INDERSCIENCE PUBLISHERS
Linking academia, business and industry through research

International Journal of Economics and Business Research

ISSN online: 1756-9869 - ISSN print: 1756-9850
https://www.inderscience.com/ijebr

Development of a financial capability model: a hybrid dual-stage partial least square structural equation modelling and artificial neural network analysis

Migena Petanaj, Lorena Çakërri, Robert Kosova

DOI: 10.1504/IJEBR.2025.10071941

Article History:

Received:	20 March 2025
Last revised:	23 April 2025
Accepted:	24 April 2025
Published online:	28 June 2025

Development of a financial capability model: a hybrid dual-stage partial least square structural equation modelling and artificial neural network analysis

Migena Petanaj* and Lorena Çakërri

Faculty of Economy,
University of Vlora 'Ismail Qemali',
Vlora, Albania
Email: migenapetanaj975@gmail.com
Email: lorenacakeri@gmail.com
*Corresponding author

Robert Kosova

Department of Mathematics,
Faculty of Information Technology,
University 'Aleksander Moisiu',
Durres 2000, Albania
Email: robertko200@gmail.com

Abstract: This study investigates the impact of financial knowledge, financial attitude, financial technology, and financial advice on financial capability. Additionally, it analyses the influence of financial attitude and financial capability on financial satisfaction. The research is conducted through an individual-level survey in Albania. Two methods are used: first, partial least square structural equation modelling (PLS-SEM) is used to determine which constructs have a significant effect on financial capability; in the second phase, an artificial neural network (ANN) model is applied to rank the relative influence of significant determinants identified through by PLS-SEM. The findings reveal that financial knowledge and financial technology have a significant impact on financial capability. Furthermore, the study identifies financial attitude and financial capability as key predictors of financial satisfaction. In practice, these insights can help policymakers and financial institutions in Albania develop effective strategies to enhance financial technology programmes and tailor financial education initiatives.

Keywords: financial capability; financial satisfaction; financial knowledge; financial attitude; financial technology; financial advice; FAD; artificial neural network; ANN; PLS-SEM.

Reference to this paper should be made as follows: Petanaj, M., Çakërri, L. and Kosova, R. (2025) 'Development of a financial capability model: a hybrid dual-stage partial least square structural equation modelling and artificial neural network analysis', *Int. J. Economics and Business Research*, Vol. 29, No. 14, pp.37–54.

Biographical notes: Migena Petanaj is a Lecturer and researcher in the Department of Accounting and Finance at Ismail Qemali University of Vlora, Albania. She specialises in various disciplines of financial economics and has

contributed extensively to the field. She is the author and co-author of several papers published in peer-reviewed journals and has presented her research at national and international scientific conferences. Additionally, she actively participates in Erasmus+ exchange programs.

Lorena Çakërri is a Lecturer and researcher in the Department of Accounting and Finance at Ismail Qemali University of Vlora, Albania. She specialises in various areas of financial economics, with a particular focus on topics such as foreign direct investment and economic growth. She has authored and co-authored several scholarly articles published in peer-reviewed journals and has presented her research at numerous national and international scientific conferences. In addition to her academic work, she actively engages in Erasmus+ exchange programmes, contributing to international academic collaboration and knowledge exchange.

Robert Kosova holds the title of Associate Professor in the field of Statistics. For the past 15 years, he has served as a Lecturer and researcher in the Department of Mathematics at the Faculty of Information Technology, University 'Aleksandër Moisiu' in Durrës, Albania. Her research interests encompass machine learning, multivariate statistics, operations research, and statistical programming with R and Python.

1 Introduction

Strengthening financial capability (FC) is essential for overcoming major economic challenges. It has been gaining increasing attention from policymakers in both high-income and emerging economies, as it is recognised for its role in promoting financial stability, advancing financial inclusion, and ensuring the efficient functioning of financial markets (World Bank, 2013). The concept of FC has been defined in various ways by different researchers. FC is defined as an individual's ability to effectively apply relevant financial knowledge (FK), perform ideal financial behaviours, and take advantage of available financial opportunities to achieve financial well-being. Key factors such as sustaining a livelihood, managing money, and possessing the right FK, attitudes, and behaviours are essential in assessing FC (Goyal and Kumar, 2021). According to Brown (2020), FC encompasses two key dimensions: an internal focus, which involves knowledge, skills, and behaviour, and an external focus, which addresses the influence of systems and structures within an individual's environment. Similarly, the World Bank (2013) defines FC as the combination of knowledge, skills, attitudes, and behaviours that enable individuals to effectively manage their financial resources. It includes the ability to understand, choose, and use financial products and services that align with their personal needs.

FC is closely linked to concepts such as financial literacy. In academic discourse, FK and financial literacy are often treated as interchangeable concepts (Huang et al., 2013). In 1992, the National Foundation for Educational Research described FK as the ability to make informed decisions in managing money (Noctor et al., 1992). Many scholars argue that the concept of FC has a broader scope than that of financial literacy (Shim et al., 2013; Taylor, 2011; World Bank, 2013).

Research suggests that financial literacy consists of three essential elements: FK, financial attitudes (FAs), and financial behaviour (Vieira et al., 2018). While financial

literacy includes the ability to act it does not account for external opportunities, such as financial advice (FAD) and financial inclusion (Kempson, 2020). FC links internal competencies, such as FK, behaviour and skills, with the external environment, including financial inclusion (i.e., access to and use of financial products and services), extending beyond the scope of financial literacy (Shi et al., 2024). Thus, FC integrates both financial literacy and access to opportunities through financial inclusion.

This study was conducted in Albania and aims to analyse the impact of FK, financial technology (FT), FA and FAD on FC. Existing literature provides limited evidence to clearly establish the relationship between FT and FC. To address this gap, the study examines the effect of FT on FC. It presents and introduces a conceptual model that integrates FK, FT, FAD, and FA in relation to FC. Additionally, the study explores the influence of the constructs of FC and FA on financial satisfaction (FS).

Previous studies have used partial least square structural equation modelling (PLS-SEM) to estimate parameters and test the research hypotheses. However, while PLS-SEM is effective for assessing linear relationships between variables in a model, unable to evaluate nonlinear relationships (Leong et al., 2013). To address this limitation, this study employs an artificial neural network (ANN) model to capture the nonlinear relationships between the variables in the model (Xhafaj et al., 2024). To the best of our knowledge, no existing studies have integrated both PLS-SEM and ANN approaches to analyse the factors influencing FC.

