Potential for Predicting Risk Through Individual Behavioral Indicators in Fintech Lending Using a Two-Stage Model

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This study aims to examine the impact of individuals on fintech lending positions. While short-term, fast-decision online lending services are rapidly developing in the Mongolian fintech lending industry, the failure to consider consumer financial education, psychological impact, and consumption habits in loan evaluation is one of the main reasons for the emergence of non-performing loans.

The PLS-SEM model was used to analyze the effects of behavioral variables such as financial literacy, risk perception, materialism, and emotionality on individual indebtedness. The results showed that financial literacy had the strongest positive effect on indebtedness. Risk perception positively affects emotionality and materialism, indicating that individual behavior could be explained indirectly. The model explains 32% of the variance in individual indebtedness ($R^2 = 0.32$).

The study concludes that the integration of individual behavioral and psychological determinants into fintech lending-risk assessment frameworks, coupled with the development of targeted borrower financial-literacy interventions, has the potential to substantially mitigate default risk among fintech loan recipients. This study demonstrates that individual behavioral indicators significantly shape individual indebtedness; therefore, validating the foregoing results using an artificial neural network (ANN) approach was methodologically appropriate.

Keywords

Fintech Loan, Credit Risk, Non-Performing Loan, Non-Bank Financial Institution, Individual Behavior, Artificial Neural Network, Two-Stage Model.

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Introduction

In recent years, financial institutions have been intensively introducing technology-based (Zhang et al., 2022) financial products and services (Anestiawati et al., 2025). It creates opportunities to access financial products and services regardless of location or time.

In Mongolia, the number of institutions providing fintech loan services has been growing rapidly year by year. While there were 37 institutions engaged in both fintech and traditional operations in 2022, this number increased to 55 in 2023 and reached 64 in 2024, representing an average annual growth of 1.4 times (Byambaa et al., 2025). Following this trend, the number of customers using fintech loan services has also increased sharply. As of 2024, 94.4% of the total customers and 75.8% of the total borrowers of the Non-Bank Financial Institutions (NBFIs) are obtaining loans through fintech platforms (Yang & Jung, 2024).

Fintech lending plays a crucial role in supporting citizens' financial needs and investments, promoting economic growth, and making credit services more accessible (Yang & Jung, 2024) Furthermore, by leveraging data from social networks and transaction histories, it creates opportunities for lending that were previously unavailable. It also reduces (Anestiawati Chietra Aracely et al., 2025) the operational costs (Chhaidar Ahlem et al., 2023) of lending activities and utilizes artificial intelligence and big data analytics to quickly assess a customer's creditworthiness, thereby enabling fast and efficient loan disbursement (Shanti Riris et al., 2023).

In the Mongolian financial sector, the volume of non-performing loans (NPLs) continues to grow due to several key factors, such as a weak regulatory environment for fintech lending, inadequate assessment of borrowers' creditworthiness, the issuance of excessively accessible loans, and a lack of financial literacy among citizens regarding debt management (Davaajargal et al., 2020). For instance, the total NPLs in the NBFI sector surged from 140 billion MNT in 2021 to 350 billion MNT by the end of 2024, marking a 2.5-fold increase. Specifically, for fintech NBFIs, 5.2% of the fintech loan portfolio is classified as non-performing. Although the percentage of non-performing loans is decreasing, their quantitative value is still increasing.

Furthermore, the increase in online commerce and payment services with Installment Plan and Buy Now, Pay Later terms is creating previously unquantifiable risks in the financial market, making it necessary to improve customers' credit risk management (Krause David, 2025).

A study of risk mitigation practices for borrowers in the United States, China, and India, countries that are global leaders in fintech services, reveals that they commonly implement policies based on borrower behavior, psychology, and social factors (Berg Tobias et al., 2019; Creemers Rogier, 2018). For instance, China introduced a "Personal Credit Scoring System," which incorporates multiple indicators to detect individual behavioral patterns. These indicators include a user's e-commerce transaction behavior, social media activity, the financial status of their friends, and their personal reliability (Claessens Stijn et al., 2018).

Although technology-based credit risk assessment systems are advancing, international research continues to demonstrate that behavioral and demographic factors - such as a borrower's education, income, debt level, psychological state, and financial habits - have a strong influence on the likelihood of non-performing loans (Muñoz-Murillo et al., 2020; Ottaviani & Vandone, 2011).

For financial institutions, fintech lending risk is significantly influenced by individual behavioral factors such as level of financial literacy, self-control ability, financial decision-making patterns, social influences, attitudes towards money, attitudes towards oneself, and others. Behavioral finance plays a key role in investor psychology and financial decision-making, as individuals make decisions based on their emotions (Kapoor & Prosad, 2017).

