Do Personality and Demographic Variances of Individual Investors Challenge the Assumption of Rationality? A Two-Staged Regression Modeling-Artificial Neural Network Approach

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Abstract

Purpose : The present study aimed to determine the influence of personality traits and demographic characteristics on the investment behavior of individual investors in North India.

Design/Methodology/Approach : The current study adopted a survey method and purposive sampling technique to collect the data from 315 respondents using Google Forms. For analysis, a two-stage analysis approach was adopted. In the first stage, regression analysis was used for hypotheses testing, and in the second stage, an artificial neural network (ANN) approach was adopted to validate the regression results.

Findings : The impact of the neurotic trait was found to be significantly positive on short-term investment decisions and significantly negative on long-term investment decisions. Conscientiousness was found to be a positive and significant predictor of long-term investment decisions and an insignificant predictor of short-term investment decisions. Among demographical variables, education was the only variable that positively and significantly impacted short-term investment decisions. In determining the long-term investment decisions, the role of all four demographic variables was found to be insignificant.

Practical Implications : This study found its relevance among retail investors as this study would assist them in knowing their personality type before making investment decisions.

Originality/Value : Determining the investment behavior of Indian retail investors by debating their personality traits and demographic variances made this study novel. The other feature that adds originality and novelty to this study is the use of a non-linear approach (ANN) along with a linear approach (regression) to predict the significance of the determining factors.

Keywords : **neuroticism, conscientiousness, demography, investment decisions, regression, ANN**

JEL Classification Codes : G1, G2, G4, G5

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Investment is the commitment of funds for future gain. Investment can be more appropriately described as sacrificing something in the present to get benefits in the future. All traditional finance theories are based upon the assumption of rationality. When investors get through the obscurity and wariness in making choices, they use cognitive prejudices to make decisions (Nga & Ken Yien, 2013). The rationality concept popularized by traditional theorists was criticized by Amos Tversky and Kahneman (1974). In their study "Judgment under Uncertainty: Heuristics and Biases," they initiated that sometimes investors act irrationally in choosing their financial assets. After these two noble laureates, many other theorists gave their views and challenged the overweighed assumption of rationality of traditional finance. Nowadays, numerous investment alternatives or options are available to the investor.

Many factors shape investors' investment decisions, as no two individuals are alike (Aprayuda et al., 2021). Factors can influence investment decisions (Raut & Das, 2015). Risk is a significant factor to consider in financial decision-making. Financial advisors usually analyze various risk measurements to predict the behavior of investors toward risk in financial markets (Virlics, 2013). In response to traditional finance, behavioral finance researchers have unearthed several factors that determine the investment behavior of investors, such as demographic factors (Senda et al., 2020), psychological factors (Shobha & Chakraborty, 2017), and personality traits (Pak & Mahmood, 2015). The planned behavior theory (PBT) debated many related factors (personality, socioeconomic position, gender, age, ethnicity, education, and investment proficiencies) that can impact the behavioral aspects held by people (Ajzen, 2002). However, very few existing research studies were divulged about the influence of different personality traits on investment decisions. Thus, to increase the understanding of the financial behavior of investors, the present study will inspect the role of the vital background aspects of personality traits and demographic factors. Psychology states that personality is a relatively eternal composition of acts, opinions, tenderness, etc., which different persons display differently in various situations, making them different from each other (Maslej et al., 2017). Individuals differ in personality traits, risk perception, emotional stability, and financial literacy (Sadi et al., 2011). Investors who are risk seekers often put their funds in risky investment instruments (Lutfi, 2010). Demographic differences are prominent factors that shape investors' financial decisions regarding their investment choices (Patel et al., 2017). Along with other factors, demographic variances of the investors also affect their investment management process (Choudhary et al., 2021). Demographic variables like sex, age, and social groups influence the investment behavior of respondents (Sayankar et al., 2021).

Despite having a huge rush of investors (7.7 crores), India's stock market is still considered a developing one. This vast Stock market is mainly dominated by retail investors, having 44% of the total share in the National Stock Exchange of India (NSE). One of the main reasons behind the development of stock markets in developed countries is the in-depth research on individual investors who make up the stock markets. Despite the immense role of individual investors in making the Indian stock market efficient, little work has been conducted on their behavioral aspects. As per behavioral finance theory, behavioral factors determine the investor's decision-making pattern (Dangi & Kohli, 2018). Investors' demographic characteristics and personality traits affect their financial decision-making, but the endeavor to associate them with investment behavior is much less restricted to only a few studies (Nandan & Saurabh, 2016; Raheja & Dhiman, 2017). This paper will shed light on the factors affecting the investment decisions of investors in India concerning their personality and demographic traits.

