# FINANCIAL INNOVATION ADOPTION AS A DRIVER OF COMPETITIVE ADVANTAGE AMONG COMMERCIAL BANKS IN MACEDONIA

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**Abstract**

In an increasingly digital economy, financial innovation has become a key driver in transformation of how financial institutions provide value, run their businesses, and remain relevant. It includes development of new technological solutions, digital payment systems (DPS) and service channels that have changed the nature of banking. The aim of this research is to find out how the DPS, mobile banking (MB), online banking (OB) and risk-control mechanisms (RCM) affect the competitive advantage (CA) of commercial banks in Macedonia and what is the moderating effect of risk-control between variable variables. There were 300 managerial and operational staff members who were sampled and structured questionnaires were used to gather primary data; secondary financial performance records were also gathered. The International Business Machines Corporation (IBM) Statistical Package for the Social Sciences (SPSS) version 29.0 was used for quantitative analysis of the data obtained and the statistical techniques used were the following: Demographic analysis, Pearson correlation, multiple linear regression and hierarchical multiple regression for moderation tests. In addition, data screening and diagnostics of multicollinearity were also carried out. The results show that there are positive relationships between DPS $\beta = 0.352$, MB $\beta = 0.241$, and OB $\beta = 0.186$ with CA. Financial innovation adoption (FIA) is also positively related with OE $\beta = 0.617$. In addition, the relationship between FIA and RCM is positive and statistically significant ($\beta = 0.142$, $p = 0.008$), which indicates that RCM could reinforce the relationship between FIA and CA. The findings highlight the importance of digital infrastructure investment, accessible banking services, and effective risk-control practices for strengthening competitive positioning.

*Keywords:* Financial Innovation, Competitive Advantage, Digital Payment Systems, Mobile banking, Online Banking, Commercial Banks Macedonia.

## 1. Introduction

Financial innovation is significant part of competitiveness of commercial banks because it improves provision of services to customers, reduces costs and adapts to customer needs. Operational efficiency (OE), customer satisfaction and market positioning are improved by the use of digital payments, MB, OB and RCM. Digital technologies are also enabling greater financial access and services (Filipovska and Pendevska, 2023). Financial technology is shaping the future of banking, but its impact on consumers hinges on implementation and organizational skills. The research revealed that it is essential to comprehend consumer reactions to new technologies for the successful incorporation of AI into e-business in North Macedonia (Josimovski *et al.,* 2023). In the case of Macedonian banking sector, the research on fintech solutions shows their relevance to the financial service innovation. Sustainable competitive advantages, however, may be developed in these solutions, and research is needed to explore them (Stanoevska *et al.,* 2023). Likewise, it is essential to grasp customers' perceptions of electronic payment systems to assess the adoption of technology and the implications for financial services usage (Rexha, 2025). Digital transformation is a chance to improve the competitiveness of banking services and develop finance sector in North Macedonia. In the case of commercial banks, a interest rates and inflation rate are significant macroeconomic indicators that affect the savings of commercial banks (Maksuti, 2024). The challenges that organisations face in accessing wider markets has already been explored in existing research within cross-border regions in Europe. The results are not however directly determining the effect of financial innovation on CA of Macedonian commercial banks

(Baftijari and Hebibi, 2024). Moreover, the studies conducted on North Macedonian banks have focused on profitability and determinants of profitability, but profitability is not necessarily a full indicator of customer retention and bank's efficiency and market positioning (Spaseska *et al.,* 2025). Additionally, studies on MB applications have explored how customer experience drives their perceived value and satisfaction, underscoring the critical role of user experience in adoption of digital banking services (Palamidovska-Sterjadovska *et al.,* 2024). Although these have contributed to the development of commercial banks' CA in North Macedonia, further research is required to examine how digital payments, MB, OB and commercial banks' internal risk-control systems together affect commercial banks' CA in North Macedonia. To fill this research void, survey data, secondary financial data, correlation, and multiple regression method were utilized to explore relationship between these market positioning variables, customer retention variables, OE variables and cost reduction variables. This section emphasizes the research's findings and insights into North Macedonia's banking profitability and digitalization and financial innovation. The gap in this research is their relationships with market positioning, customer retention, OE and cost reduction by survey data, secondary financial data, correlation and multiple regression analysis.
In this section, the most important findings of the research to the knowledge of banking profitability, digitalization and financial innovation in North Macedonia are highlighted.