2 Literature review

FK is defined as an individual's comprehension of microeconomics, macroeconomics, and personal finance (Atlas et al., 2019). According to the OECD, FK is considered essential for determining an individual's financial literacy, which is assessed through questions on concepts such as simple and compound interest, risk and return, and inflation (Atkinson and Messy, 2012). Effective financial decision-making depends on individuals possessing the appropriate FK (Huston, 2010). FK is recognised to have both direct and spillover effects on FC (Xiao and O'Neill, 2016). Existing literature emphasises the pivotal role of FK in enhancing an individual's FC (Çera et al., 2020). Bhargava et al. (2022) reinforce this perspective by demonstrating a clear correlation between FK and FC. Similarly, Ali et al. (2015) highlight the positive impact of FK on FC. Furthermore, a broader body of evidence, including studies by Çera et al., 2021; Khan et al., 2022), consistently supports the strong link between FK and FC. Below is the hypothesis proposed concerning the relationship:

H1 FK has a positive effect on FC.

FT, commonly referred to as 'FinTech', represents an innovative financial service that has evolved alongside advancements in new technologies, enabling consumers to carry out financial activities digitally (Sabri et al., 2024). French et al. (2020) are among the few researchers who have explored critical factors, examining how the use of smartphone apps influences financial behaviour and highlighting the positive impact of FT on FC in the UK (French et al., 2020). Similarly, in the USA, Lusardi et al. (2021) emphasise the benefits of online technology in improving financial decision-making. FinTech empowers individuals to monitor their financial transactions, streamline payment schedules, and manage savings plans, thereby enhancing their FC (Nourallah and Ohman, 2021).

Nourallah et al. (2024) further underscore the significant positive impact of FinTech on FC, emphasising the crucial role of financial service providers in this progression. The authors also suggest that robust financial systems and infrastructure, which facilitate regular electronic payments, play a key role in strengthening FC. Therefore, the following hypothesis is developed:

H2 FT has a positive effect on FC.

Attitude represents underlying beliefs that influence behavioural intentions (Ajzen, 1991). FA refers to an individual's cognitive and emotional disposition, encompassing thoughts, beliefs, and evaluations related to financial matters (Talwar et al., 2021). Recognised as a key determinant of financial behaviour, FA reflects an individual's values and perspectives on critical issues, such as the importance of saving (Chowa et al., 2012). It integrates both cognitive and emotional dimensions, including belief systems, evaluative judgements, and thought processes, which collectively guide financial decision-making (Talwar et al., 2021). FA also encompasses confidence in making sound financial decisions, positioning it as a key factor in FC (Shim et al., 2013). Recent studies highlight the crucial influence of FA, demonstrating its significant positive effect on FC (Al Rahahleh, 2023; Shim et al., 2013). Bhargava et al. (2022) further reinforce this perspective, emphasising the strong correlation between FA and FC. French et al. (2020) demonstrate that changes in FAs, combined with improvements in FK and basic skills, can enhance FC. Therefore, the following hypothesis is proposed:

H3 FA has a positive effect on FC.

FAD refers to guidance provided by professionals or experts on managing investments, savings, and debt effectively. Such can enhance guidance can strengthen individuals' FCs by providing tailored recommendations and strategies to help them achieve their financial objectives (Chatterjee and Fan, 2023). Financial guidance and advice are essential for individuals to develop FC, enabling them to effectively plan and manage their finances for future financial stability (Overton, 2016). Empirical evidence suggests that FAD is instrumental in enhancing household financial literacy, a critical element of FC (Lotto, 2020). Through tailored guidance on investment strategies and debt management, FAD not only improves FK but also strengthens their financial management competencies, thereby fostering more informed and effective financial decision-making (Korankye et al., 2023). These studies suggest that greater access to FAD enables individuals to enhance their FC. Therefore, the following hypothesis is proposed:

H4 FAD has a positive effect on FC.

FS reflects an individual's level of fulfilment with their current financial circumstances. It represents a personal assessment of one's financial conditions to determine whether an individual is happy with it or not (Joo and Grable, 2004). Certain aspects of FC, including knowledge, understanding, skills, beliefs, and attitudes, influence FS (Owusu, 2023). Data from the 2009 US State-by-State Survey on FC revealed a positive relationship between perceived FC and FS (Xiao et al., 2014). Research by Zainul Arifin (2018) also demonstrates a strong positive relationship between FC and FS studies highlight FC as a key determinant in achieving FS (Xiao and O'Neill, 2018). Enhancing FC significantly improves individuals' FS (Xiao and O'Neill, 2018).

Further research is essential to better understand the influence of FA on FS. FA is defined as an individual's mindset, opinion, and judgment regarding financial matters

(Rai et al., 2019). These elements are fundamental aspects of attitude, closely linked to the human cognition, and have the potential to influence financial decision-making, thereby impacting FS (Zainul Arifin, 2018). A positive attitude towards financial matters is a crucial step towards achieving FS in life (Owusu, 2023).

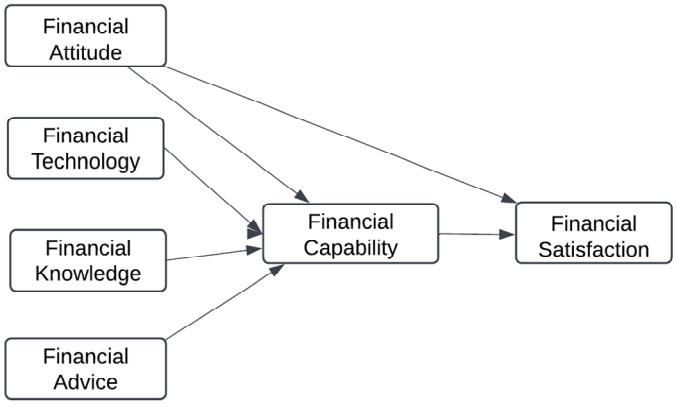
Studies by Falahati et al. (2012) and Owusu (2023) have demonstrated that FA is one of the factors that positively influencing FS. However, existing research remains limited in fully supporting the relationship between FA and FS. Based on this, we propose the following hypotheses regarding the effects of FC and FA on FS:

H5 FC has a positive effect on FS.

H6 FA has a positive effect on FS.

Building on the insights from the literature review, this study presents the research model depicted in Figure 1. As illustrated, the framework outlines the relationships between the constructs (variables) examined in the study. Specifically, the study investigates FT, FA, FK and FAD as key determinants of FC, while FS is explored as an outcome of both FC and FA.

