others reveal a negative correlation (Asfira *et al.*, 2019). Age also mitigates the relationship between personality and risk inclination (Perveen *et al.*, 2020). Confident investors are most likely to have a preference for specific stocks, thereby setting aside index funds or bonds, which is not the case with risk-averse investors (Barber and Odean, 2001; Grinblatt and Keloharju, 2001). Therefore, the following hypotheses are suggested.

- H7. Investors with higher investment levels demonstrate significantly greater risk tolerance.
- H8. The source of investment is positively associated with risk tolerance.
- H9. More experienced investors exhibit higher risk tolerance.
- H10. Investment preferences significantly affect risk tolerance, with larger portfolios linked to higher risk tolerance.

2.2.2 Attitudinal factors and risk tolerance. Although the stock market is attractive, many investors are hesitant to participate due to the potential for volatility and loss (Baugwala and Jogdand, 2021). Investment decisions are made based on the trade-offs between return and risk (Prasad *et al.*, 2021; Baláz, 2021), as well as market analysis and short-term factors, including behavioral aspects (Baugwala and Jogdand, 2021), such as tax exemption and security concerns. It is closely linked to personality traits, such as openness and conscientiousness (Sadiq and Amna, 2019). This notion is further checked by the influences of education and income (Oberholzer and Maritz, 2019).

Risk dispositions themselves also influence investment decisions (Bodie *et al.*, 2014) and are better predictors of risk tolerance than socio-demographics (Baláz, 2021). Experience and demographic factors are significant (Baláz, 2021); however, risk questionnaires alone do not provide sufficient differentiation. Return expectations and demographic factors offer a better distinction (Sivarajan, 2019). Financial literacy improves through financially effective risk management and decision-making (Baker *et al.*, 2019; Akhtar and Das, 2019), with accounting knowledge and technical skills playing a critical part (Prasad *et al.*, 2021). Thus, the propagating assumptions are as follows.

- H11. Investors' market selection attitudes significantly influence their risk tolerance.
- H12. General investment attitudes are strongly associated with risk tolerance.
- H13. Investors' risk attitudes significantly correlate with their overall risk tolerance.

2.2.3 Knowledge and skills and risk tolerance. Investment knowledge has a substantial impact on market-cap preference: less-educated investors typically prefer low-cap stocks due to their lower prices, whereas educated investors can choose from low-, mid- and high-cap assets, as they utilize modern valuation metrics (Aeknarajindawat, 2020; Buss *et al.*, 2020). Stocks in the mid-cap category have also shown the highest Sharpe ratio, greater than that for large- and small-cap stocks and a high risk-adjusted return ratio (Kaprielyan and Jansen, 2023). Additionally, they are also under-researched by analysts (Hughen *et al.*, 2018). Active managers typically select value stocks with larger market capitalizations and higher volatility (Brands *et al.*, 2006). On the other hand, student-managed funds outperform in mid-cap and sector allocations (Hughen *et al.*, 2018).

Risk tolerance and financial literacy as a whole have a combined impact on investment behavior (Mubaraq *et al.*, 2021), but this varies; some studies associate better understanding with more risk (Mazumdar, 2014; Grable and Rabbani, 2023), while others find the opposite,

that it reduces risk tolerance while increasing comprehension (Asfira *et al.*, 2019). Demographic variables, including gender, socioeconomic status and educational background, also influence this relationship. These findings contradict rational theories (Mazumdar, 2014), implying an increasing list of context-based capital market strategies (Mubaraq *et al.*, 2021). As a result, the following possibilities were proposed.

H14. Greater investment knowledge is associated with higher risk tolerance.

H15. The choice of investment avenues has a significant positive relationship with risk tolerance.

3. Objectives of the study

- (1) To analyze the association between investors' demographic, investment behavioral, attitudinal factors and knowledge and skills on their risk tolerance levels in the emerging capital market of Bangladesh.
- (2) To identify the impact of investors' demographic, investment behavioral, attitudinal factors and knowledge and skills on their risk tolerance levels in the emerging capital market of Bangladesh.
- (3) To provide insights that could inform policymakers, financial institutions and investors on optimizing investment strategies and financial literacy programs.

4. Research methodology

4.1 Research design

This study employs a quantitative design, where primary data have been collected from questionnaires administered to retail investors in a nascent capital market. Both the exploratory and explanatory research methodologies have been used to study the links between demographic, investment behavioral and attitudinal variables, as well as knowledge and skills linked to risk tolerance.

4.2 Populating and sampling

Population: The population consists of ordinary shareholders who are involved in the emerging stock market of Bangladesh, a country with a growing economy.

Sampling method: A stratified random sampling method was used to ensure representation across several strata, including gender, age, socioeconomic level and education.

Sample size: Following the formula suggested by Fisher *et al.* (1991), 385 individuals were selected as the sample units for the inquiry. The study was administered using a questionnaire to gather information on the participants' demographics and risk tolerance. Experts in this particular sector have carefully reviewed and confirmed the results of the questionnaire. The categorization and presentation of Table 1 highlight the risk profile of the sample units while considering the degree of each respondent's FRT.

Table 1. Shows the sample respondents' risk profiles

Financial risk tolerance group	Number of respondents
Conservative	69
Moderate	263
Aggressive	53

Source(s): Researcher's own work

4.3 Data collection

Primary data were collected through structured questionnaires. The questionnaire includes the following factors.