Fintech presents significant potential for financial innovation (Anestiawati Chietra Aracely et al., 2025) its success depends on understanding and addressing the psychological barriers that influence adoption. To this, future research should focus on expanding empirical studies in this area, particularly across diverse demographics and regions, to better understand how behavioral aspects operate within different contexts.

This study contributes to the growing body of literature on behavioral finance by highlighting the critical role of cognitive biases in shaping the future of digital finance. Many studies have examined, in specific cases, how personality factors such as emotion, personal traits and psychological factors (Ganbat et al., 2021; Matos Celso Augusto de et al., 2019) predict borrowing behavior (Domingo & Buvanendra, 2023; Ellen. Nyhus, 2002; Rahman et al., 2020)

Therefore, this research aims to define how a borrower's personal and behavioral characteristics influence fintech lending risk. It is held that by doing so, the study holds significant importance for refining a customer-centric loan assessment system, consequently improving the risk management of fintech institutions, and ultimately making a tangible contribution to supporting the stable development of the financial sector.

Theoretical Foundation

Personal financial decisions relate to questions of where to get money from, how much, when, and how to use the money. Consequently, individuals' approaches to managing their own risk, as well as their perceptions, beliefs, and emotions regarding credit, are highly diverse.

Consumer behavior issues in the financial sector are mainly explained by Behavioral Finance Theory, Consumer Psychology Theory, and Risk Perception Theory.

Behavioral Finance Theory is a field of study that posits individuals do not always make financial decisions in a purely logical and calculated manner. Instead, it argues that decisions are often influenced by psychological factors such as emotions, past experiences, habits, and personal attitudes. This theory challenges the traditional economic concept of "homo economicus" or the "rational actor," highlighting how

people in the real world frequently rely on cognitive biases and heuristics (mental shortcuts) when making decisions (Daniel Kahneman & Amos Tversky, 1977).

Traditional financial theory posits that individuals always think logically and make decisions to maximize their utility and returns (Kapoor & Prosad, 2017). However, in reality, people often commit psychological biases such as overestimating profits, excessive fear of losses, herd behavior, and overconfidence. These psychological biases directly influence people's decisions regarding investments, loan acquisition, and savings (Ellen. Nyhus, 2002).

Behavioral finance theory provides a crucial theoretical foundation for understanding fintech credit usage, investment decision-making, and consumer financial responsibility. It specifically explains that consumers' borrowing decisions, risk assessment approaches, and misuse behaviors are influenced not only by income but also significantly by behavioral factors (Goel & Rastogi, 2023; Kapoor & Prosad, 2017; Mwirigi et al., 2024; Sinha et al., 2024).

Consumer psychology theory is a field of study that examines the reasons behind people's purchasing decisions and how consumer behavior is linked to psychology (Richins & Dawson, 1992). According to this theory, the consumption patterns of some individuals are driven not only by practical needs but also by psychological motivations, such as seeking inspiration or excitement, alleviating stress, achieving a sense of social belonging, and enhancing self-esteem.

Risk perception theory examines the subjective assessment of how an individual perceives, accepts, and evaluates the consequences of their actions and financial decisions. This theory posits that risk is not perceived solely through quantitative probabilities but is instead experienced differently by each person, depending on their personal experiences, available information, emotions, and value systems (Almansour et al., 2023; Victor Ricciardi et al., 2004). The perception makes them more susceptible during purchasing decisions, often leading to behavior where they sustain their consumption through loans and debt, even when it is unnecessary. Therefore, consumer psychology theory is highly effective in explaining attitudes toward debt at a psychological level.

Since behavioral factors influence financial decision-making, many researchers have studied how these factors affect credit decisions, especially in indebtedness. Individuals' indebtedness (Rahman et al., 2020) refers to the aggregate of an individual's overall perspective, encompassing their thoughts, beliefs, and feelings about debt or loans, which is subsequently reflected in their behavior. This indebtedness is a tendency to either accept or avoid credit, and it is a behavioral factor that directly influences a person's borrowing decisions. While some individuals view credit as a tool to fulfill financial needs, others perceive debt negatively, associating it with stress and financial risk. Consequently, this attitude forms the fundamental psychological basis for the decision to borrow money, serving as a critical indicator that can either increase or decrease the likelihood of incurring debt. Based on this approach, it can be inferred that personality characteristics serve as a significant predictor of an individual's loan repayment behavior (Özşahin et al., 2018).

Determinants of individual loan indebtedness encompass financial literacy, risk perception, materialism, and emotional factors.

The first, financial literacy (Domingo & Buvanendra, 2023; Matos Celso Augusto de et al., 2019; Muñoz-Murillo et al., 2020; Mwirigi et al., 2024; Sevim et al., 2012; Sinha et al., 2024; Xiao, 2020) sensitively influences borrowing decisions, as it enhances the understanding of financial situations and increases the ability to make confident decisions. Within literature, low levels of financial literacy, limited financial management skills, and insufficient experience in handling money are identified as key drivers of over-indebtedness (Gutiérrez-Nieto et al., 2017).