Figure 1 Conceptual model



3 Data

This research was conducted in Albania, focusing on the individual level. This study adopts a quantitative approach, with data collected through a self-administered questionnaire. The questionnaire comprised two sections: the first gathered respondents' demographic information, while the second sought to assess their level of FC and the factors influencing it, using a five-point Likert scale. Additionally, the study examined respondents' perceptions of their FS levels and the underlying FCs and FAs that influence these outcomes.

The data collection process involved distributing a link to an online survey via social media channels between October 2024 and December 2024. A total of 210 surveys were completed, and the collected data were subsequently coded using SPSS. According to Hair et al. (2021), small to medium-sized models require a minimum sample size of 210 respondents, with at least ten respondents per estimated path.

FC was measured using two indicators (FINRA, 2012), while FK was operationalised with four indicators (Al Rahahleh, 2023), FS was measured using three indicators, FT was evaluated through 12 indicators (Sabri et al., 2024) additionally, five indicators were used to measure both FA and FAD (Nabila et al., 2023; Khan et al., 2022).

4 Methodology

The single-stage PLS-SEM analysis in the conceptual model is effective in identifying linear relationships among factors but is insufficient for predicting complex decision-making processes. To address this limitation, studies have incorporated the ANN approach as a second-stage analysis (Al-Emran et al., 2021). Initially, PLS-SEM was employed to identify the significant factors influencing FC. Subsequently, ANN was applied to rank the relative importance of the significant predictor variables identified through PLS-SEM (Sohaib et al., 2020).

4.1 PLS-SEM

The conceptual model of this study was analysed using PLS-SEM using Smartpls software 3.3.2. PLS-SEM is a widely used analytical method in confirmatory empirical studies to explore relationships between multiple variable sets (Yadav et al., 2024). It is particularly valuable for analysing causal connections and validating theoretical models (Igbaria et al., 1995). Furthermore, in terms of sample size and data distribution, the PLS-SEM method demonstrates superior statistical power (Xhafaj et al., 2025). The interpretation of the PLS-SEM model involves two stages: analysis of the measurement model (outer model) and analysis of the structural model (inner model) (Cakerri et al., 2025; Mooi, 2018). Importance-performance map analysis (IPMA) was conducted to assess the impact of indicators and constructs on the dependent variable.

The validity of the measurement model was evaluated by examining factor loadings, Cronbach's alpha (α), composite reliability (CR), average variance extracted (AVE), and the heterotrait-monotrait (HTMT) ratio (Xhafaj et al., 2022). Hair et al. (2021) suggested that the threshold values for both the Cronbach's alpha and CR coefficients should be greater than 0.7. The reliability of the indicators was assessed using factor loading values, with values exceeding 0.70 indicating strong factor loadings (Henseler et al., 2009). Convergent validity was examined using the AVE value. According to Hair et al. (2021), an AVE value greater than 0.50 is recommended, as it indicates that at least 50% of the variance in the indicators is explained by the construct. Discriminant validity confirms that two distinct constructs, representing different concepts, are empirically separable. The HTMT ratio of correlations is the criterion used to assess discriminant validity. An HTMT ratio below the threshold of 0.85 indicates that the two constructs being compared are distinct and not interchangeable (Ab Hamid et al., 2017).

The structural model is evaluated based on R^2 values, path coefficients, and their associated p-values (Hair et al., 2019). The bootstrapping technique, using 10,000 subsamples with replacements from the original dataset, was employed to assess the size and significance of the path coefficients.

4.2 Importance-performance map analysis (IPMA)

The IPMA was applied using the PLS-SEM approach, with FC designated as the target variable in this research. As outlined by Ringle and Sarstedt (2016), the IPMA assesses the structural equation model's relationships, focusing on the importance of latent constructs, while also introducing an additional dimension: the performance of these constructs. In IPMA, importance scores are derived from the total effects of the outcome variable in the structural equation model, while performance scores are calculated by rescaling the latent variable scores to range from 0 (lowest) to 100 (highest) (Ringle and Sarstedt, 2016).

4.3 ANN method

ANNs, a subset of artificial intelligence and machine learning techniques, are advanced models designed to efficiently capture and model nonlinear relationships (Negnevitsky, 2005). The multilayer perceptron (MLP) neural network is among widely used methods and consists of several hierarchical layers, including an input, a hidden layer, and an output. Each layer of the network is composed of neurons (nodes) that are interconnected with the neurons in the subsequent layers through adjustable synaptic weights (Kalinić et al., 2021; Shanbhag and Chandanshive, 2023). The input layer contains a number of neurones equal to the input predictors, while the output layer has neurones corresponding to the dependent variables. Following the recommendations of Sternad Zabukovšek et al. (2019), hidden neurons are automatically generated, with the sigmoid activation function applied to both the hidden and output layers. To mitigate the risk of overfitting, a ten-fold cross-validation approach was implemented, with 90% of the data allocated for model training and the remaining 10% for testing (Leong et al., 2015). The root mean square error (RMSE) was used to evaluate the predictive accuracy of ANN models (Yadav et al., 2016). Additionally, sensitivity analysis was conducted to assess the impact of each predictor on FC. Normalised importance was expressed as a percentage, calculated by dividing the relative importance of each neuron by the highest relative importance observed (Yadav et al., 2016).

5 Results

A total of 210 responses were collected, with 42.2% from male respondents and 57.8% from female respondents. Most of the participants 37.3% were between the ages of 20 and 25 years. About 9.2% of participants were between the ages 26 years and 35 years, 20.3% of participants were between the ages of 36 and 45 years, about 32.7% of participants were between the ages 46 years and 55 years, and 0.5% of participants belonged to the age group of over 55 years. In terms of residential background, 79.7% of respondents were from urban areas, while 20.3% came from rural areas (Table 1).

As presented in Table 2, all indicators in the research model demonstrated factor loadings exceeding the recommended threshold of 0.70, confirming strong indicator reliability. Both Cronbach's alpha and CR coefficients for all indicators surpassed the threshold value of 0.7, affirming the internal consistency of the survey instrument. Furthermore, the AVE values ranged from 0.543 to 0.812, satisfying the criteria for convergent validity across all constructs.

Table 1 Demographics data of respondents

Category	*Subcategory*	*Percentage*
Gender	Male	42.2
	Female	57.8
Age	Younger than 25 years old	37.3
	26–35	9.2
	36–45	20.3
	46–55	32.7
	Over 55 years	0.5
Education	High school	34
	Bachelor	43.1
	Master	22.9
Zone	Urban	79.7
	Rural	20.3

Table 3 presents the discriminant validity assessment using the HTMT criterion. All HTMT values range from 0.396 to 0.825, remaining below the conservative threshold of 0.85 (Henseler et al., 2015), thereby confirming discriminant validity. These results validate that each construct in the model is empirically distinct from the others, as supported by Hair et al. (2019).