- *Demographic factors*: Gender, age, marital status, education, occupation and income.
- *Investment behavioral factors*: Investment level, investment source, investment experience and investment preferences.
- *Attitudinal factors*: Market selection attitudes, investment attitudes and investors' risk attitudes.
- *Knowledge and skills*: Investment knowledge and investment avenues.
- *Risk tolerance*: The aggressive, the moderate and the conservative are three distinct types of risk tolerance seen in the world of finance ([What Is Risk Tolerance and Why Does It Matter?, 2022](#)). We used this variable as the dependent variable.

4.4 Variable definitions and measurement

- *Dependent variable*: Risk tolerance (categorical: aggressive risk tolerance = 3, moderate risk tolerance = 2 and conservative risk tolerance = 1).
- *Independent variable*: Different types of independent variables, their measurement scales and key citation are given in [Table 2](#).

4.5 Bayesian logistic regression model

4.5.1 Bayesian approach. The Bayesian approach is a statistical technique that adjusts the probability of a hypothesis based on new evidence. In contrast with traditional ("frequentist") statistics, Bayesian statistics view parameters as being random, i.e. having a probability distribution. Bayesian techniques have found extensive application in public health, medicine and psychology due to their capacity for flexible modeling and integration of prior information ([Block et al., 2014](#)). Their use has increased with the availability of software such as WinBUGS and R ([Burgos, 2010](#)).

4.5.2 Model specification. The general form of the Bayesian logistic regression model is as follows:

$$P(Y_i = 1 | X_i) = \frac{1}{1 + \exp(-(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki}))}$$

Where:

- Y_i is the dependent variable (risk tolerance level of the i -th investor),
- X_{ki} are the independent variables (demographic, behavioral, attitudinal and knowledge factors for the i -th investor).
- β_k are the coefficients (estimated using Bayesian techniques).

4.5.3 Advantages of Bayesian logistic regression for analyzing investor risk tolerance in Bangladesh. Bayesian logistic regression can be an ideal model to assess investor risk tolerance in Bangladesh's emerging capital market. It will facilitate data limitations in assessment by effectively incorporating prior knowledge ([Kruschke, 2010](#)). It works with

Table 2. Shows the independent variables, measurement scales, and citations

Category	Variable	Levels/Options	Adopted scale	Key citations
Demographic Factors	Gender	Male, Female	Nominal	Barber and Odean (2001), Ghosh (2022), Koekemoer (2019), Grable and Roszkowski (2007), Neelakantan (2010), Faff <i>et al.</i> (2011), Woods <i>et al.</i> (2020)
	Age	<40 years, = 40 years and above	Ordinal	Kabra <i>et al.</i> (2010), Anbar and Eker (2010), Wang <i>et al.</i> (2022, 2023), Cardak and Martin (2023)
	Marital Status	Married, Unmarried, Widower	Nominal	Yao and Hanna (2005), Chen and Tsai (2010), Roussanov and Savour (2014), Bhattacharya and Dutta (2019)
	Education	Masters and above, Bachelors and below	Ordinal	Koekemoer (2019), Heenkenda and Chandrakumara (2016)
	Occupation	Employed, Self-employed	Nominal	Bhattacharya <i>et al.</i> (2022), Shtudiner (2018), Bonin <i>et al.</i> (2007)
	Income	<50,000 Tk., = 50,000 Tk. and above	Ordinal	Wright (2017), Reddy and Mahapatra (2017), Bashir <i>et al.</i> (2014)
Investment Behavioral Factors	Investment Level (Tk.)	<100,000; 100,000–500,000; = 500,000 and above	Ordinal	Grable and Roszkowski (2007), Riley and Chow (1992), Goetzmann and Kumar (2008)
	Investment Source	Own savings, Borrowings, Both (own + borrowings)	Nominal	Chen <i>et al.</i> (2007), Haisley <i>et al.</i> (2008), Malmendier and Nagel (2011)
	Investment Experience (Years)	<5 years, 5–10 years, = 10 years and above	Ordinal	Yuliani and Nurwulandari (2023), Asfira <i>et al.</i> (2019), Perveen <i>et al.</i> (2020)
	Investment Preferences	Shares, Bonds/ Debentures, Mutual Funds, Others	Nominal	Barber and Odean (2001), Grinblatt and Keloharju (2001)
Attitudinal Factors	Market Selection Attitudes	Primary market, Secondary market, Both	Nominal	Baugwala and Jogdand (2021), Prasad <i>et al.</i> (2021), Baláz (2021)
	Investment Attitudes	Long-term investor, Day trader, Both (mixed)	Nominal	Barber and Odean (2001), Oberholzer and Maritz (2019), Jain and Kumar (2024)
	Investors' Risk Attitudes	Risk compared to return (risk-averse), Both risk and return (balanced), Risk and return separately (specific focus)	Ordinal	Kahneman and Tversky (1979), Bodie <i>et al.</i> (2014), Baláz (2021), Sivarajan (2019)
Knowledge & Skills	Investment Knowledge	Low, Medium, High	Scale (1–3)	Mubaraq <i>et al.</i> (2021), Mazumdar (2014), Grable and Rabbani (2023), Baker <i>et al.</i> (2019), Akhtar and Das (2019), Lodhi (2014), Prasad <i>et al.</i> (2021)
	Investment Avenues	Low cap, Mid cap, High cap	Ordinal	Kaprielyan and Jansen (2023), Hughen <i>et al.</i> (2018), Aeknarajindawat (2020), Buss <i>et al.</i> (2020), Brands <i>et al.</i> (2006)

Source(s): Researcher's own work

sparse and noisy data and takes in missing values, which is very important in the growing markets whilst enabling sequential updates (Feinberg and Gonzalez, 2012). The multilevel model also detects intricate sociocultural interactions in the behavior of investors using the hierarchy modeling (Kruschke, 2010) and also gives probability distributions in the study of uncertainty in the relationship, e.g. the impact of financial literacy (Costa et al., 2017). It is resourceful enough when examining financial behavior due to its capacity to study previous studies (Block et al., 2014) and its track record of success in various fields (Namin and Sridharan, 2010; Martinez and Achcar, 2014). When applied with explicit assumptions, this technique will provide a firm understanding upon which a policymaker can base his/her research in the dynamic market environment of Bangladesh to devise specific investor education programs.