- Examines relationships of DPS, MB, and OB on competitive advantage.
- Compares costs and benefits of financial innovation for economy and society.
- Investigates moderating role of RCM in strengthening banking competitiveness in Macedonia.

The remaining work in this research is organized as follows. Related literature is reviewed in Section 2, hypothesis development in Section 3, methodology in section 4, discussion of the results in Section 5 and conclusions in section 6 with implication and direction for further research.

## 2. Related work

It critically reviews relevant empirical research, highlighting their investigation approaches, key findings, and limitations. The review establishes the foundation for identifying the research gap addressed in the research.

Ajrula *et al.* (2026) explored the bank-specific and macro-economic drivers of banking profitability in North Macedonia during 2010-2024 using Pearson correlation, and descriptive statistics. Their results showed that internal banking variables had higher relationships with profitability than macroeconomic variables. The research, however, only included the bank-specific and macro-economic determinants selected and excluded variables that could be other factors influencing the organisation and the market. The research analyzes the level of adoption of FinTech services and digital economic development in seven Balkan countries, employing the tools of Principal Component Analysis (PCA), analysis of variance (ANOVA), cluster analysis and regression analysis. They found that there is a positive relationship between the adoption of FinTech and development of digital economy, and five factors are identified: digital payments, MB, digital infrastructure, regulatory quality, financial literacy and trust. Nevertheless, it is important to recognize the limitations in regional coverage of the research, which could impact the relevance of its results for each country. Selamovski (2025) examined the drivers of Foreign Direct Investment (FDI) inflows to North Macedonia for the period 2010-2023, relying on a gravity model with 490 observations and 35 countries. The complete model had an adjusted ($R^2$) of 0.325. The correlations with distance, bilateral investment treaties and double taxation avoidance agreements came out to be −0.227, 0.313 and 0.323 respectively. In the full model, the host-country and source-country GDP coefficients were

2.520 and statistically significant at 1% level, respectively. However, the results are applicable only for the chosen countries and observation period, and might not reflect variations in FDI determinants outside the research period or in countries not included in the analysis. In the context of the country's North Macedonia, Lokce and Bojadzievska Danevska (2025) examined the feasibility of developing a digital participation bank based on interest-free financing. They have taken into account the banking environment, experiences and the regulatory framework in other countries. Potential areas of financial inclusion, development of small & medium enterprises and investment attractiveness were identified in the research and challenges of regulatory barriers and lack of awareness among consumers & institutions were identified. Nevertheless, the research was mainly centred on the institutional feasibility and regulatory conditions, therefore it was not possible to draw the findings to the extent that it would result in practical financial performance of the recommended banking model.