As financial markets undergo continual transformation, the significance of financial literacy and comprehensive financial understanding correspondingly intensifies (Sevim et al., 2012). Studies have shown that having good financial literacy can help you save, retirement plan, and accumulate wealth. This not only affects your future savings, but also your decisions about your current debt. People with low financial literacy are more likely to have more debt than they earn and are more likely to be late in paying off their debts (Brown et al., 2016; Carlander & Hauff, 2019; Hilgert & Hogarth, 2003).

Second, risk perception (Berger Sven C., 2009; Byambaa Oyundari et al., 2025; Flores & Vieira, 2014; Rahman Mahfuzur et al., 2020; Yuan et al., 2016). In financial contexts, individuals with a high awareness of risk approach decisions such as taking on debt or loans with greater caution and planning. Consequently, some research observes that people who understand risk well often exhibit debt-aversion behavior. However, under certain conditions, precisely because they comprehend and can calculate loan terms, they may feel more confident and consequently display a greater tendency to borrow (Slovic, 1987).

The third, emotionally (Ao et al., 2019; Drentea & Reynolds, 2012; Flores & Vieira, 2014; Rendall et al., 2021; Tian & Guo, 2023) sensitive people are more likely to make financial decisions under psychological influence, leading to unplanned or impulsive borrowing.

The fourth, individuals with high materialistic values tend to incur debt, as they prioritize consumption. Individuals with high levels of materialism (Flores & Vieira, 2014; Mishra & Mishra, 2016; Rahman Mahfuzur et al., 2020) tend to view consumption as a primary source of success and happiness. Empirical evidence indicates that materialism serves as a more powerful determinant of indebtedness levels than income or financial management capabilities (Gutiérrez-Nieto et al., 2017; Oliveira, 2020).

Materialism constitutes a significant determinant of consumers' indebtedness levels within modern economies, where immediate liquidity is no longer a prerequisite for consumption, as the widespread availability of credit allows individuals to purchase goods and defer payment (Pham et al., 2012; Watson, 2003).

The Current State of Fintech Lending in Mongolia

In response to the rapid development of the Fintech sector in Mongolia, the Central Bank of Mongolia created a banking sector reform in 2021. The Ministry of Electronic Development, Innovation, and Communications was newly established in 2022, marking the initial formation of a foundational legal and regulatory environment. The regulations under the Digital Development Package, which include the Laws on Public Information Transparency, Personal Data Protection, Electronic Signatures, and Cybersecurity, came into force on May 1, 2022. These laws are establishing a crucial legal framework aimed at ensuring the information security of consumers using digital services, strengthening the reliability of the digital environment, reducing paper-based operations to promote the shift to digital forms, and increasing the number of electronic contracts and transactions. For the Non-Banking Financial sector, with the goal of introducing technology-based new products, services, and business models into the domestic financial sector and establishing a regulatory sandbox environment, the "Regulatory Sandbox Framework" was approved on March 1, 2021.

Mongolia is positioned 71st in the Global Innovation Index (GII) (Global Innovation Center, 2022) and has identified telecommunications and information technology as core sectors for enhancing national economic competitiveness. To this end, a five-year policy roadmap has been introduced to facilitate the transformation toward a “digital nation” (Yang & Jung, 2024).

A comparison of the volume of traditional lending and fintech lending by NBFIs over the past five years shows a continuous increase. In 2020, the volume of fintech loans was 77.4 billion MNT, and by 2024, it reached 1,349.9 billion MNT, representing an increase of approximately 17.4 times. This indicates that fintech companies are rapidly expanding their market share and beginning to exert a greater influence on the financial market. The degree of market contribution of traditional NBFIs is gradually declining, signifying the enhanced competitiveness of fintech products and a shift in consumer behavior.

This is largely because fintech lending has created the potential to provide more accessible services to consumers, typically for small, short-term credit needs. In contrast, traditional loans primarily focus on higher-value, long-term loan products.

An analysis of the changes in the NBFI fintech loan portfolio from 2020 to 2024 shows that the quality of the loan book has remained stable. The proportion of standard loans has shown an increasing trend, rising from 90% to 92%, while the proportion of non-performing loans has shown a decreasing trend, falling from 7% to 5%.

For instance, in 2022, new regulations for fintech lending were introduced, making it mandatory to calculate the debt-to-income (DTI) ratio for fintech. This regulatory change indicates an improvement in fintech lending policies and risk management.

The fact that the NPL ratio has remained at a certain level to date continues to be an issue that requires close attention. Given that fintech institutions predominantly offer

small-amount, short-term loan products, there is a persistent risk of credit quality deterioration stemming from their large number of borrowers. Therefore, it is essential to further enhance policies and controls for credit risk management and improve the quality of borrower credit assessment moving forward.