4.5.4 Model diagnostics.

- *Convergence check:* Effective sample sizes (ESS) and trace plots have been used for measuring sufficient sampling of posterior distributions for stable inference.
- *Posterior predictive check:* Posterior predictive checks have been conducted to ensure that the model fits the data well. Rhat values close to 1.00 for all parameters indicate that the model has converged well, suggesting reliable posterior estimates.

5. Analysis and discussion

Table 3 reveals that investors’ demographics (excluding marital status and income level), investment behavior, attitudinal qualities and knowledge and skills are significantly correlated with investors’ risk tolerance levels, since *p*-values for all of these variables are below 0.05.*

The graphical presentation of the above table is given below.

While those that are colored red imply non-significant factors, the green columns represent significant variables (*p*-value < 0.05). Figure 1 demonstrates that the degree of risk tolerance of the investors is significantly affected by all variables except income and marital status. Of them, investment attitudes, investment level, education and investors’ risk attitudes rank as the four most significant characteristics.

Table 3. Shows the results of investors’ demographic, investment behavioral, attitudinal factors, and knowledge and skills and their risk tolerance level

Independent variable	Chi-squared statistic (X ²)	Degrees of Freedom (df)	<i>p</i> -value	Significance
Gender	19.169	2	6.879e−05	Significant
Age	7.3937	2	0.0248	Significant
Marital_status	5.2011	4	0.2673	Not Significant
Education	76.688	2	<2.2e−16	Significant
Occupation	6.5571	2	0.03768	Significant
Income	3.5317	2	0.171	Not Significant
Investment_level	81.22	4	<2.2e−16	Significant
Investment_source	39.094	4	6.661e−08	Significant
Investment_experience	11.015	4	0.0264	Significant
Investment_preferences	38.308	6	9.778e−07	Significant
Market_selection_attitudes	29.756	4	5.487e−06	Significant
Investment_attitudes	87.115	4	<2.2e−16	Significant
Investors_risk_attitudes	66.678	4	1.14e−13	Significant
Investment_knowledge	9.9495	4	0.04129	Significant
Investment_avenues	16.073	4	0.002923	Significant

Source(s): Researcher’s own analysis

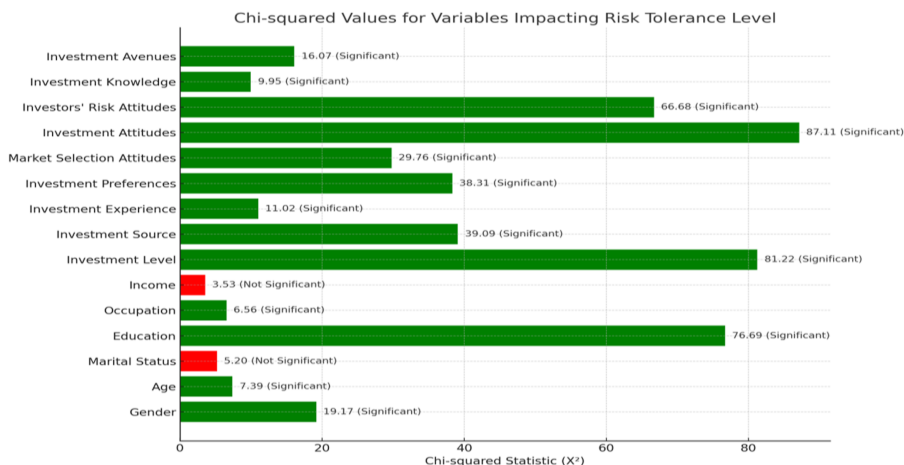


Figure 1. Represents the graphical representation of the chi-squared values for each variable. (Source: Researcher's own analysis)

Table 4 shows the results of Bayesian ordinal logistic regression. From the table, it has been apparent that risk tolerance is significantly predicted by gender, education, income, investment level, investment attitudes and risk attitudes of the investors. In particular, there is a negative estimate for gender (−1.01), with a credible interval between −1.85 and −0.22, representing lower risk tolerance of being female. This estimate for the relationship between risk tolerance and higher education levels is supported by a credible interval ranging from 0.01 to 1.35 and an estimate of 0.70. Risk tolerance is negatively related to income and the estimate is −0.60 (with credible interval −1.12 and −0.07), indicating that as income increases, so does risk tolerance. Risk tolerance is also positively influenced by investment level, investment attitudes and