Table 2 Measurement model evaluation

Constructs and indicators	*Outer loadings*	*Cronbach's alpha (α)*	*CR*	*AVE*
Financial knowledge (FK)		0.794	0.859	0.606
FK1	0.834			
FK2	0.782			
FK3	0.810			
FK4	0.877			
Financial advice (FAD)		0.796	0.854	0.543
FAD1	0.623			
FAD2	0.638			
FAD3	0.787			
FAD4	0.802			
FAD5	0.806			
Financial satisfaction		0.875	0.923	0.800
FS1	0.864			
FS2	0.915			
FS3	0.903			
Financial capability (FC)		0.769	0.896	0.812
FC1	0.892			
FC2	0.911			

Table 2 Measurement model evaluation (continued)

Constructs and indicators	Outer loadings	Cronbach's alpha (α)	CR	AVE
Financial technology		0.794	0.947	0.599
FT1	0.778			
FT2	0.866			
FT3	0.878			
FT4	0.840			
FT5	0.805			
FT6	0.787			
FT7	0.701			
FT8	0.787			
FT9	0.870			
FT10	0.752			
FT11	0.791			
FT12	0.745			
Financial attitude (FA)		0.861	0.895	0.586
FA1	0.720			
FA2	0.791			
FA3	0.816			
FA4	0.734			
FA5	0.785			
FA6	0.777			

The structural model illustrates the relationships among the constructs (Figure 2). The structural model was assessed by analysing the significance of all direct effects and hypotheses using path coefficients and p-values. As shown in Table 4, the influence of FK on FC was found to be significantly positive ($\beta = 0.171$, $p < 0.1$), supporting H1. Hypothesis H2, which proposed that FT positively influences FC, was also supported ($\beta = 0.320$, $p < 0.01$). However, Hypothesis H3, which suggested that FA affects FC, was rejected as the effect was found to be insignificant ($\beta = 0.09$, $p > 0.01$). Similarly, FAD exhibited a positive but insignificant relationship with FC ($\beta = 0.001$, $p > 0.01$), leading to the rejection of H4. For FS, Hypothesis H5, which predicted a positive effect of FC on FS, was supported ($\beta = 0.527$, $p < 0.01$). Lastly, Hypothesis H6, which suggested a positive association between FA and FS, was also supported ($\beta = 0.262$, $p < 0.01$).

FC was found to have an R^2 of 0.34 indicating that 34% of the variable was explained by the FA, FT, FK and FAD. FS exhibited an R^2 value of 0.47, signifying that 47% of its variance was explained by FC and FA.

To further investigate the empirical results, this study employed the importance-performance map analysis (IPMA) technique (Ringle and Sarstedt, 2016). This approach utilises the average latent variable scores. To assess the significance and performance of key predictor constructs in relation to a specific target construct.

In this study, FC was designated as the target construct, and IPMA was applied to evaluate the relative importance and performance of the influencing factors. The findings revealed that FT emerged as the most important determinant of FC, making it a crucial area for policymakers' attention. The results of the IPMA are presented in Table 5.

Table 3 Heterotrait-monotrait

	FA	*FAD*	*FC*	*FK*	*FS*	*FT*
FA						
FAD	0.559					
FC	0.400	0.396				
FK	0.814	0.646	0.437			
FS	0.468	0.610	0.748	0.458		
FT	0.496	0.825	0.505	0.576	0.644	

Table 4 Estimation of the structural model

Hypothesis	*Path coefficients*	*P-values*	*T- statistic*
FA→FC	0.09	0.358	0.906
FA→FS	0.262	0.001	3.493
FAD→FC	0.001	0.882	0.149
FC→FS	0.527	0.000	6.997
FK→FC	0.171	0.08	1.701
FT→FC	0.320	0.006	2.734

Table 5 IPMA results for the construct FC

Factor	*Importance*	*Performance*
FK	0.329	78.148
FT	0.487	67.918

The PLS-SEM estimation identifies FT and FK as the key constructs influencing FC. Consequently, these two constructs are used as inputs in the ANN model's input layer (model A), while FC serves as the output layer. Similarly, PLS-SEM demonstrates the variables that impact FS are FC and FA. Therefore, in this framework, FC and FA function as inputs, while FS serves as the output (model B).

The two ANN models demonstrate highly accurate predictions, as evidenced by their RMSE values (Table 6 and Table 7) which range from 0.125 to 0.136 (Leong et al., 2015).

The ANN ranking normalised relative importance confirms that FT is the most significant predictor of FC (Table 8). Results of the sensitivity analysis show that FC is the most important predictor of FS (Table 9).

Figure 2 The structure and relationships of the conceptual model (see online version for colours)