Kosumi and Zharku (2024) examined the profitability of banking industry in North Macedonia using quarterly data for period of 2007-2022 and a Vector Error Correction Model (VECM). A reported Augmented Dickey–Fuller test reported a first difference stationary ROA with 0.00 probability. According to Johansen cointegration test, nine cointegrating relationships were found to be significant at 5% level. Research found that the negative association of credit risk, liquidity, and non-performing loans with profitability and the positive association of capital adequacy and OE with profitability, respectively. The analysis, however, was limited to the selected financial and macro-economic variables and observation period and may not have captured other variables or developments beyond the model or changes in the banking environment since 2022. The research by Prenaj, Miftari and Berisha (2024) examined the profitability of commercial banks in Western Balkan countries based on panel data of period 2010–2020. They found coefficients for their random-effects model of return on assets of −0.0821 for the non-performing loan ratio, 0.0683 for real GDP growth, and −0.0069 for number of banks. Random-effects specification was also supported by the model reported ($R^2$=0.36) and adjusted ($R^2$=0.31) as well as by the Hausman test (p=0.706). However, the results are based on variables selected for each bank and macroeconomic level of sample countries in Western Balkans and do not necessarily fully capture variation among banking systems. Qerimi Sadiku has investigated the effectiveness and constancy of banking sector in North Macedonia during the period 2004-2024 and Demiri Bekteshi (2025) based on annual data and linear regression analysis. Their model reported ($R^2$=0.858), (F=15.148), and a model significance value of (p<0.001). There were negative coefficients for cost-to-income ratio at −0.063 (p=0.004) and a positive coefficient for employee cost to total regular income at 0.021 (p=0.001). Non-interest margin was not statistically significant (β=-0.036, p=0.394), while net interest margin had a negative coefficient of −0.021 (p<0.001). The analysis, however, was restricted to a few indicators of efficiency and stability in the banking sector, such that conclusions that can drawn about other dimensions of their performance are necessarily more limited.

*2.1 Research gap:* Although previous research has examined banking profitability, financial efficiency, FinTech adoption, and digital participation in North Macedonia and the Western Balkans (Ajrula *et al.,* 2026; Radulović & Jovović, 2025; Kosumi & Zharku, 2024; Lokce & Bojadzievska Danevska, 2025), limited attention has been given to how specific digital banking innovations influence competitive advantage. Existing research primarily focuses on profitability, macroeconomic determinants, and digital transformation. Therefore, this research overcomes issues through examining digital payments, MB, and OB in relation to competitive advantage, while investigating OEand moderating role of RCM among commercial banks in Macedonia.

## 3. Hypothesis Development

Research has aim to investigate effect of FIA on CA of commercial banks in North Macedonia. Three pillars of financial innovation are: DPS, MB and OB. CA is the primary outcome variable while additional outcome variable is OE. The moderating variable is RCM that is defined as the procedures used in identifying and mitigating financial and digital transaction risks. In the conceptual framework, the direct relationships between DPS, MB, and OB as well as between FIA and OE were discussed, and the role of RCM as a moderator in the relationship between FIA and CA was discussed. The correlations between these variables can be seen in Figure 1.