Table 4. Shows the results of Bayesian ordinal logistic regression

Parameter	Estimate	Std. Error	2.5% CI	97.5% CI	Rhat	Bulk ESS	Tail ESS
Intercept[1]	2.13	1.70	−1.20	5.44	1.00	5,724	3,090
Intercept[2]	6.64	1.73	3.28	10.01	1.00	5,583	3,040
Gender	−1.01	0.42	−1.85	−0.22	1.00	5,575	3,187
Age	−0.16	0.24	−0.63	0.31	1.00	5,697	3,289
Marital_status	−0.30	0.25	−0.78	0.19	1.00	5,248	3,156
Education	0.70	0.35	0.01	1.35	1.00	5,186	3,449
Occupation	0.05	0.26	−0.47	0.57	1.00	5,079	2,782
Income	−0.60	0.27	−1.12	−0.07	1.00	5,560	3,061
Investment_level	1.00	0.26	0.49	1.51	1.00	5,466	3,049
Investment_source	0.27	0.14	0.00	0.55	1.00	4,701	2,813
Investment_experience	−0.25	0.24	−0.73	0.23	1.00	5,506	3,157
Investment_preferences	−0.13	0.14	−0.40	0.14	1.00	5,512	3,157
Market_selection_attitudes	−0.14	0.43	−0.99	0.66	1.00	5,649	3,057
Investment_attitudes	0.72	0.22	0.30	1.15	1.00	4,487	3,493
Investors_risk_attitudes	0.54	0.19	0.16	0.93	1.00	5,735	3,191
Investment_knowledge	0.14	0.27	−0.41	0.69	1.00	4,861	2,775
Investment_avenues	−0.09	0.20	−0.50	0.30	1.00	5,678	3,297

Source(s): Researcher's own analysis

investors' risk attitudes. Based on the estimates of 1.00, 0.72 and 0.54, a man who has a higher investment level, more positive investment attitude and risk attitudes will show higher risk tolerance.

In contrast, many, but not all, predictors such as age, marital status, occupation, investment experience, investment preferences, market selection attitudes, investment knowledge and investment avenues were not statistically significant in their relationship to risk tolerance. For these variables, our credible intervals for all include zero, implying that there is no strong evidence of an effect. For example, age had little effect with the estimate -0.16 and 95% credible interval from -0.63 to 0.31 , covering zero, indicating little indication of a relationship with risk tolerance.

Overall, the results indicate that demographics such as gender and education and attitudes such as investment attitudes and risk attitudes play a substantial part in determining risk tolerance. Yet, socioeconomic variables such as income and investment experience also reveal insights into what makes for complex investment behavior.

5.1 Diagnostic information

Posterior predictive check: From the Table 4, it has been observed that *Rhat* values close to 1.00 for all parameters indicate that the model has converged well, suggesting reliable posterior estimates.

Figure 2 is the posterior predictive check (PPC) of a Bayesian model. This kind of plot shows how well the model fits the data. The y (dark line) lines show the observed, actual values for the dependent variable (in this case, risk tolerance levels) and the y_{rep} (light lines) lines show the predicted values from the model, which come from the posterior predictive distribution. One can assess the model's ability to replicate the observed data by creating synthetic data using parameter estimates from the posterior. The plot displays the actual data (y) and multiple replications (y_{rep}) of the posterior predictive distribution. If the data fit very well, the replications (light blue curves) should come close to the actual observed data (a dark line). It has been observed that the two appear visually similar, indicating that the model has somehow managed to capture the patterns from the data. The plot shows a peak around 2.0 and the replication curves closely match the actual data curve. This indicates that the model accurately predicts the data. It has been observed that the replicated values align with the data,

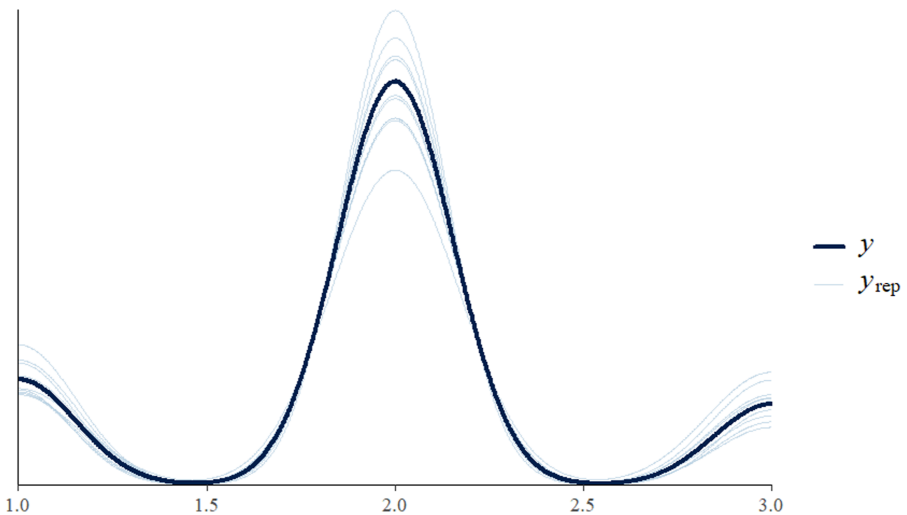


Figure 2. Represents the posterior predictive check (PPC) (Source: Researcher's own analysis)

indicating a high degree of model fit. The model explains both the distribution and the pattern of the data, as evidenced by the posterior predictive checks.

Convergence check: Bulk ESS (a measure of autocorrelation and chain mixing) ranges from 2,447 to 5,978, indicating adequate sample size for inference. Tail ESS (a measure of how well the tail end of the distribution is sampled) ranges from 1,759 to 3,509, also indicating adequate sample size for inference.