In Mongolia's fintech lending sector, approximately 60 companies, such as Zeely, Pocket, Lendmn, Numur, Toki, Sono, Payon, Tus, Money-T, Net Pay, and Simply, among many more companies, are providing fintech and application loans. The terms and conditions for fintech loans vary depending on the specific institution. The interest rate on a loan differs based on the loan amount and term. Most fintech companies incentivize borrowers by offering benefits for on-time repayment, such as increasing the loan amount for subsequent applications or reducing service fees for future loans. For example, borrowers using the Pocket application can start from the "Fan" level and progress through ranks like "Star," "King," "Boss," and "God" by accumulating points. As their rank increases, users can enjoy various rewards, such as reducing their service fee to as low as 1%. After they increased their credit limit to up to 35 million MNT. Receiving partner coupons and promotions at higher discount rates.

Methodology

The data were analyzed using the Structural Equation Modeling (SEM) technique, specifically the Partial Least Squares method (PLS-SEM), with the Smart-PLS software. This method is effective for identifying causal relationships between unobservable variables (latent constructs) and testing research hypotheses. The variables examined in this research were adapted from the referenced study, and all four underlying constructs were systematically assessed. Each construct was measured using a five-point Likert-type scale, with response options ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Furthermore, we attempted to double-validate the quantitative data from the questionnaire using ANN.

Data

The study employed a purposive sampling method to include 162 digital loan service users aged 18-25. Data was collected via Google Forms.

On the basis of the above theoretical status, we have formulated the following research hypothesis. This study uses four independent variables (e.g., financial literacy, risk perception, materialism, and emotion) and one dependent variable (indebtedness).

Research Hypotheses: Hypotheses were proposed regarding how borrower behavior influences their debt management.

H1: Financial literacy (FI) has a positive influence on individual indebtedness (D).

H2: Risk perception (R) has a positive influence on individual indebtedness (D).

H3: Risk perception (R) has a negative influence on materialism.

H4: Risk perception (R) has a positive influence on emotion.

H5: Materialistic (M) values have a positive influence on individual indebtedness (D).

H6: Emotion (E) has a positive influence on individual indebtedness (D).

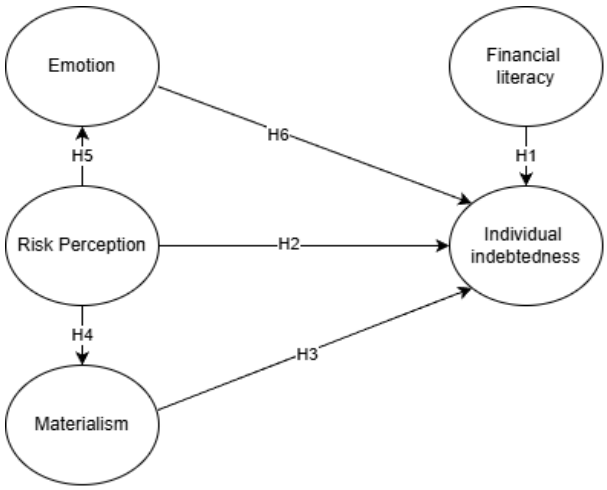

Figure 1. **Theoretical Model Structure**

Financial literacy refers to an individual's ability to understand, process, and apply financial concepts and information in practice. It emphasizes the critical importance of this variable in debt-related behavior, defining it as the competence in making decisions regarding loans, savings, interest, and planning, which fosters responsible credit usage (Muñoz-Murillo et al., 2020; Sevim et al., 2012; Sinha et al., 2024; Xiao, n.d.). Individuals with high financial literacy tend to be more cautious in their borrowing decisions and are proficient in managing their finances. Conversely, those with low financial literacy face higher risks of taking out unplanned loans, failing to understand loan terms, and being unable to make timely repayments. Therefore, financial literacy is a crucial variable for mitigating the risk of NPLs (Mwirigi et al., 2024; Mwirigi et al. 2024).

Risk perception is a subjective assessment that reflects how an individual perceives and evaluates risk and uncertainty when making decisions in a given situation. Individuals who perceive risk as high tend to be more cautious and vigilant towards debt and credit. Conversely, those with a low perception of risk, or who overestimate their financial resilience, are more prone to making unplanned, emotionally-driven financial decisions (Flores & Vieira, 2014).Therefore, how a person perceives risk is directly correlated with their level of debt and the likelihood of generating non-performing loans.

Materialism is a psychological tendency to view possessions, consumption, and wealth as the primary indicators of success, happiness, and social status. Research has concluded that individuals with materialistic attitudes tend to borrow more, driven by their high levels of consumption (Manafe & Fanggidae, 2021; Maria, 2023; Matos et al., 2019; Rahman et al., 2020). Such individuals are more likely to direct the value

of money toward immediate consumption rather than savings or investment. Consequently, unplanned credit use, unnecessary purchases, and excessive spending are common, which often impair their ability to service debt on time. Therefore, materialism has a negative impact on the incidence of non-performing loans.