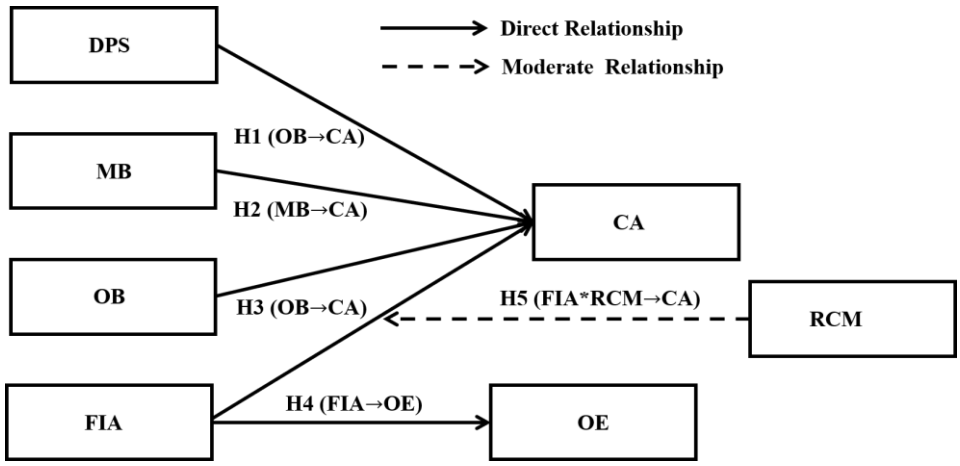



**Figure 1.** Conceptual frameworks on FIA, OE, RCM and CA.

*H1: DPS has a significant positive effect on CA:* DPS contribute to more efficient service, better accessibility to payment and faster transaction time. The benefits can increase the convenience of the customer and improve the competitive position of a commercial bank.
*H2: CA is highly positively influenced by the adoption of MB:* MB provides convenient access to financial services and flexible transactions. These benefits can enhance service provision and customer retention, which can positively affect banks' market position.
*H3: The effect of adoption of OB to CA is significant and positive:* OB helps in making financial transactions possible from remote areas, helps in making the financial services more accessible and helps in simplifying the banking process. These can enable commercial banks to deal with digital competition and enhance their competitive edge.
*H4: FIA has a significant positive impact on OE*: Using FIA in digital banking service can help to streamline transactions, minimize manual processes, and optimize resource utilization, which helps to support the efficiency of operations.
*H5: RCM positively moderates the relationship between FIA and CA*: When RCM is more effective the relation between FIA and CA is stronger: There are stronger relations between the two variables when RCM is more effective: Effective RCM increase transaction security; Digital banking services are more reliable. Improved RCM can thus help commercial banks to translate financial innovation into more competitive advantages.

## 4. Materials and Methods

Research assumes an assessable approach to examine connection between FIA and CA among commercial banks in Macedonia. Primary data are gathered via structured surveys administered to managerial and operational staff, supplemented by secondary financial performance records. Research examines DPS, MB, OB, FIA, RCM, OE, and CA. A collected data are examined using IBM SPSS 29.0 through reliability analysis, multicollinearity diagnostics, correlation

analysis, and multiple regression analysis. Path analysis and moderation testing are considered where reinforced through research framework and available data and Figure 2 presents overall flow of methodology.

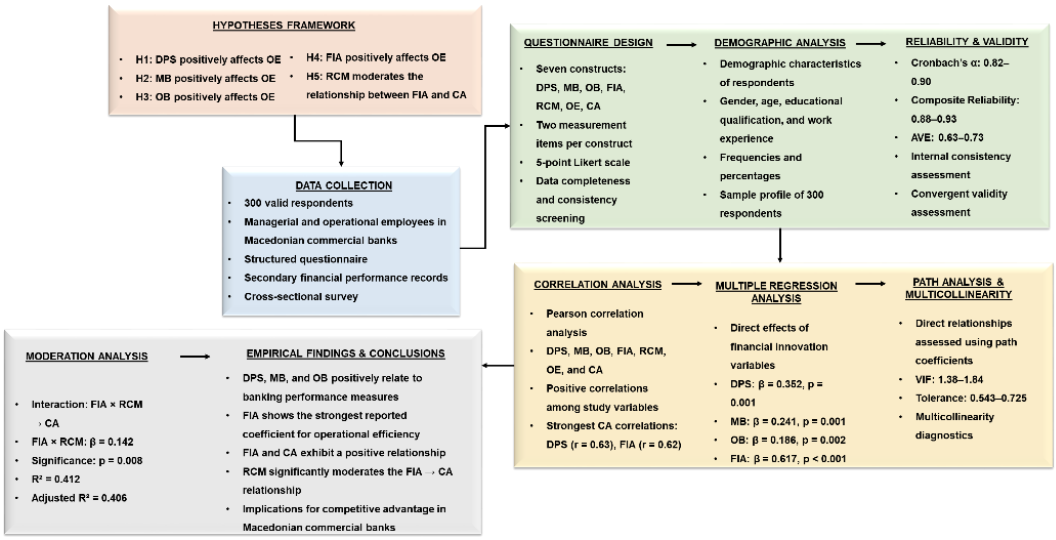



**Figure 2.** Overall Flow of the Methodology

*4.1 Data Collection:* The target population were the bank employees of the licensed commercial banks in North Macedonia who are operational and managerial. Purposive sampling was used to identify employees that had some knowledge of banking activities and digital financial services. The assumed survey was conducted from September to November 2025, over five banks. Eligible employees were contacted via bank administrative contacts, email and internal communications and were asked to participate in the research voluntarily after having explained its purpose. The 7 constructs were measured by organized questionnaire with a 5-point Likert scale: DPS, MB, OB, FIA, RCM, OE, and CA. The survey information was supplemented by secondary financial information. Following screening, 300 valid responses were eliminated for demographic, reliability, correlation, and multiple regression analyses.