Figure 3 reveals that the posterior means of the parameters intercept [1] and intercept [2] are higher, while the centers of Gender, age and marital status are closer to zero. These predictors may have a smaller or no effect and the well-converged Markov Chain Monte Carlo (MCMC) chains suggest the reliability of parameter estimates and the proper fitting of the Bayesian model.

Figure 4 shows that higher education and investment levels have a positive influence on the outcome. Income shows a negative correlation, while occupation and investment source approach zero, suggesting a minimal or non-existent influence. Both posterior distributions and trace plots confirm that the Bayesian model is well-fitted, with well-converged and stable results.

From Figure 5, it has been observed that the outcome is positively influenced by investment experience and investment attitudes, both with relatively narrow distributions, which indicate a more certain outcome. As can be seen, the influence of particularly investors' risk attitudes is strong and highly positive. Posterior means of investment preferences and market selection attitudes are not far from 0, implying no or little effect on the outcome. The result shows the convergence and mixing of chains on all parameters, which implies that the model is accurately fitted by the Bayesian.

The Figure 6 displays diagnostic plots for Bayesian regression parameters from a probabilistic model. The plots look at posterior distributions and the performance of MCMC sampling for three parameters: investment knowledge, investment avenues and disc. The posterior distributions display well-defined, bell-shaped and symmetric distributions, while the trace plots display well-mixed and stationary sampling chains across four chains. Key observations confirm the reliability of the model, indicating weak effects or no strong evidence for large parameter values.

Figure 7 shows estimated parameters with 95% CI, providing the directional, magnitude and statistical significance of the estimates. If a parameter does not cross the vertical dashed line at

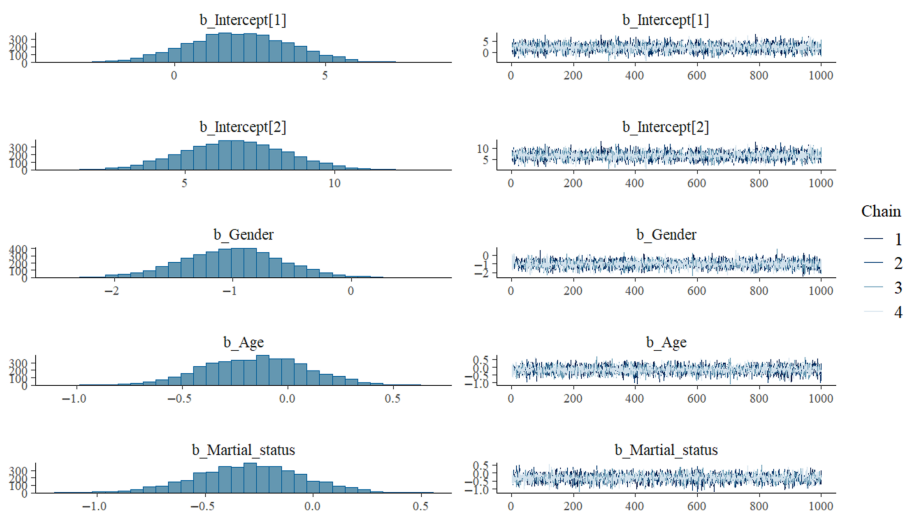


Figure 3. Shows the posterior distributions and trace plots on intercepts, gender, age and marital status. (Source: Researcher's own analysis)

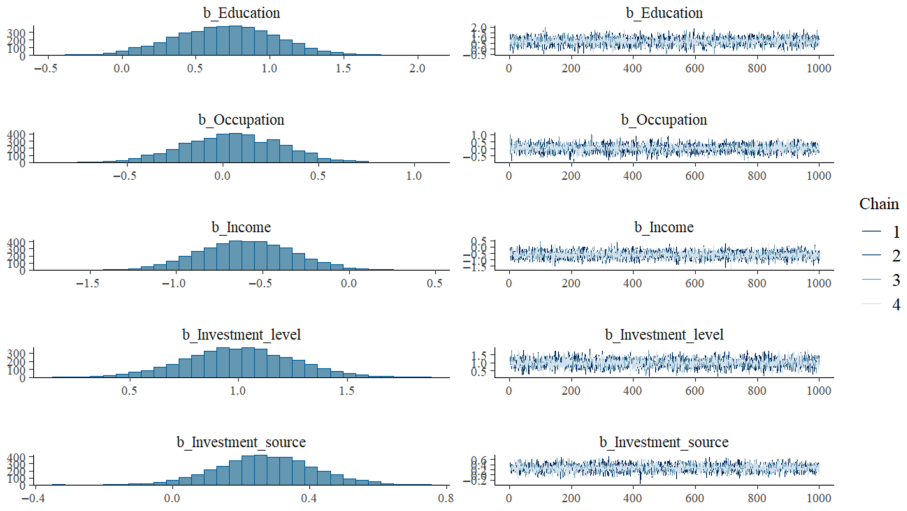


Figure 4. Shows the posterior distributions and trace plots of education, occupation, income, investment level and investment source. (Source: Researcher’s own analysis)