Literature Review

The rationality assumption of traditional finance theories, such as the efficient market hypotheses, was first criticized by Kahneman and Tversky (1979) in their paper "Judgment under Uncertainty: Heuristics and Biases." According to them, investors may take a high risk to avoid loss and a low risk for gain.

Demography and Investment Decisions

An individual's financial decisions are based on a multifaceted blending of their demographic profile (Maxfield et al., 2010; Özmen & Sümer, 2011). Not all demographic factors have a relationship with investment decision-making. Demographic characteristics and investment choices of investors are positively correlated with each other (Lutfi, 2010). Gender significantly affects investment decisions. Male investors always prefer to invest in risky instruments (Lan et al., 2018). Investment decisions vary according to the investors' marital status. Married people prefer bank deposits, while single people invest their funds in the capital market (Aren & Aydemir, 2015). Hence, the following hypotheses are proposed :

- **H01 :** Demographic factors do not significantly impact individual investors' short-term and long-term investment decisions.
- **Ha1 :** Demographic factors significantly impact individual investors' short-term and long-term investment decisions.

Personality and Investment Decisions

Personality is the mode of interacting and responding with others, typically expressed through quantitative attributes (Crysel et al., 2013). Although divergent research has suggested dissimilar personality traits, the "Big Five model" is the predominant taxonomy developed by Allport and Odbert (1936). The model comprises of five traits: extraversion, conscientiousness, neuroticism, openness to experience, and agreeableness. Researchers have used a varied number of traits to determine investment choices. Manzoor et al. (2023) operationalized two dimensions of the Big Five model. Oehler et al. (2018) used two traits (extraversion and neuroticism) to determine the investor's investment choice in asset markets. Ishfaq et al. (2020) operationalized the extraversion dimension of the Big Five model to determine its moderating effect on investment decisions. Similarly, the current study will use two dimensions (neuroticism and conscientiousness) and demographic variables to predict individual investors' short-term and long-term investment decisions.

Neuroticism and Investment Decisions

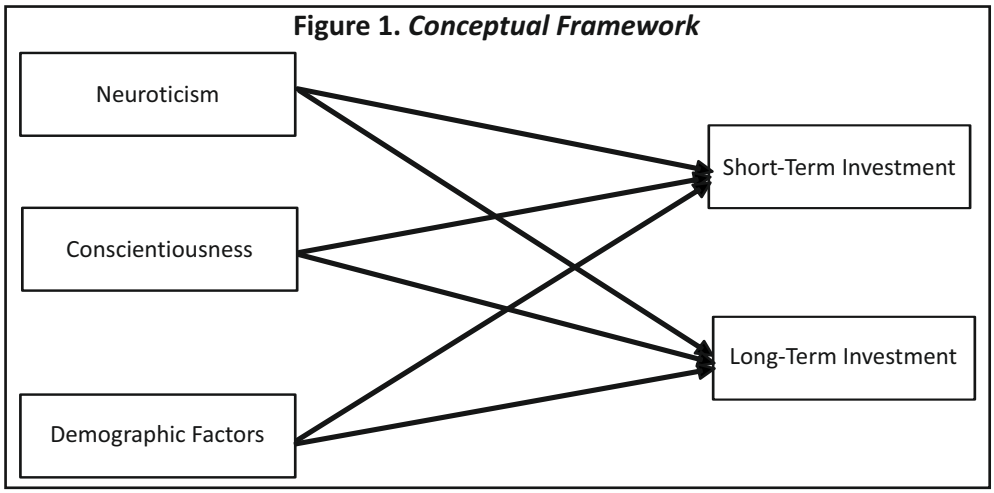
Depressed, anxious, and pessimistic individuals fall underneath the neurotic category of the Big Five model (Brown & Taylor, 2014). When it emanates from risky decision-making, neurotic people feel anxiety and nervousness and don't take risks; instead, persons who possess less of this trait are not easily worried and have less emotional sensitivity (Sadiq & Amna, 2019). Neurotic individuals prefer short-term trading options and are reluctant to take persistent risks (Ferreira-Schenk et al., 2021). Ramesh et al. (2019) found a negative influence of neuroticism on the investment decisions of women investors in the Indian context. Hence, the following hypotheses are proposed :

- **H02 :** There is no positive impact of neuroticism on short-term investment decisions.
- **Ha2 :** There is a positive impact of neuroticism on short-term investment decisions.