Emotion is a psychological feeling that shapes an individual's response to any given situation and has a direct impact on financial decision-making. Rahman et al. identified emotion as a primary influence on debt-related behavior, concluding that decisions dominated by emotion often lead to unplanned borrowing and reduce a borrower's financial capacity (Flores & Vieira, 2014; Goel & Rastogi, 2023; E. K. Nyhus & Webley, 2001; Rahman et al., 2020).

Specifically, feelings such as anger, sadness, pride, and fear can trigger financially irresponsible actions, the consequence of which is an increased risk of generating NPLs. Therefore, accurately assessing emotional influence and preventing financial decisions from being based on emotion is a key strategy for mitigating credit risk.

Research Findings

Regarding the gender distribution of survey participants, 22.3% were male, and 77.7% were female, all residing in Ulaanbaatar city. In terms of education level, 64.2% had a higher education degree (bachelor's or above), 34.57% had completed full secondary education, and 1.23% had vocational education. In relation to borrower income distribution, 38.27% had a monthly income of up to 1 million MNT, 32.10% earned between 1-2 million MNT, 23.46% earned 2-4 million MNT, while 6.17% had income exceeding 4 million MNT. Furthermore, 51.7% obtained loans from two or more applications, meaning they had multiple simultaneous loans. Among borrowers, the most widely used applications were Zeely, Toki, and Pocket.

Table 1. Demographic Profile of the Survey Respondents

Question	Category	%	Question	Category	%
Gender	Male	22.22%	Monthly income	0-1,000,000	38.27%
	Female	77.78%		1,000,000-1,500,000	32.10%
Education	Higher	64.20%		2,000,000-4,000,000	23.46%
	Secondary	34.57%		4,000,000<	6.17%
Marital status	Married	33.33%	Location	Ulaanbaatar	82.72%
	Single	66.67%		Rural Area	17.28%

Source: Compiled by the Authors

Correlation Analysis

To establish the relationships between factors, a correlation analysis was conducted. The results presented in Table 2 indicate that the strongest observed correlation (r = 0.32) was between FL and ID.

Table 2. Results of the Factor Correlation Analysis

	ET	FL	ID	MT	RP
ET					
FL	-0.159				
ID	0.050	0.458			
MT	0.335	-0.007	0.042		
RP	0.293	-0.068	0.028	0.437	

Reliability Analysis of a Variable

To verify the reliability of the research factors, a reliability analysis (Cronbach's Alpha) was conducted for each factor. The results showed that four out of the five factors had a value above 0.7, while one factor had a value of 0.627. The Composite Reliability (rho_c) for all variables was ≥ 0.790. Based on this, the analysis proceeded with confirming high internal consistency and that the questionnaire was well-structured.

Table 3. Evaluation Results of the Structural Model

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
ET	0.882	0.930	0.911	0.673
FL	0.724	0.769	0.840	0.638
ID	0.730	0.740	0.804	0.579
MT	0.839	0.859	0.884	0.605
RP	0.710	0.720	0.784	0.648