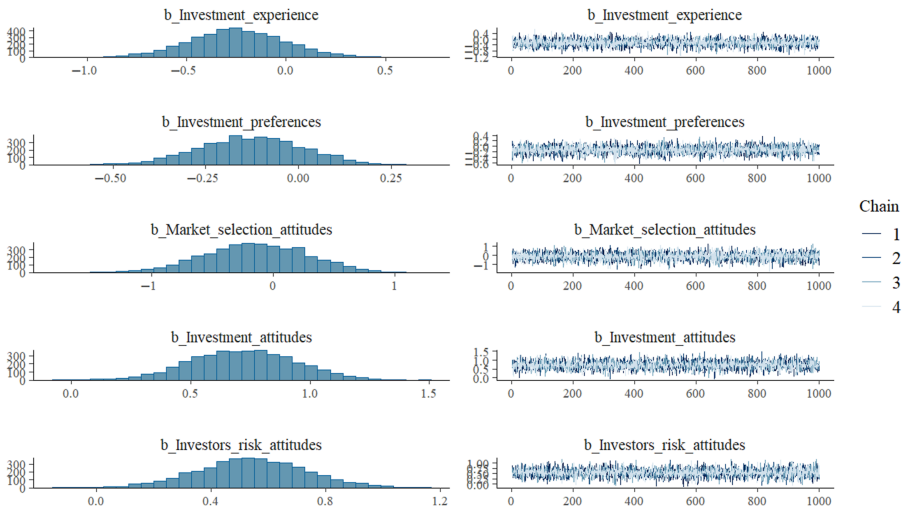


Figure 5. Shows the posterior distributions and trace plots of investment experience, preferences, market selection attitudes and investors’ risk attitudes. (Source: Researcher’s own analysis)

zero, this is interpreted as a statistically significant parameter and implies that the parameter has a statistically relevant effect on the dependent variable. Various parameters, such as gender, education, income, investment level, investment attitude and investor risk attitude, have proven to have a significant effect. Women have a statistically significant negative effect (CI $[-1.85, -0.22]$ and estimate -1.01), while investment level (CI $[0.49, 1.51]$ and estimate 1.00), investment attitudes (CI $[0.30, 1.15]$ and estimate 0.72) and investment risk attitudes (CI $[0.16, 0.93]$ and estimate 0.54) have a statistically significant positive effect on risk tolerance level.

By comparison, confidence intervals of parameters like age, occupation and market selection attitudes overlap at zero and their effects are therefore not statistically significant.

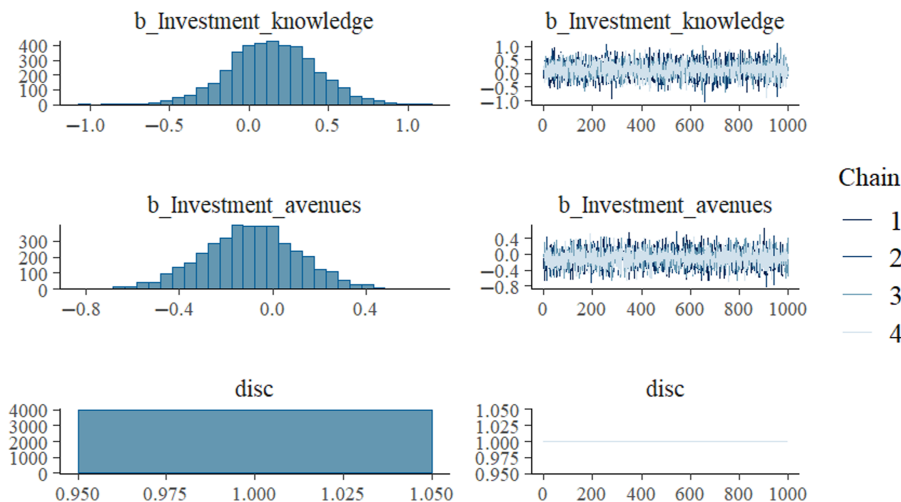


Figure 6. Shows the posterior distributions and trace plots of investment knowledge, avenues and disc. (Source: Researcher's own analysis)

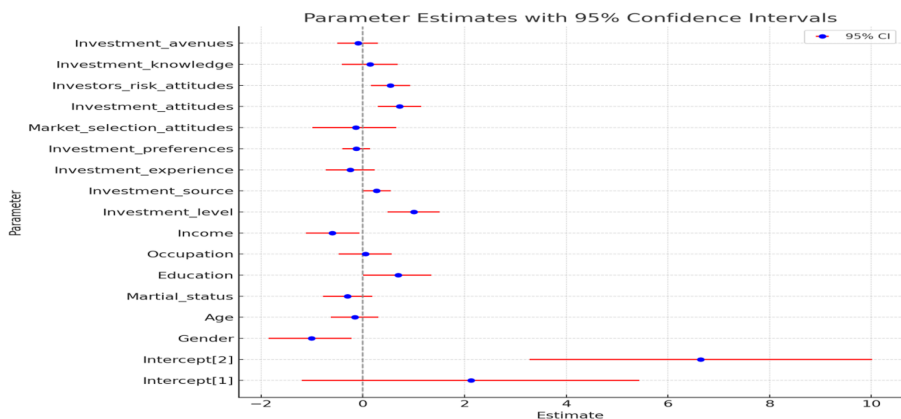


Figure 7. Represents the forest plot of Bayesian ordinal logistic regression coefficients. (Source: Researcher's own analysis)

Positive estimates (e.g. investment attitudes (0.72)) imply favorable relationships with the dependent variable; negative estimates (e.g. income (-0.60)) make negative associations with the dependent variable. The size of the estimate is approximately the strength of the effect, with larger values indicating stronger impacts. Overall, the graph graphically presents the key factors influencing the result and highlights the reliable and significant variables.