Conscientiousness and Investment Decisions

Conscientious persons are competent, determined, sensible, and planned (Lai, 2019). Conscientiousness means

Figure 1. *Conceptual Framework*



an intimacy for orderliness rather than imprudent and volatile conduct. People who score low on conscientiousness are inclined to be unfocused, unorganized, and erratic (Akhtar & Das, 2020). This personality feature may be a fundamental determinant of why some persons will likely use money as an influencing technique (Athira & Kakkakunnan, 2020). Conscientiousness and long-term investment are positively related (Manzoor et al., 2023). Conscientious individuals are very careful and accountable and believe in being ready, so they choose long-term investment options over short-term ones (Zeb et al., 2020). Hence, the following hypotheses are proposed :

- **H03 :** There is no positive impact of conscientiousness on long-term investment decisions.
- **Ha3 :** There is a positive impact of conscientiousness on long-term investment decisions.

Figure 1 depicts the conceptual framework of this research.

Research Methodology

The current study is descriptive, as it explores the influence of demographic characteristics and personality on the investment conduct of individual investors. The present study adopted the two-stage methodology. In the first stage, regression is used to test the study hypotheses. In the second stage, the artificial neural network (ANN) approach is used to justify the regression results and label the most significant determining variable of investment behavior.

Data Organizing

Respondents included the individual investors of North India. Data were collected from three states and three union territories (States: Punjab, Haryana, Himachal Pradesh; UT: J&K, Chandigarh, Delhi) through a purposive sampling technique in January 2022. Three hundred fifty-four questionnaires were distributed. After discarding the wrong or invalid questionnaires, only 315 (response rate of 88.9%) were found fit for analysis. The 50-times rule of thumb for ANN testing, which bounds the benchmark sample size to not below 50 times the number of modifiable parameters in the neural network, has also been exceeded by this sample size (Alwosheel et al., 2018).

Table 1. ***Demographic Profile***

Demographic Characteristics	Total	Percentage
Gender		
Male	197	62.5%
Female	118	37.5%
Age		
Below 20	24	7.7%
20 – 40	212	67.3%
Above 40	79	25%
Income		
Less than 2 lakhs	64	20.3%
2 – 4 lakhs	113	35.9%
4 – 6 lakhs	93	29.5%
Above 6 lakhs	45	14.3%
Education		
Secondary	39	12.4%
Graduate	91	28.9%
Post-graduate	112	35.5%
Professional	73	23.2%

Because the ANN model has six parameters, the minimum sample size required is 300. Therefore, the sample size of 315 is sufficient for ANN analysis. SPSS v16 is used to carry out the data analysis.

The demographic features of the study respondents are shown in Table 1. Out of 315 respondents, 197 were male, and the remaining 118 were female. Twenty-four respondents were below 20, 212 were between 20 and 40, and 79 were above 40 years of age. Sixty-four respondents had an annual income of fewer than 2 lakhs, 113 had 2–4 lakhs, 93 had an annual income of 4–6 lakhs, and 45 had above 6 lakhs of annual income. Out of 315, the majority were post-graduates (112), followed by graduates (91), professional degree holders (73), and secondary (39).

Measurement of Constructs

Structured measuring scales from current research are used to measure 23 items: demographic traits (4), conscientiousness (4), neuroticism (5), short-term investment decisions (5), and long-term investment decisions (5) (Table 2). Two personality traits (neuroticism and conscientiousness) are measured by the five-factor personality traits scale of Costa Jr and McCrae (1992). Since the current study attempts to explore the impact of two traits, neuroticism and conscientiousness, only nine items were adopted from the aforementioned survey instrument. The investment decisions of target respondents were measured by the scale adopted from the study by