Source: Compiled by the Authors

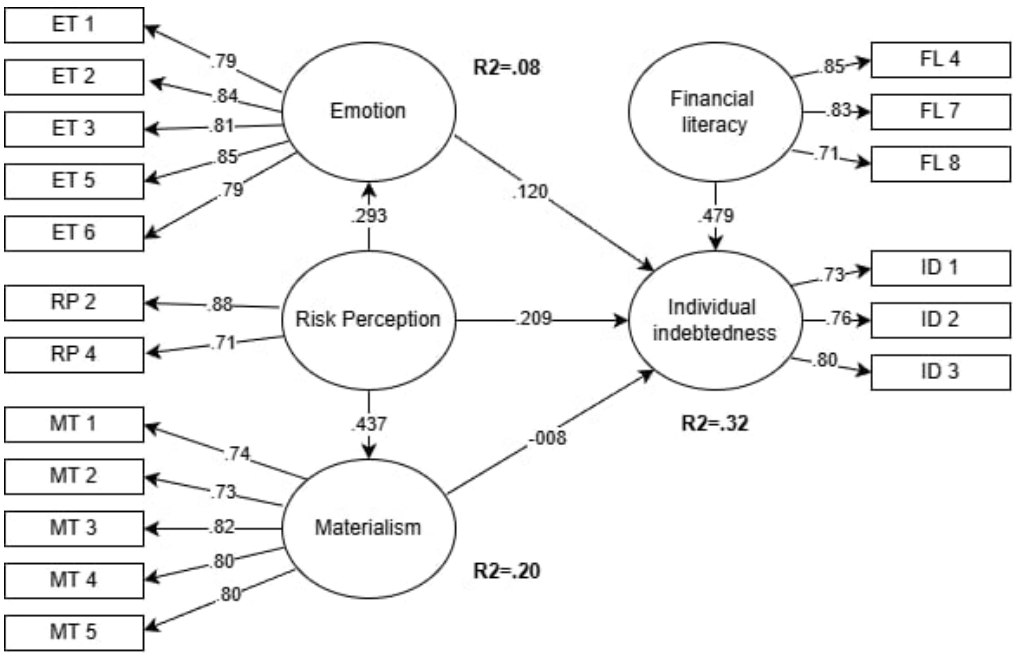

Figure 2. Structural Equation Model findings
Source: Compiled by the Authors

Furthermore, all HTMT values were below the recommended threshold of 0.90, thereby (Table 4) providing evidence that discriminant validity was adequately

established. The Fornell–Larcker criterion evaluation results confirm the discriminant validity of the structural model in Table 5.

Table 4. Heterotrait–Monotrait (HTMT)

	ET	FL	ID	MT	RP
ET					
FL	0.228				
ID	0.147	0.642			
MT	0.366	0.163	0.118		
RP	0.418	0.123	0.155	0.644	

Table 5. Fornell-Larcker

	ET	FL	ID	MT	RP
ET	0.82				
FL	-0.159	0.799			
ID	0.05	0.458	0.761		
MT	0.335	-0.007	0.042	0.778	
RP	0.293	-0.068	0.028	0.437	0.805

The variance inflation factor (VIF) values of the dependent variables were systematically examined to assess potential multicollinearity effects. Although the threshold for concern in this assessment is a VIF value less than 5, the results of our study fall within the range of 1.1 to 2.05, indicating that multicollinearity is not problematic and remains well within acceptable limits. We assessed model performance using multiple statistical indicators, including the effect size (f^2) and the coefficient of determination (R^2). The results presented in Fig. 2 indicate that the research model explains 32% of the variance in individual indebtedness, as reflected by an R^2 value of 0.32.

The practical significance of the path communication was assessed using effect size (f^2), which was interpreted according to established thresholds: large ($f^2 = 0.35$), moderate ($f^2 = 0.15$), and small ($f^2 = 0.02$). The effect sizes of FL on ID and RP on ID were found to be substantial, with f^2 values of 0.28 and 0.23, respectively. In contrast, the effect of RP on ET was of small magnitude ($f^2 = 0.09$), while the remaining relationships exhibited no meaningful practical effect.

The results of determining the statistical significance of variables using bootstrapping analysis are as follows:

Table 4. Results of Bootstrapping Analysis

	Beta coefficient (β)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
FL -> ID	0.479	0.055	8.631**	0.000
RP -> ID	0.209	0.077	0.375	0.707
MT -> ID	-0.008	0.075	0.104	0.917
RP -> MT	0.437	0.047	9.357**	0.000
RP -> ET	0.293	0.056	5.231**	0.000
ET -> ID	0.120	0.063	1.892	0.059

Note: ** $\rho < 0.01$, * $\rho < 0.05$

Based on the results of the research model, the variable with the strongest influence on individual indebtedness is **financial literacy**, which demonstrates a significant positive effect with β = 0.479, t = 8.631, and p < 0.001.

In contrast, **materialism** (β = -0.008, p = 0.917) and **emotion** (β = 0.120, p = 0.059) were found to be statistically insignificant, indicating minimal influence on indebtedness.

Risk perception positively influences individual (β = 0.437, p = 0.000) materialism, indicating a highly significant positive effect. Furthermore, risk perception also has a significant positive impact on emotion (β = 0.293, p = 0.000).

Of the six hypotheses proposed in the study, three (H1, H2, H4) were statistically supported, while three hypotheses (H3, H5, H6) were rejected.

Based on the research results, the influence of each factor can be explained as follows:

Financial literacy showed a strong positive impact on attitudes toward debt (p < 0.001). This indicates that individuals with higher financial literacy possess a better understanding of financial products, interest rates, loan terms, and repayment periods, and demonstrate greater confidence in financial decision-making. Therefore, the results suggest that financial literacy stimulates borrowing behavior and serves as a fundamental behavioral factor influencing debt-related decision making.

Risk perception was shown to exert a statistically significant positive effect on emotional state (p < 0.001). This indicates that individuals who are sensitive to risks tend to experience strong emotions - such as fear, anxiety, shame, and worry - when making financial decisions.

Risk perception was found to have a significant positive influence on materialism (p < 0.001). This indicates that individuals who thoroughly understand loan risks and terms tend to approach borrowing decisions with greater caution and organization. Such people are more likely to view credit as a potential tool for fulfilling financial

needs, and their ability to properly assess risks may make them more open to decisions regarding loans and debt.