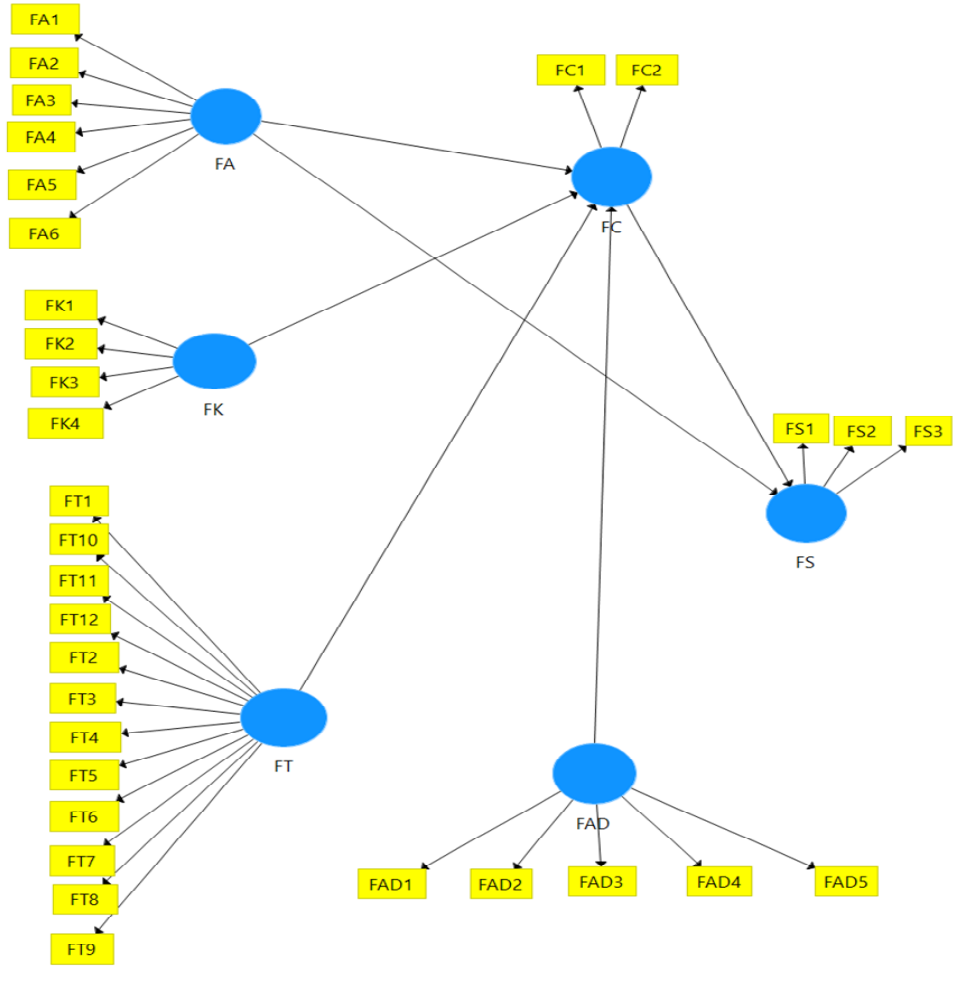


Table 6 RMSE values for the ANN model-A

Network	*Training*	*Testing*
ANN1	0.171	0.141
ANN2	0.176	0.178
ANN3	0.180	0.153
ANN4	0.184	0.167
ANN5	0.176	0.148
ANN6	0.185	0.117
ANN7	0.175	0.192
ANN8	0.177	0.176
ANN9	0.180	0.167
ANN10	0.190	0.17

Figure 3 ANN model-A (see online version for colours)

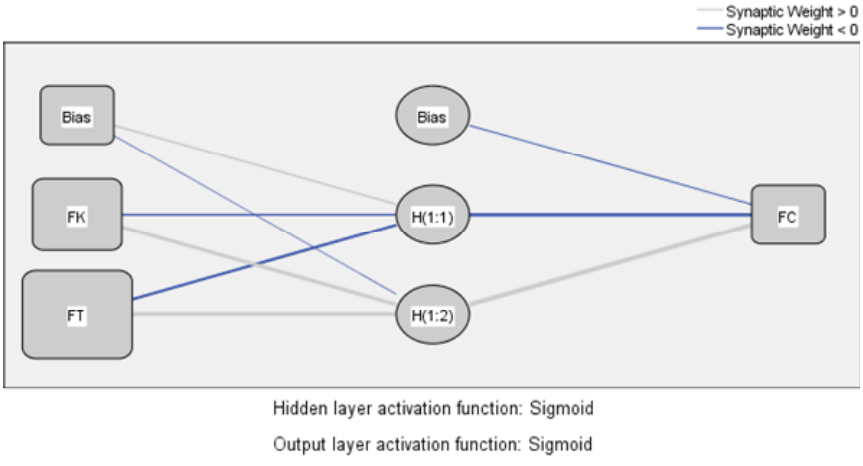


Figure 4 ANN model-B (see online version for colours)

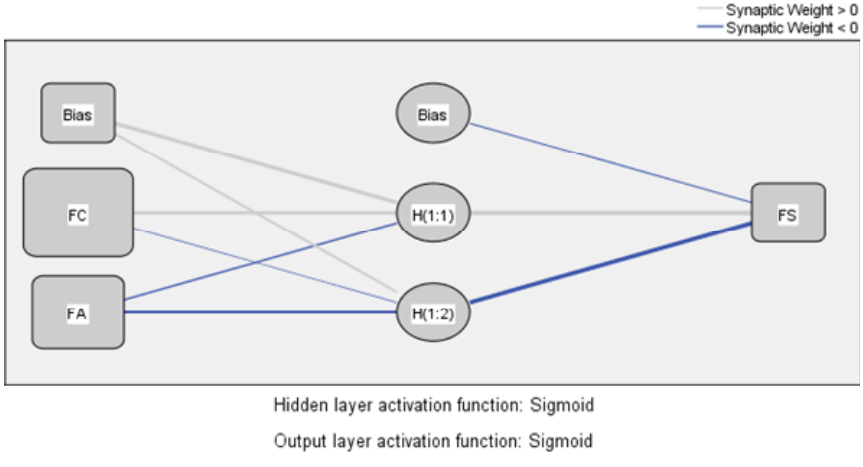


Table 7 RMSE values for the ANN model-B

Network	*Training*	*Testing*
ANN1	0.120	0.131
ANN2	0.134	0.139
ANN3	0.128	0.110
ANN4	0.146	0.155
ANN5	0.135	0.080
ANN6	0.127	0.037
ANN7	0.122	0.134
ANN8	0.126	0.110
ANN9	0.129	0.106
ANN10	0.140	0.142

Table 8 Normalised relative importance (target construct FC)

Independent constructs	*Importance*	*Normalised relative, importance*	*Ranking*
FT	0.539	100%	1
FK	0.461	85.4%	2

Table 9 Normalised relative importance (target construct FS)

Independent constructs	*Importance*	*Normalised relative, importance*	*Ranking*
FC	0.570	100%	1
FA	0.430	75.4%	2

6 Discussion

The study's findings are two-fold: one concerns the factors influencing FC, and the other is related to the FC and FA as predictors of FS. This study found that FT has a significant positive impact on FC. This suggests that FT plays a key role in enhancing individuals' FC. The positive and significant effect of FinTech on FC highlights the crucial role of financial service providers in strengthening individual FC (Nourallah et al., 2024). This finding aligns with the conclusion of D'Acunto and Rossi (2023), which highlights that certain FinTech solutions, such as robo-advisors, can assist households in overcoming behavioural biases by providing vital information and helping them make informed financial decisions.

FK was found to have a significant impact on FC, suggesting that improving individuals' FK can effectively enhance their FC. It is reasonable to conclude that FK strengthens financial decision-making, leading to better FC. This finding is consistent with the work of Bhargava et al. (2022) and Al Rahahleh (2023), who highlight the critical role of FK in shaping FC.

An individual's understanding of financial systems and markets is a key component of FC (Lusardi and Mitchell, 2014). In addition to FT, advancements in FK are likely to play a positive role in enhancing FC in Albania.

On the other hand, FA was found to have a positive yet insignificant relationship with FC. Holding a certain attitude toward money does not automatically result in the ability or opportunity to act upon it (FC) (von Stumm et al., 2013). This finding also aligns with the results (Çera et al., 2021).