Table 2. ***Scales Used to Measure the Study Constructs***

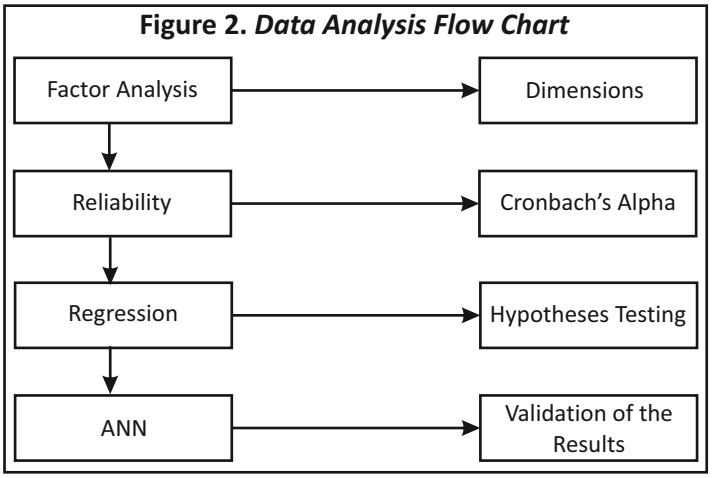
Constructs	Authors
Personality Traits (Neuroticism and Conscientiousness)	Costa Jr & McCrae (1992)
Investment Decisions (Short-term and Long-term)	Ahmad (2021)

Ahmad (2021). This scale contains five items: Five for short-term investment decisions and five for long-term investment decisions. All the survey items are demarcated utilizing the 5-point Likert scale as it improves the response rate, where 1 represents *"strongly disagree"* and *5 "strongly agree"* except for the demographic variables.

Data Analysis and Results

The current study has adopted the four-staged data analysis approach, as depicted in Figure 2. Step 1: Factor analysis, Step 2: Reliability analysis, Step 3: Regression analysis, and Step 4: ANN.

Figure 2. ***Data Analysis Flow Chart***



Factor Analysis

Factor analysis is employed in the present study to determine the dimensions of the survey items. The value of Kaiser-Meyer-Olkin (KMO) was obtained at 0.79, over the cutoff limit of 0.5, as advised by Kaiser (1974). Bartlett's test of sphericity is also found remarkable ($\chi^2 = 105128.50, p = 0.02$). The factor loadings of all the survey items (Figure 3) are obtained over the recommended value of 0.5 (Hair et al., 2019). Four factors are extracted (Factor 1: Neuroticism, Factor 2: Conscientiousness, Factor 3: Short-term investment, Factor 4: Long-term investment) with a total variance of 79.12%.