However, the finding that risk perception has a positive influence on materialistic values contradicts the initial hypothesis (H3), which has therefore been rejected (Flores & Vieira, 2014).

Previous research (Abrantes-Braga & Veludo-de-Oliveira, 2020) suggested that individuals with high-risk perception tend to consciously evaluate the consequences of purchases and adopt more restrained and cautious financial behaviors to mitigate risks, often avoiding excessive consumption.

In contrast, a study by Rahman et al. (2020) yielded similar results to this study, showing a positive relationship between risk perception and materialistic values. The researchers proposed that for risk-aware individuals, material consumption may transcend mere possession - it can serve as a means to achieve psychological balance, express self-identity, and demonstrate social status.

Particularly in developing countries, factors such as urbanization**,** evolving consumption patterns**,** and social positioning may drive individuals toward materialistic goals. Even when people perceive financial risks, they might still engage in consumption as a form of self-expression or self-protection, leading to a more complex relationship between risk awareness and material attitudes.

This contrast highlights the context-dependent nature of risk perception's influence - shaped by cultural, economic, and social factors unique to Mongolia's rapidly modernizing environment.

Although materialism showed a positive influence on individual indebtedness, this relationship was not statistically significant ($\beta = -0.008$, $p = 0.917$). Previous researchers have identified materialism as a key predictor of debt attitudes, suggesting that financial institutions should consider borrowers' materialistic tendencies when evaluating credit applications.

Similarly, the hypothesis that emotion positively influences debt attitudes was not statistically supported. However, prior studies indicate that individuals with high emotional arousal tend to exhibit debt-prone behavior. For instance, it has been demonstrated that people often engage in impulse purchases to alleviate feelings of anxiety, stress, or depression.

Furthermore, the PLS-SEM analysis confirmed that financial literacy is the most significant predictor of indebtedness ($\beta = 0.479$, $p < 0.001$). Materialistic values and emotional state were statistically insignificant; risk perception demonstrated a complex influence pattern; it positively affected emotional state and materialistic values while materialism negatively affected indebtedness. These findings highlight the need for a nuanced assessment of consumer behavior characteristics.

Artificial Neural Network (ANN) Model

Based on the outcomes of the SEM analysis, an ANN model will be constructed that retains the fundamental structure of the original model. The performance of the ANN model will then be compared with the SEM results to facilitate a comprehensive evaluation.

In the structural model presented in Figure 6, the variables Emotion, Risk Perception, Materialism, and Financial Literacy are denoted as X_1, X_2, X_3, and X_4, respectively. The responses to items with factor loadings exceeding 0.7 were transformed using the following formula 1 to compute the mean scores. Similarly, the responses to items ID1, ID2, and ID3, corresponding to the construct Individual Indebtedness, were transformed using the same procedure.

Formula 1. Formula for calculating the mean of variables

$$z = \frac{1}{k}\sum_{1}^{k} x_i \quad (1)$$

Following the above transformation, the dependent variable, individual Indebtedness (Y), assumes values ranging from 1 to 5. The first 89 observations, corresponding to values 1–3, were assigned a value of 0, indicating consumers with poor debt management. The remaining participants were considered to have an adequate level of debt management, resulting in the creation of a binary variable coded as 0 and 1.

The artificial neural network (ANN) model was trained with a layer configuration of 64, 32, 16, and 1 nodes, using 100 epochs, a batch size of 32, and a learning rate of 0.0001. The binary cross-entropy loss function was employed, with ReLU activation functions in the hidden layers and a sigmoid activation function in the output layer. Early stopping was implemented based on the validation loss to prevent overfitting.

ANN Model Evaluation

The objective was to assess the performance of this model relative to the predictive outcomes of the SEM model. Accordingly, its performance was evaluated using standard metrics, including Accuracy, F1-score, Precision, Recall, the Brier score, and interpretability analysis through LIME.

The model evaluation yielded the following performance metrics: Accuracy = 0.72, F1-score = 0.68, and Brier score = 0.16. Based on the evaluation results, the outcomes of the LIME analysis can be primarily compared with those of the SEM model, and the comparison is interpreted as follows.

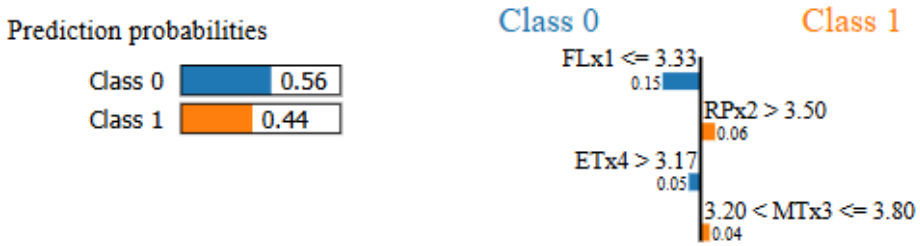

Figure 3. Lime evaluation result

A financial literacy scores below 3.33, combined with an emotion score above 3.17, indicates inadequate debt management. Conversely, an average risk perception score exceeding 3.5, or a higher degree of risk sensitivity, is associated with more effective debt management planning. Another notable finding is that a materialism score between 3.2 and 3.8 is indicative of effective debt management planning.