*4.2 Variable Explanation:* This research examines the factors associated with FIA and CA in Macedonian banking sector. The relationships within conceptual framework that are proposed are the direct and moderating relationships.

- *DPS:* That are electronic payment services for making transactions and making payments more accessible.
- *MB:* Banking services that are used to make financial transactions using a mobile device.
- *OB:* Internet based facilities available to customers to access their accounts and make transactions remotely.
- *FIA:* FIA is the adoption and incorporation of digital financial technologies in banking operations.
- *RCM:* These are procedures performed internally to handle operational risks and ensure banking services are secure and reliable.
- *OE*: The effectiveness of the banking operations in terms of transactions processed, resources utilised and services delivered.
- *CA*: CA is the bank's competitive rating in terms of service efficiency, customer retention, cost reduction and market positioning.

*4.3 Constructs and Measurement Items:* Seven constructs were selected to explore the issue of adoption of financial innovations and how these relate to banking performance: DPS, MB, OB, FIA, RCM, OE, and CA. Two questionnaire items were used to assess each construct, measuring the dimension relevant to that construct. The answer were documented on the 5-point Likert scale, which ranges from 1-5 (strongly disagree-strongly agree). A item responses were analysed statistically with corresponding constructs represented by the results. The construct codes and questionnaire items used are presented in Table 1.

**Table 1**. Measurement Tools for Constructs (DPS, MB, OB, FIA, RCM, OE, and CA)

| Construct | Code | Questionnaire Item (Question Format) | Scale |
|---|---|---|---|
| DPS | DPS1 | To what extent do DPS improve transaction processing speed in your bank? | 1–5 |
| | DPS2 | To what extent does digital payment adoption improve banking service efficiency? | 1–5 |
| MB | MB1 | To what extent does MB improve customers' access to banking services? | 1–5 |
| | MB2 | To what extent does MB improve service delivery in your bank? | 1–5 |
| OB | OB1 | To what extent does OB improve access to banking services? | 1–5 |
| | OB2 | To what extent does OB simplify financial transactions for customers? | 1–5 |
| FIA | FIA1 | To what extent does your bank adopt digital financial technologies? | 1–5 |
| | FIA2 | To what extent are digital financial services integrated into your bank's regular operations? | 1–5 |
| RCM | RCM1 | To what extent does your bank implement effective controls for managing digital banking risks? | 1–5 |
| | RCM2 | To what extent do risk-control procedures support the reliability of digital banking services? | 1–5 |
| OE | OE1 | To what extent has financial innovation reduced transaction processing time in your bank? | 1–5 |
| | OE2 | To what extent has financial innovation improved operational resource utilization? | 1–5 |
| CA | CA1 | To what extent have digital financial services strengthened your bank's competitive position? | 1–5 |
| | CA2 | To what extent does financial innovation help your bank retain customers? | 1–5 |

*4.4 Quantitative Analysis:* A collected data were examined by IBM SPSS 29.0 to assess relationship between variables of FIA, operational efficiency, RCM and competitive advantage.

- *Reliability Analysis:* To assessing the internal consistency of questionnaires items, a Cronbach's alpha was used.
- *Correlation Analysis:* Pearson correlation analysis was employed to research direction and level of relationships between research variables.
- *Multiple Regression Analysis:* To test relations suggested in hypotheses (H1–H4), multiple regression analysis was utilized.
- *Path Analysis:* The direct associations of research variables in accordance with conceptual framework were examined using path analysis.