The relationship between FC and FS was found to be positive and statistically significant. Effectively managing one's FCs allows individuals not only to meet their immediate needs but also to plan for future ones, leading to greater overall FS.

The positive coefficient indicates that as FC improves, the likelihood of achieving FS increases. These findings are in line with previous studies (Xiao and O'Neill, 2018; Zainul Arifin, 2018).

The results indicate that there is a positive and significant relationship exists between FA and FS. This outcome suggests that having a positive attitude toward financial matters is considered an important step in achieving FS in life (Owusu, 2023). These findings are consistent with the conclusions of Owusu (2023) and Zainul Arifin (2018).

7 Conclusions

The overall aim of this study was to develop a FC model. The determinants of FC and FS were outlined within the context of Albania, an upper-middle-income economy.

This study employed a dual approach, combining two-stage PLS-SEM and ANNs, to model and assess FC and FS.

PLS-SEM is used to analyse linear relationships among variables. However, as a linear technique, it cannot account for nonlinear effects within the research model, which may sometimes result in oversimplification and inaccurate findings (Tan et al., 2014). ANN was employed to rank the relative importance of significant predictor constructs identified by PLS-SEM. Additionally, ANN excels at modelling complex relationships, both linear and nonlinear (Tan et al., 2014). To the authors' knowledge, no previous studies have combined PLS-SEM and ANN approaches to examine the factors affecting FC. The results of the two-step PLS-SEM and ANN approach confirm the robustness of the findings obtained through PLS-SEM analysis. IPMA was also employed to offer a more precise understanding of the importance and performance of each construct.

This study developed and verified an extended model to determine an individual's FC and FS. The study's novelty lies in examining the role of FT in FC, addressing the significant gap in existing literature on the relationship between FT and FC. As evidenced by the findings, FC was influenced by FK and FT being the most important construct. Furthermore, it is confirmed that FA and FC are important drivers for enhancing individuals' FS.

The research findings offer valuable insights for individuals, policymakers, financial planners, and educators, guiding the creation of effective programs to enhance FC and inclusion. Specifically, they emphasise the importance of developing strategies to improve FT programs and customise educational initiatives, ultimately contributing to greater financial well-being and overall satisfaction.

EU policy discussions have focused on improving public financial literacy, particularly in response to challenges posed by the COVID-19 pandemic and the conflict in Ukraine. However, it is essential to recognise that financial literacy is inherently a passive strategy. To complement efforts in this area, a more proactive approach should be explored, with FC offering a promising solution.

This study has certain limitations. The data were gathered exclusively in Albania, which may limit the generalisability of the findings. Future research could explore a cross-country comparative study using a larger dataset. Additionally, incorporating moderator variables such as age and gender for comparison could yield interesting insights.

Declarations

All authors declare that they have no conflicts of interest.

References

Ab Hamid, M.R., Sami, W. and Mohmad Sidek, M.H. (2017) 'Discriminant validity assessment: use of Fornell & Larcker criterion versus HTMT criterion', *Journal of Physics: Conference Series*, Vol. 890, No. 1, https://doi.org/10.1088/1742-6596/890/1/012163.

Ajzen, I. (1991) 'The theory of planned behavior. Organizational behavior and human decision processes', in *Disability, CBR and Inclusive Development*, Vol. 33, No. 1.

Al Rahahleh, N. (2023) 'Determinants of the financial capability: the mediating role of financial self-efficacy and financial inclusion', *International Journal of Economics and Financial Issues*, Vol. 13, No. 6, https://doi.org/10.32479/ijefi.14531.

Al-Emran, M., Abbasi, G.A. and Mezhuyev, V. (2021) 'Evaluating the impact of knowledge management factors on m-learning adoption: a deep learning-based hybrid SEM-ANN approach', in *Studies in Systems, Decision and Control*, Vol. 335, https://doi.org/10.1007/978-3-030-64987-6_10.

Ali, A., Rahman, M.S.A. and Bakar, A. (2015) 'Financial satisfaction and the influence of financial literacy in Malaysia', *Social Indicators Research*, Vol. 120, No. 1, https://doi.org/10.1007/s11205-014-0583-0.

Atkinson, A. and Messy, F-A. (2012) *Measuring Financial Literacy: Results of the OECD/International Network and Financial Education*, OECD Working Papers on Finance, Insurance and Private Pensions.

Atlas, S.A., Lu, J. and Micu, P.D. (2019) 'Financial knowledge, confidence, credit use, and financial satisfaction', *Journal of Financial Consueling and Planning*, Vol. 30, No. 2, pp.175–190.

Bhargava, M., Sharma, A., Mohanty, B. and Lahiri, M.M. (2022) 'Moderating role of personality in relationship to financial attitude, financial behaviour, financial knowledge and financial capability', *International Journal of Sustainable Development and Planning*, Vol. 17, No. 6, https://doi.org/10.18280/ijsdp.170635.

Brown, J.B. (2020) *Economic Dignity and Financial Capabilities*, Brotherhood of St. Laurence, Fitzroy, Vic.

Cakerri, L., Petanaj, M. and Kosova, R. (2025) 'Factors influencing intention to use e-banking: an integrated model approach', *International Journal Innovative Research and Scientific Studies*, Vol. 8, No. 1, pp.2346–2356.

Çera, G., Khan, K.A., Mlouk, A. and Brabenec, T. (2021) 'Improving financial capability: the mediating role of financial behaviour', *Economic Research-Ekonomska Istrazivanja*, Vol. 34, No. 1, https://doi.org/10.1080/1331677X.2020.1820362.

Chatterjee, S. and Fan, L. (2023) 'Surviving in financial advice deserts: limited access to financial advice and retirement planning behavior', *International Journal of Bank Marketing*, Vol. 41, No. 1, https://doi.org/10.1108/IJBM-01-2022-0022.

Chowa, G., Despard, M. and Akoto, I. (2012) *Financial Knowledge and Attitudes of Youth in Ghana*, Youth Save Research Brief No.12-37, Washington University, Center for Social Development, St. Louis, MO.

D'Acunto, F. and Rossi, A.G. (2023) 'Robo-advice: transforming households into rational economic agents', in *Annual Review of Financial Economics*, Vol. 15, https://doi.org/10.1146/annurev-financial-110921-013217.

Falahati, L., Sabri, M.F. and Paim, L.H.J. (2012) 'Assessment a model of financial satisfaction predictors: examining the mediate effect of financial behaviour and financial strain', *World Applied Sciences Journal*, Vol. 20, No. 2, https://doi.org/10.5829/idosi.wasj.2012.20.02.1832.