Conclusion

The Mongolian fintech sector is rapidly developing, and credit services are becoming more accessible. This growth has introduced new challenges, such as non-performing loan risks, consumer over-indebtedness, and financial irresponsibility. Financial institutions typically offer fintech loans under conditions characterized by short terms, rapid decision-making, and limited oversight. Incorporating indicators such as consumer behavior, psychological influences, and financial literacy into assessments of borrowers' creditworthiness is crucial for mitigating credit risks.

From a legal and regulatory perspective, the new regulations approved by the Financial Regulatory Commission in 2022, debt-to-income ratio limits, ISO/IEC 27001 requirements, and the implementation of the "regulatory sandbox" demonstrate progress at the policy level. However, challenges such as the lack of specialized legislation covering the fintech sector and the increasing number of disputes related to digital loan agreements highlight the need to ensure the stability of the legal environment.

This study aims to investigate how fintech users' behavioral, psychological, and demographic factors influence loan quality - particularly the likelihood of NPLs. The research is grounded in behavioral finance theory, consumer psychology, and risk perception theory, which collectively demonstrate that financial decision-making is influenced not only by logic but also by subjective elements such as emotions, perceptions, and awareness.

Since 2021, Mongolia has witnessed a sharp increase in fintech loan users. Notably, 76–82% of all NBFI borrowers now use fintech lending services. Fintech lending terms vary by institution but are generally characterized by small amounts and short durations compared to traditional loans.

Using PLS-SEM modeling, this study analyzed the relationships between behavioral and psychological factors - such as emotional state, materialistic values, financial literacy, and risk perception - and their impact on attitudes toward debt. The model revealed that financial literacy has the strongest positive influence on debt attitudes (β

= 0.479, $p < 0.001$), indicating that knowledgeable consumers better understand loan risks and make more responsible decisions.

Risk perception was found to positively influence both emotional state and materialistic values, suggesting that risk-prone situations can create psychological pressure, which may in turn stimulate a tendency toward external consumption. Although the direct effects of emotional state and materialistic values on individual indebtedness were not statistically significant, they may still play an indirect or mediating role in shaping financial behavior.

The study concludes that in the fintech sector, accurately assessing a user's credit risk requires not only financial and quantitative indicators but also consideration of personal characteristics such as education level, gender, financial literacy, and risk perception. Therefore, it is essential to enhance financial product design and lending policies by integrating behavior-based analysis to better serve diverse consumer profiles and mitigate credit risk.

In this research, an interesting result was found that ANN can not only determine but also predict an individual's behavior patterns in terms of their tendency towards debt.

Recommendations and Suggestions

For fintech NBFIs, there is a growing need to implement behavior-based evaluation models to accurately assess customers' credit risk. By developing systems that assess customers in greater depth based on psychological variables such as financial literacy, emotion, and materialism, it will be possible to reduce non-performing loan risks and manage loan portfolios more reliably. Such a system will help correctly estimate a customer's risk exposure and support taking optimal preventive measures.

It is necessary to deliver financial education programs targeted directly at consumers. Simplified explanations of basic financial concepts - such as loan terms, repayment schedules, and interest calculations - provided through introductions, guidelines, interactive content, as well as in-app notifications and reminders within fintech applications, play a crucial role in improving borrowers' decision-making and prevent over-indebtedness.

It is advisable to develop and implement targeted policies for users who are easily influenced by emotions and tend to make quick decisions. For example, digital tools such as cooling-off periods, consciousness verification, and conscious decision-making checklists can positively mitigate users' impulsive decision-making.

In Mongolia, there is a pressing need to establish a technology-driven, unified database and information exchange platform that can consolidate and display the overlapping loan data of customers who use multiple fintech applications simultaneously. This platform would serve as a vital mechanism for fostering inter-sectoral coordination, enabling a realistic assessment of customers' financial burdens and supporting more informed and responsible lending decisions.

Although laws related to the fintech sector are being passed in Mongolia, specific regulations governing fintech lending remain limited and are often subsumed under broader NBFI regulations. Therefore, it is essential to meticulously refine the legal framework to create a more reliable and user-friendly digital lending environment.

It is also appropriate for regulatory agencies and financial companies to consider these customer indicators in their operations, as it is possible to use artificial intelligence technology to determine the attitude towards debt through individual behavioral indicators.

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