The Bayesian ordinal logistic regression equation incorporating the significant coefficients can be expressed as

$$\text{Log-Odds} = \beta_0 + \beta_1 (\text{Gender}) + \beta_2 (\text{Education}) + \beta_3 (\text{Income}) + \beta_4 (\text{Investment_level}) + \beta_5 (\text{Investment_attitudes}) + \beta_6 (\text{Investors_risk_attitudes})$$

Substituting the posterior mean values for the significant coefficients:

$$\begin{aligned}\text{Log-Odds} = & \beta_0 - 1.01 (\text{Gender}) + 0.70 (\text{Education}) - 0.60 (\text{Income}) \\ & + 1.00 (\text{Investment_level}) + 0.72 (\text{Investment_attitudes}) \\ & + 0.54 (\text{Investors_risk_attitudes})\end{aligned}$$

Here, β_0 is the intercept term (or set of intercepts for ordinal categories). The coefficients (β_1, β_2, \dots) reflect the estimated change in log-odds for a one-unit change in the respective variables, holding all other variables constant.

6. Key findings, theoretical contributions and policy implications

A summary of findings from the study is presented in [Table 5](#), which integrates theoretical contributions and policy implications.

6.1 Time-sensitive policy recommendations for investor segments

Immediate interventions (0–12 months).

- (1) Arrange 4–6 hours of mandatory workshops on diversification and risk control, taught by young professionals to curb overconfidence ([Barber and Odean, 2001](#)) and informed decision-making.
- (2) Limit low-income investors' exposure to high-risk derivatives to avoid lottery-style speculating ([Grable and Roszkowski, 2007](#)).

Medium-term reforms (1–3 years).

- (1) Within mid-career investors, time-strapped investors with mid-level education apply automated risk-profiling tools with behavioral nudges through fintech solutions to make timely changes in the portfolio ([Grinblatt and Keloharju, 2001](#)).
- (2) In the case of self-managed investing, where their portfolios are not diversified, they provide a tax incentive on ETFs and give a subsidy to advisory services to decrease occupational bias and increase the diversification of their portfolio ([Shtudiner, 2018](#)).

Long-term structural changes (3–5+ years).

- (1) A decreasing gender risk aversion can be achieved by reforming pension systems such that they have gender-neutral default asset allocation, as in Sweden ([Neelakantan, 2010](#)).
- (2) In the case of the rural and underserved, financial literacy should be a component of learning in schools and encourage the use of mobile micro-investment services to close the urban-rural investment-readiness gap ([Heenkenda and Chandrakumara, 2016](#)).

7. Conclusion

This research attempts to identify the variables that influence the risk tolerance of investors in Bangladesh's developing capital market. Investors in Bangladesh's capital market are predominantly conservative (18–81%) or moderate (45–77%), with only a marginal presence (1–10%) of aggressive risk-takers. Demographic factors (gender and education), investment behavior attitudes and levels of investment knowledge, as well as experience, influence risk

Table 5. Shows the consolidated Table of Risk Tolerance Determinants in Bangladesh's Capital Market

Demographics variables					
Variables (hypotheses)	Key findings	Supported theories	Challenged theories	Theoretical contributions	Policy implications
Gender (H1)	Men exhibit higher risk tolerance ($\chi^2 = 19.17$, $*p < 0.001$; $\beta = -1.01$)	Barber and Odean (2001) Gender Differences	Rational Choice Theory (gender-neutral rationality)	Confirm gender variation in risk tolerance (Barber and Odean, 2001), which raises doubts with regard to the rational choice assumptions of gender-invariant financial behavior	Introduce gender-sensitive financial literacy education courses and risk counseling provisions
Age (H2)	Younger investors are more risk-tolerant ($\chi^2 = 7.39$, $*p = 0.025$; $\beta = -0.16$)	Life-Cycle Hypothesis (Modigliani, 1966)	Permanent Income Hypothesis (stable risk preferences)	Supports the human capital theory (Becker, 1964) by demonstrating the direct influence of education on risk tolerance, without the need for peer intervention	Develop age-tiered investment products by implementing an auto-risk-adjustment feature
Marital Status (H3)	No significant effect ($*p = 0.2673$)	–	Family Responsibility Theory	–	–
Education (H4)	Higher education increases risk tolerance ($\chi^2 = 76.69$, $*p < 0.001$; $\beta = 0.70$)	Human Capital Theory (Becker, 1964)	Information Cascade Theory (peer effects dominate)	Supports human capital theory (Becker, 1964) in demonstrating a direct influence of education on the risk tolerance without the intervention of peers	Promote the teaching of investments in higher education courses and professional licenses
Income (H5)	Not significant ($\chi^2 = 3.53$, $*p = 0.171$; $\beta = -0.60$, CI excludes 0)	Income-Risk Models	Linear Utility Models	Makes an important discovery about the non-linear relationship between income and risk-taking, thereby challenging the conventional utility models	Develop risk-exposure variants of income bracket-specific investment vehicles
Occupation (H6)	Weakly significant ($\chi^2 = 6.56$, $*p = 0.0377$; $\beta = 0.05$, not significant)	Occupational Risk Theory (Sahm, 2012)	Efficient Market Hypothesis (ignores occupational biases)	Discovers subtle and quantifiable effects of occupation on risk perception, which the Efficient Market Hypothesis overlooked	Provide career-specific training in investment (e.g. unsteady income jobs vs. fixed income)

(Source: Researcher's own work)