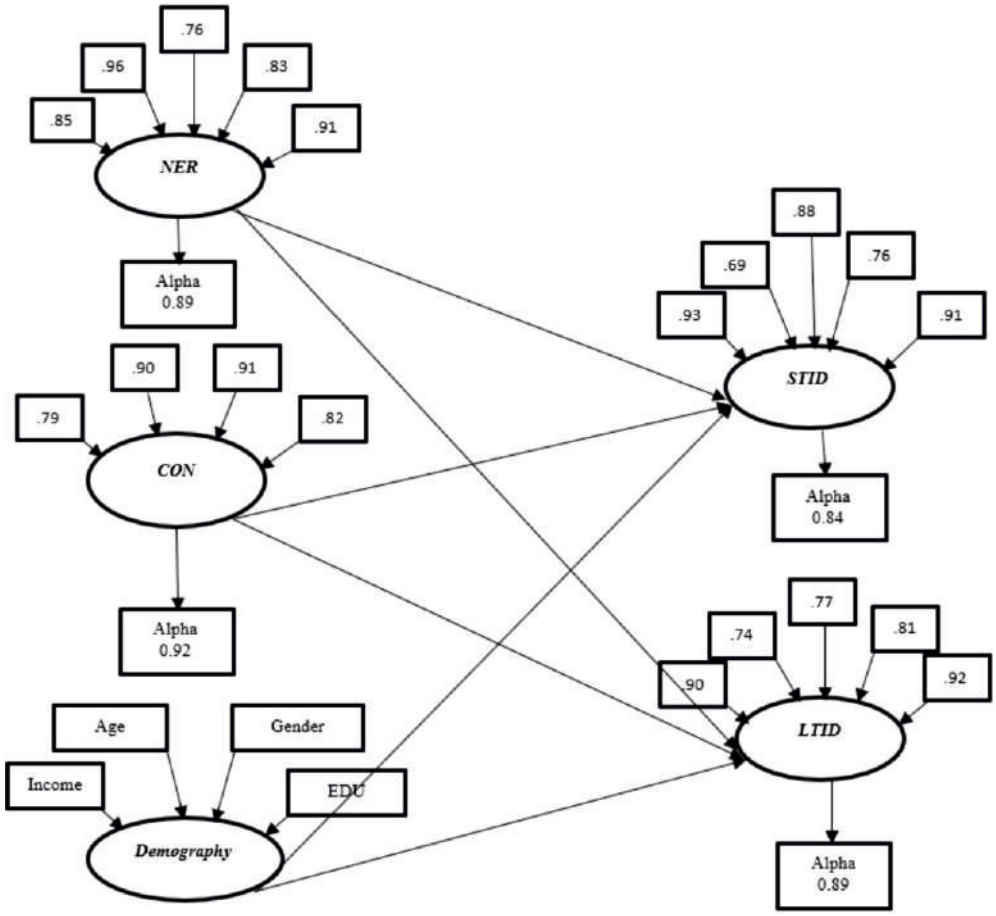
Reliability of the Survey Instrument

The study model is tested for reliability (Figure 3). Cronbach's alpha is used as a measure of reliability with a threshold limit of 0.7 (Hair et al., 2019). The values of Cronbach's alpha of all the factors are found (Neuroticism: 0.892, Conscientiousness: 0.921, Short-term investment: 0.840, Long-term investment: 0.895) well above the suggested value of 0.7, which evades the possibility of the reliability issue.

Hypotheses Testing (Regression Analysis)

Before the regression analyses, descriptive analysis (Table 3) is performed to determine the research variables' mean score, standard deviation, skewness, and kurtosis. Table 4 shows the findings of a linear regression in which short-term investment decisions are used as the dependent variable and demographic parameters (qualification,

Figure 3. ***Factor Scores and Cronbach's Alpha***



Note. *CON* : Conscientiousness, *NER* : Neuroticism, *STID* : Short-term investment decisions, *LTID* : Long-term investment decisions, *EDU* : Education, Alpha : Cronbach's alpha.

Table 3. ***Descriptive Analysis***

Variables	Mean	*SD*	Skewness	Kurtosis
Neuroticism	11.237	5.908	0.322	–1.396
Conscientiousness	11.5111	4.454	–0.344	–.656
Short-Term Investment	12.3905	5.538	0.33	–1.251
Long-Term Investment	13.4730	5.7211	–0.403	–1.330

gender, income, and age) and personality traits (neuroticism and conscientiousness) are used as the independent variables. The outcomes of the model summary are estimated to assess the model fit. The results depict 78.20% (*R*-square = 0.782) variations in short-term investment as determined by the exogenous variables. The adjusted *R*-squared value is 0.778, which is very close to the *R*-square value. The reliability of the model is indicated by the high value of correlation (*R* = 0.884). Neuroticism is the only predictor with a high beta value of 0.839, and all other predictors have a negligible effect on the dependent construct.

Table 4. ***Short - Term Investment Decisions***

	R	*R* - square	*F*-value	Adjusted *R*-square	Beta	*t*-value	Sig.
	0.884	0.782	184.497	0.778			0.000
Nero					0.839	22.005	
Cons					–0.073	–1.964	
Gender					–0.008	–0.294	
Age					–0.006	–0.181	
Education					0.014	0.473	
Income					0.052	1.473	

Note. [a.] Predictors : (Constant), Education, Gender, Cons., Age, Income, and Nero.

[b.] Dependent Variable : STID.

Table 5. ***Long - Term Investment Decisions***

	R	*R* - square	*F*-value	Adjusted *R*-square	Beta	*t*-value	Sig.
	0.888	0.788	190.445	0.784			0.000
Nero					–0.779	–20.690	
Cons					0.120	3.268	
Gender					0.025	0.911	
Age					–0.048	–1.474	
Education					0.054	1.706	
Income					–0.033	–0.966	

Note. [a.] Predictors : (Constant), Education, Gender, Cons., Age, Income, Nero.

[b.] Dependent Variable : LTID.

The regression results (Table 5) show the significant impact of demographic factors and personality traits on the long-term investment decisions. The *R*-square value of 0.788 depicts that the independent variables determine 78.8% of the variation in the dependent variable and also resembles the good fitness of a model. The adjusted *R*-squared value is 0.784, close to the *R*-squared value. The high value of *R* (0.888) shows the significant relationship between the variables. Neuroticism is the only highest influencer among the predictors, with a beta value of –0.779. All other exogenous variables have a negligible impact on long-term investment decision-making.