FINRA (2012) *National Financial Capability Study Military Survey*, Regulatory Authority Investitor Education FoundationFinancial Industry, Washington, DC.

French, D., McKillop, D. and Stewart, E. (2020) 'The effectiveness of smartphone apps in improving financial capability', *European Journal of Finance*, Vol. 26, Nos. 4–5, https://doi.org/10.1080/1351847X.2019.1639526.

Goyal, K. and Kumar, S. (2021) 'Financial literacy: a systematic review and bibliometric analysis', in *International Journal of Consumer Studies*, Vol. 45, No. 1, https://doi.org/10.1111/ijcs.12605.

Hair Jr., J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., Danks, N.P. and Ray, S. (2021) *Using R: A Workbook. Partial Least Squares Structural Equation Modeling (PLS-SEM)*.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019) 'When to use and how to report the results of PLS-SEM', in *European Business Review*, Vol. 31, No. 1, https://doi.org/10.1108/EBR-11-2018-0203.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modelling', *Journal of the Academy of Marketing Science*, Vol. 43, No. 1, https://doi.org/10.1007/s11747-014-0403-8.

Henseler, J., Ringle, C.M. and Sinkovics, R.R. (2009) 'The use of partial least squares path modeling in international marketing. New challenges to international marketing', in *Advances in International Marketing*, Vol. 20, pp.277–319.

Huang, J., Nam, Y. and Sherraden, M.S. (2013) 'Financial knowledge and child development account policy: a test of financial capability', *Journal of Consumer Affairs*, Vol. 47, No. 1, https://doi.org/10.1111/joca.12000.

Huston, H.S. (2010) 'Measuring financial literacy', *Journal of Consumer Affairs*, Vol. 44, No. 2, pp.296–316.

Igbaria, M., Guimaraes, T. and Davis, G.B. (1995) 'Testing the determinants of microcomputer usage via a structural equation model', *Journal of Management Information Systems*, Vol. 11, No. 4, https://doi.org/10.1080/07421222.1995.11518061.

Joo, S.H. and Grable, J.E. (2004) 'An exploratory framework of the determinants of financial satisfaction', *Journal of Family and Economic Issues*, Vol. 25, No. 1, https://doi.org/10.1023/B:JEEI.0000016722.37994.9f.

Kalinić, Z., Marinković, V., Kalinić, L. and Liébana-Cabanillas, F. (2021) 'Neural network modeling of consumer satisfaction in mobile commerce: an empirical analysis', *Expert Systems with Applications*, Vol. 175, https://doi.org/10.1016/j.eswa.2021.114803.

Kempson, E. (2020) *Measuring Financial Capability: A New Instrument and Results from Low- and Financial Literacy Education*, October, Financial Literacy and Education Rusia Trust Fund, World Bank Group, Washington, DC.

Khan, K.A., Çera, G. and Alves, S.R.P. (2022) 'Financial capability as a function of financial literacy, financial advice, and financial satisfaction', *E a M: Ekonomie a Management*, Vol. 25, No. 1, https://doi.org/10.15240/tul/001/2022-1-009.

Korankye, T., Pearson, B. and Salehi, H. (2023) 'Financial advice use and saving for children's college education: a propensity score matching approach', *Journal of Financial Counseling and Planning*, Vol. 34, No. 1, https://doi.org/10.1891/JFCP-2021-0069.

Leong, L.Y., Hew, T.S., Lee, V.H. and Ooi, K.B. (2015) 'An SEM-artificial-neural-network analysis of the relationships between SERVPERF, customer satisfaction and loyalty among low-cost and full-service airline', *Expert Systems with Applications*, Vol. 42, No. 19, https://doi.org/10.1016/j.eswa.2015.04.043.

Leong, L.Y., Hew, T.S., Tan, G.W.H. and Ooi, K.B. (2013) 'Predicting the determinants of the NFC-enabled mobile credit card acceptance: a neural networks approach', *Expert Systems with Applications*, Vol. 40, No. 14, pp.5604–5620, https://doi.org/10.1016/J.ESWA.2013.04.018.

Lotto, J. (2020) 'Towards improving households' investment choices in tanzania: does financial literacy really matter?', *International Journal of Financial Studies*, Vol. 8, No. 2, https://doi.org/10.3390/ijfs8020029.

Lusardi, A. and Mitchell, O.S. (2014) 'The economic importance of financial literacy: theory and evidence', *Journal of Economic Literature*, Vol. 52, No. 1, https://doi.org/10.1257/jel.52.1.5.

Lusardi, A., Hasler, A. and Yakoboski, P.J. (2021) 'Building up financial literacy and financial resilience', *Mind and Society*, Vol. 20, No. 2, https://doi.org/10.1007/s11299-020-00246-0.

Mooi, Z.Y. (2018) 'Mobile-social media shopping: a partial least squares-structural equation modelling (PLS-SEM) approach', *International Journal of Modelling in Operations Management*, Vol. 7, No. 1, https://doi.org/10.1504/ijmom.2018.095659.

Nabila, F.S., Fakhri, M., Pradana, M., Kartawinata, B.R. and Silvianita, A. (2023) 'Measuring financial satisfaction of Indonesian young adults: a SEM-PLS analysis', *Journal of Innovation and Entrepreneurship*, Vol. 12, No. 1, https://doi.org/10.1186/s13731-023-00281-4.

Negnevitsky, M. (2005) *Artificial Intelligence: A Guide to Intelligent Systems*, Vol. 2, Pearson Education Limited, London.

Noctor, M., Stoney, S. and Stradling, R. (1992) *Financial Literacy*, a Report Prepared for the National Westminster Bank, National Foundation for Educational Research, London.

Nourallah, M. and Öhman, P. (2021) 'Impact of advanced technologies on consumer finance and retail investment: mobile bank applications and robo-financial advisors', in *Impact of Globalization and Advanced Technologies on Online Business Models*, IGI Global, USA.

Nourallah, M., Öhman, P. and Hamati, S. (2024) 'Financial technology and financial capability: study of the European Union', *Global Finance Journal*, Vol. 62, p.101008, https://doi.org/10.1016/J.GFJ.2024.101008.

Overton, L. (2016) 'Nancy Morrow-Howell and Margaret S. Sherraden (Eds.), *Financial Capability and Asset Holding in Later Life: A Life Course Perspective*, Oxford University Press, Oxford, 2015, hbk £34.49, ISBN 13: 978 0 019 937430 4', *Ageing and Society*, Vol. 36, No. 9, https://doi.org/10.1017/s0144686x16000787.