Investment behavior					
Variables (hypotheses)	Key findings	Supported theories	Challenged theories	Theoretical contributions	Policy implications
Investment Level (H7)	Strong influence ($\chi^2 = 81.22$, $*p < 0.001$; $\beta = 1.00$)	Mental Accounting (Thaler, 1999)	CAPM (wealth-independent risk assumption)	Supports the existence of mental accounting in relation to the allocation of risk, which is the opposite of wealth neutrality hypothesized under CAPM	We recommend risk-tiered investment products that accommodate different wealth allocation behaviors
Investment Source (H8)	Investors take higher risks with his or her very own savings vs borrowed funds ($\chi^2 = 39.09$, $*p < 0.001$; $\beta = 0.27$)	Endowment Effect (Kahneman et al., 1991)	Fungibility Principle (money interchangeability)	Strengthens the endowment effects in finance, putting into question fungibility	Differentiate risk disclosures based on fund sources (own savings vs borrowed/inherited)
Experience (H9)	Weak inverse effect ($\chi^2 = 11.02$, $*p = 0.026$; $\beta = -0.25$, not significant)	Learning by Doing (Arrow, 1962)	Myopic Loss Aversion (experience increases caution)	Complication learning theories show that experience can decrease the risk appetite	Need for experience-based investor education pathways that address emerging risk aversion

(continued)

Table 5. Continued

Investment behavior					
Variables (hypotheses)	Key findings	Supported theories	Challenged theories	Theoretical contributions	Policy implications
Investment Preferences (H10)	Significant in χ^2 but not Bayesian ($\chi^2 = 38.31$, $*p < 0.001$; $\beta = -0.13$)	–	–	Suggests preferences are context-dependent, requiring hybrid behavioral models	Call for diversified product offerings that accommodate situational rather than fixed investor behaviors

(Source: Researcher's own work)

Attitudinal factors					
Variables (hypotheses)	Key findings	Supported theories	Challenged theories	Theoretical contributions	Policy implications
Market Selection Attitude (H11)	Significant χ^2 (29.76, $*p < 0.001$; $\beta = -0.14$ (not significant))	Market Participation Theory	EMH	Subjective states of investors threaten the EMH due to the opening of gaps in participation, which promotes the Behavioral Market Participation Theory that emphasizes non-rational obstacles to investments	Overcome the irrational exclusion by implementing trust-building activities and education on both formal (stocks, bonds) and informal (gold, real estate) options
Investment Attitude (H12)	Strongest predictor ($\chi^2 = 87.12$, $*p < 0.001$; $\beta = 0.72$)	Prospect Theory (Kahneman & Tversky)	Random Walk Theory (investment choice irrelevant)	The results confirm Prospect Theory, that in investing decisions, are motivated by emotions rather than reason and that attitudes trample on knowledge or market fundamentals in determining behavior	Brokerages should teach investors about cognitive biases (i.e. overconfidence) and introduce the 24-hour delay window on risky purchases to avoid them making impulsive decisions
Risk Attitude (H13)	High impact ($\chi^2 = 66.68$, $*p < 0.001$; $\beta = 0.54$)	Psychometric Scales (Weber et al., 2002)	Expected Utility Theory (quantitative-only risk)	The results are at the crossroads of the psychometric risk model and economic models as the perception of risk is more important than the reality (Risk as-Feelings Theory argument)	Psychometric profiling and simplification of risk communication have been called into effect in an attempt to fill the gap between statistical models and investor psychology

(Source: Researcher's own work)

Knowledge & skills					
Variables (Hypotheses)	Key findings	Supported theories	Challenged theories	Theoretical contributions	Policy implications
Investment Knowledge (H14)	Mild effect ($\chi^2 = 9.95$, $*p = 0.041$; $\beta = 0.14$, CI includes 0)	Planned Behavior Theory (Ajzen, 1991)	Classical Financial Literacy Theories	Broaden Planned Behavior Theory by revealing its boundary conditions-the relevance of knowledge dissipates as organization-wide distrust, or particular cognitive tendencies, become overwhelming	Combine practical training, behavioral prompts, and risk communication that goes beyond the conventional literacy programs
Investment Avenues (H15)	Significant χ^2 (16.07, $*p = 0.003$, $\beta = -0.09$ (non-significant))	Behavioral Finance and Institutional Theory	–	Being aware is not enough to change investment behavior and this mainly fits the behavioral finance and the theory of institutions	Supplement financial literacy works with nudges to behavior, simplified systems, and trust-building activities to increase investment take up

Source(s): Researcher's own work

tolerance and the key determinants of risk appetite. Financial literacy and investment attitudes have a considerable influence on risk tolerance. However, findings on investment experience, proficiency in financial knowledge and high market capitalization suggest that less knowledgeable and capital-rich individuals tend to behave more cautiously. The findings present a compelling case for bridging the gap between theoretical knowledge and empirical behavior, enabling investors to foster greater market participation.

Suggestions for further study:

- (1) *Gender-specific investment behavior*: Conduct in-depth studies combining quantitative data with qualitative interviews to explore cultural and socio-economic factors behind gendered risk behavior.
- (2) *Post-COVID longitudinal analysis*: Track changes in investor behavior and risk tolerance over time to assess the lasting effects of global financial crises like COVID-19.
- (3) *Cross-country comparison*: Compare investor behavior in Bangladesh with other emerging markets (e.g. Vietnam, Philippines) to identify regional patterns and divergences.
- (4) *Fintech's influence on risk tolerance*: Investigate how digital financial service impact investor behavior, especially among youth and rural populations.

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Further reading

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