Artificial Neural Network

Thanks to ANN, outliers and small sample sizes are no longer problematic. It can be used to create a non-compensatory framework in which an increment in another does not recoup a reduction in one factor. IBM's SPSS neural network module was used to conduct the ANN test. The ANN algorithm can detect both linear and nonlinear relationships (Teo et al., 2015). For hidden and input layers, multilayer perceptrons and sigmond stimulating activities (Figure 4) are exercised (Leong et al., 2020). ANN takes several rounds to learn a process, which reduces errors and improves accuracy (Idrissi et al., 2019). Similar to Leong et al. (2020), 90% of the

Figure 4. ***ANN Model***

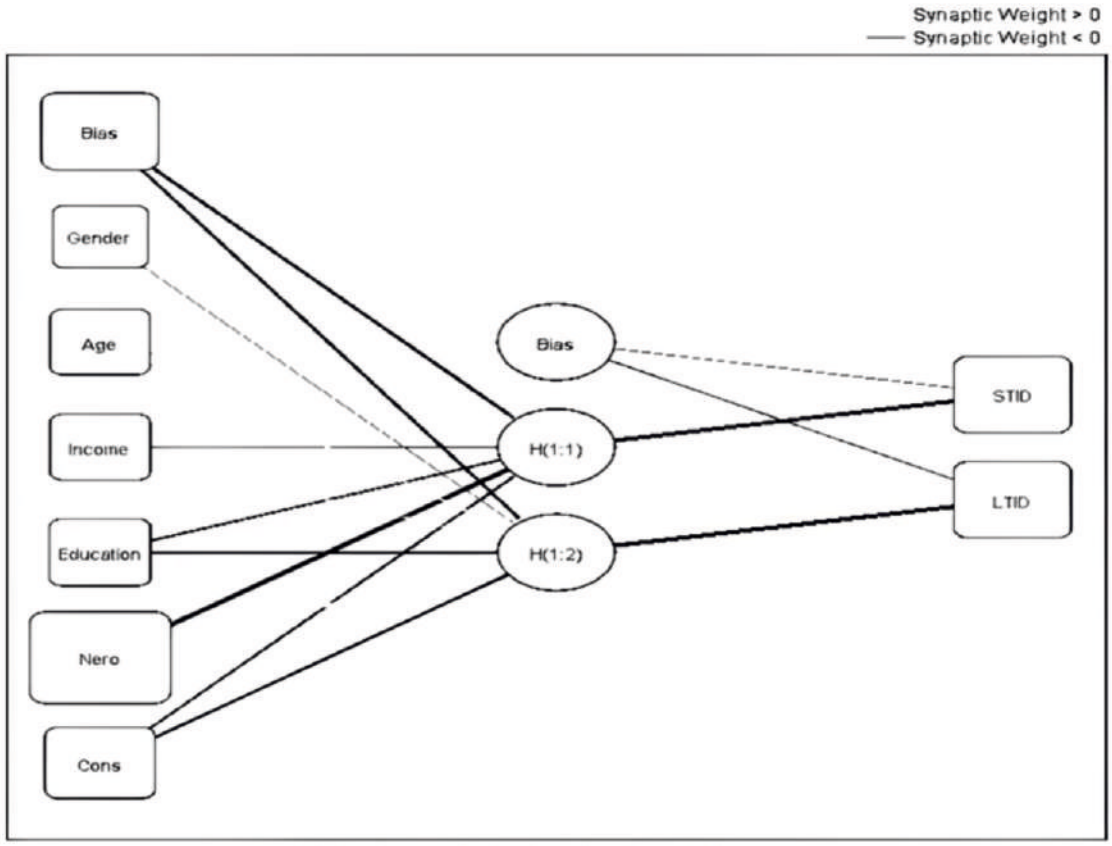


Table 6. ***RMSE Values***

Network	Sample Size Training	Sample Size Testing	RMSEA Training	RMSEA Testing
1	278	37	0.212	0.212
2	285	30	0.199	0.218
3	286	29	0.196	0.190
4	280	35	0.187	0.170
5	275	40	0.173	0.156
6	284	31	0.169	0.173
7	277	38	0.167	0.148
8	283	32	0.148	0.157
9	272	43	0.147	0.128
10	287	28	0.135	0.155
Mean			**0.173**	**0.171**
SD			**0.0252**	**0.0286**