Owusu, G.M.Y. (2023) 'Predictors of financial satisfaction and its impact on psychological wellbeing of individuals', *Journal of Humanities and Applied Social Sciences*, Vol. 5, No. 1, https://doi.org/10.1108/jhass-05-2021-0101.

Rai, K., Dua, S. and Yadav, M. (2019) 'Association of financial attitude, financial behaviour and financial knowledge towards financial literacy: a structural equation modeling approach', *FIIB Business Review*, Vol. 8, No. 1, https://doi.org/10.1177/2319714519826651.

Ringle, C.M. and Sarstedt, M. (2016) 'Gain more insight from your PLS-SEM results', *Industrial Management & Data Systems*, Vol. 116, No. 9, https://doi.org/10.1108/imds-10-2015-0449.

Sabri, M.F., Anthony, M., Law, S.H., Rahim, H.A., Burhan, N.A.S. and Ithnin, M. (2024) 'Impact of financial behaviour on financial well-being: evidence among young adults in Malaysia', *Journal of Financial Services Marketing*, Vol. 29, No. 3, https://doi.org/10.1057/s41264-023-00234-8.

Shanbhag, A. and Chandanshive, V. (2023) 'Application of artificial neural network in environmental engineering a state-of-the-art review', *International Journal of Environment and Waste Management*, Vol. 1, No. 1, https://doi.org/10.1504/ijewm.2023.10055302.

Shi, W., Ali, M. and Leong, C-M. (2024) 'Dynamics of personal financial management a biblometric and systematic review on financial literacy, financial capability and financial behaviour', *International Journal of Bank Marketing*, Vol. 43, No. 1, pp.125–165.

Shim, S., Serido, J., Bosch, L. and Tang, C. (2013) 'Financial identity-processing styles among young adults: a longitudinal study of socialization factors and consequences for financial capabilities', *Journal of Consumer Affairs*, Vol. 47, No. 1, https://doi.org/10.1111/joca.12002.

Sohaib, O., Hussain, W., Asif, M., Ahmad, M. and Mazzara, M. (2020) 'A PLS-SEM neural network approach for understanding cryptocurrency adoption', *IEEE Access*, Vol. 8, https://doi.org/10.1109/ACCESS.2019.2960083.

Sternad Zabukovšek, S., Kalinic, Z., Bobek, S. and Tominc, P. (2019) 'SEM-ANN based research of factors' impact on extended use of ERP systems', *Central European Journal of Operations Research*, Vol. 27, No. 3, https://doi.org/10.1007/s10100-018-0592-1.

Talwar, M., Talwar, S., Kaur, P., Tripathy, N. and Dhir, A. (2021) 'Has financial attitude impacted the trading activity of retail investors during the COVID-19 pandemic?', *Journal of Retailing and Consumer Services*, Vol. 58, https://doi.org/10.1016/j.jretconser.2020.102341.

Tan, G.W.H., Ooi, K.B., Chong, S.C. and Hew, T.S. (2014) 'NFC mobile credit card: the next frontier of mobile payment?', *Telematics and Informatics*, Vol. 31, No. 2, https://doi.org/10.1016/j.tele.2013.06.002.

Taylor, M. (2011) 'Measuring financial capability and its determinants using survey data', *Social indicators Research*, Vol. 102, No. 2, pp.297–314.

Vieira, K.M., Potrich, A.C.G. and Mendes-Da-Silva, W. (2018) 'A financial literacy model for university students', in *Individual Behaviors and Technologies for Financial Innovations*, https://doi.org/10.1007/978-3-319-91911-9_4.

von Stumm, S., Fenton O'Creevy, M. and Furnham, A. (2013) 'Financial capability, money attitudes and socioeconomic status: risks for experiencing adverse financial events', *Personality and Individual Differences*, Vol. 54, No. 3, https://doi.org/10.1016/j.paid.2012.09.019.

World Bank (2013) 'Why financial capability is important and how surveys can help', *Financial Capability Survey around the World*, August.

Xhafaj, E., Qendraj, D., Kosova, R., Gjikaj, N., Mersinllari, O. and Alikaj, L. (2025) 'An integrating framework through the extension of the UTAUT2 model for online banking: a context from a two-staged approach with PLS-SEM and fuzzy Z-AHP', *Engineering Economics*, Vol. 36, No. 2, https://doi.org/10.5755/j01.ee.36.2.34640.

Xhafaj, E., Qendraj, D.H. and Salillari, D. (2024) 'A novel hybrid procedure of PLS-SEM, ANN and fuzzy TOPSIS for online banking', *Journal of Intelligent and Fuzzy Systems*, Vol. 46, No. 2, https://doi.org/10.3233/JIFS-235388.

Xhafaj, E., Qendraj, D.H., Xhafaj, A. and Gjikaj, N. (2022) 'A hybrid integration of PLS-SEM, AHP, and FAHP methods to evaluate the factors that influence the use of an LMS', *International Journal of Decision Support System Technology*, Vol. 14, No. 1, https://doi.org/10.4018/IJDSST.286697.

Xiao, J.J. and O'Neill, B. (2016) 'Consumer financial education and financial capability', *International Journal of Consumer Studies*, Vol. 40, No. 6, https://doi.org/10.1111/ijcs.12285.

Xiao, J.J. and O'Neill, B. (2018) 'Propensity to plan, financial capability, and financial satisfaction', *International Journal of Consumer Studies*, Vol. 42, No. 5, https://doi.org/10.1111/ijcs.12461.

Xiao, J.J., Chen, C. and Chen, F. (2014) 'Consumer financial capability and financial satisfaction', *Social Indicators Research*, Vol. 118, No. 1, https://doi.org/10.1007/s11205-013-0414-8.

Yadav, R., Sharma, S., Rawal, P., Singhal, A., Bagga, T., Mathur, D.S. and Vishnoi, S. (2024) 'Construct modelling, statistical analysis and empirical validation using PLS-SEM: a step-by-step guide of the analysis procedure', *International Journal of Data Analysis Techniques and Strategies*, Vol. 16, No. 2, https://doi.org/10.1504/ijdats.2024.10062510.

Yadav, R., Sharma, S.K. and Tarhini, A. (2016) 'A multi-analytical approach to understand and predict the mobile commerce adoption', *Journal of Enterprise Information Management*, Vol. 29, No. 2, https://doi.org/10.1108/JEIM-04-2015-0034.

Zainul Arifin, A. (2018) 'Influence of financial attitude, financial behaviour, financial capability on financial satisfaction', https://doi.org/10.2991/insyma-18.2018.25.