Table 7. *Sensitivity Analysis*

Network	Gender	Age	Income	Education	Neuroticism	Conscientiousness
N1	3.5	9.2	14.6	14.3	92.86	35.7
N2	3.6	13.4	14.3	17.3	99.56	33.8
N3	4	14.4	16.5	18.7	97.7	34.7
N4	5.5	8.5	7.1	11.2	94.78	27.6
N5	6.4	13.1	17.3	18.2	98.62	37.4
N6	3.5	16.5	12.5	17.3	96.11	46
N7	4	8.3	8.8	12.8	95.78	31.9
N8	4.7	18.8	16.9	13.8	97.98	44.8
N9	6.6	10	3.8	8	93.28	41.5
N10	3.4	8	9.5	11.1	98.57	21.2
Average importance %	4.52	12.02	12.13	14.27	96.524	35.46
Normalized importance	0.046	0.124	0.125	0.147	1	0.367

samples are allocated to the training procedure and 10% to the testing procedure. A 10-fold cross-validating procedure is operated to elude the overfitting of the model, and RMSE (the root mean square of errors) was obtained (Tan et al., 2014). Table 6 shows the average RMSE values (0.173 and 0.171) for training and testing, which are close to the threshold limit. As a result, we confirm that this is a viable approach.

Sensitivity Analysis

To determine the robustness of the predictive power of each neuron, a sensitive analysis (Table 7) is conducted to predict the neurons' normalized importance and presented in percentage form (Karaca et al., 2019). The results depict that neuroticism is the prominent predictor, with an average significance of 96.524%, followed by conscientiousness, which has 35.46%. This is followed by education (14.27%). Gender is the least important predictor, having a value of only 4.52%.

Discussion

The study's outcome shows that demographic factors' weak and insignificant impact in determining investment decisions supports the rejection of hypothesis Ha1 and fails to reject the null hypothesis H01. These results contradict the results of Özmen and Sümer (2011). In our study, regression analysis and ANN weigh neuroticism as the most important predictor of investment decisions. These findings go against the results of Sadiq and Khan (2019). Neuroticism was found to be a strong predictor of both short-term and long-term investment options, and these results go by the results of Manzoor et al. (2023). A positive impact of neuroticism is found on short-term investment decisions, and an adverse effect is found on long-term investment decisions. The more the individuals will be neurotic, the more they will make short-term investment decisions. So, hypothesis Ha2 is accepted. Apart from neuroticism, the findings show that conscientiousness has the least positive impact on long-term investment decisions. These findings provide support to our hypothesi*s* Ha3 to get accepted.

Theoretical Contribution

The integration of the personality traits along with the demographic variables in our study has added a new theoretical contribution to the behavioral finance literature. Insertion of age, gender, income, and education, along with the neuroticism and conscientiousness traits, will provide a better comprehension of the influence on the investor's investment decision-making. The other contribution is the measurement of investment decision-making based on time horizon, not risk. Lastly, unlike the previous studies that applied linear models, this study adopted a two-staged linear regression and ANN approach.

Managerial Contribution

The theoretical contribution and the present study also offered many managerial contributions. This study will guide financial advisors in selecting the investment choices for their clients as not all individuals are alike, and they vary concerning their personalities and demographic features. This study will also assist retail investors in knowing their personality type and investing accordingly. This study will also help policymakers frame investor-friendly policies.

Limitations of the Study and Scope for Future Research

The present study has many limitations. First, this study only involves the investors of North India. Hence, the findings can't be generalized and applied to the whole investor population. Therefore, future research studies can incorporate the whole investor population of the country, and a cross-country analysis can be done to understand better. Secondly, only two constructs were used in the current study among the five constructs of the Big Five model. Future studies may test all five constructs of the Big Five model. Finally, the current study only incorporated the four demographical variables. Future studies may incorporate more demographical variables and may study their impact on investment decisions.

Authors' Contribution

Arfat Manzoor was pivotal in conceiving the research idea and formulating the study's objectives. Additionally, he spearheaded the data analysis process, applying his analytical skills to extract meaningful insights from the gathered data. Andleebah's expertise in the literature review was instrumental in providing a comprehensive and well-structured overview of the existing scholarly works related to our research topic. Mohammad Shafi made substantial contributions to the data collection phase of the research. His involvement in the data-gathering process, through meticulous planning and implementation, resulted in a robust dataset for analysis.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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