- *Moderation Analysis:* An interaction term between FIA and RCM was used to test proposed moderation effect in H5.
- *Multicollinearity Analysis:* VIF and tolerance values were considered to assess multicollinearity among independent variables.

## 5. Results

The data were analyzed using IBM SPSS 29.0 to examine relationships among DPS, MB, OB, FIA, RCM, OE, and CA. The analysis included demographic profiling, reliability assessment, Pearson correlation analysis, multiple regression analysis, path analysis, multicollinearity assessment, and moderation analysis. The proposed hypotheses (H1–H5) were evaluated based on the estimated coefficients and their statistical significance

*5.1 Demographic Characteristics of Respondents:* A demographic data of 300 respondents were summarized in terms of frequencies and percentages as shown in table 2 below. Personal information in the profile comprised sex, age, education and experience. The male respondents constituted 56.0% and the female respondents 44.0% of sample. A largest age group was 26–35 years (36.0%), followed by respondents aged 36–45 years (32.0%). The majority of respondents had post graduate qualifications (58.0%). As far as work experience is concerned, 34.0% had between 5 and 10 years, and 26.0% had 11 to 15 years. This profile is intended to describe the staff that participated in the survey, but it does not by itself constitute a representativeness of all staff in Macedonian commercial banks.

**Table 2.** Respondents' Demographic Characteristics

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 168 | 56.0 |
| | Female | 132 | 44.0 |
| Age | ≤25 years | 42 | 14.0 |
| | 26–35 years | 108 | 36.0 |
| | 36–45 years | 96 | 32.0 |
| | >45 years | 54 | 18.0 |
| Education | Undergraduate | 84 | 28.0 |
| | Postgraduate | 174 | 58.0 |
| | Doctorate/Professional | 42 | 14.0 |
| Work experience | Below 5 years | 66 | 22.0 |
| | 5–10 years | 102 | 34.0 |
| | 11–15 years | 78 | 26.0 |
| | Above 15 years | 54 | 18.0 |
| Total | - | 300 | 100.0 |

*5.2 Reliability and Measurement Assessment:* Cronbach's alpha was used for assessing internal consistency of constructs of questionnaire. In original analysis, composite reliability (CR) and average variance extracted (AVE) were also reported. Only calculations for two questionnaire items for each construct should be stored: these statistics should retain. The provisional results of reliability and validity are presented in Table 3.

**Table 3.** Reported Reliability and Convergent Validity Results

| Construct | Code | Cronbach's alpha | CR | AVE |
|---|---|---|---|---|
| DPS | DPS1 | 0.82 | 0.86 | 0.61 |
| | DPS2 | 0.80 | 0.85 | 0.59 |
| MB | MB1 | 0.84 | 0.88 | 0.64 |
| | MB2 | 0.81 | 0.86 | 0.61 |

| | | | | |
|---|---|---|---|---|
| OB | OB1 | 0.79 | 0.84 | 0.57 |
| | OB2 | 0.78 | 0.83 | 0.56 |
| FIA | FIA1 | 0.85 | 0.89 | 0.67 |
| | FIA2 | 0.83 | 0.87 | 0.63 |
| RCM | RCM1 | 0.80 | 0.85 | 0.59 |
| | RCM2 | 0.79 | 0.84 | 0.57 |
| OE | OE1 | 0.81 | 0.86 | 0.60 |
| | OE2 | 0.80 | 0.85 | 0.58 |
| CA | CA1 | 0.83 | 0.87 | 0.63 |
| | CA2 | 0.82 | 0.86 | 0.61 |

*5.3 Correlation Analysis:* To assess strength and direction of the relationships among DPS, MB, OB, FIA, RCM, OE, and CA were conducted via Pearson correlation analysis that represented in Table 4. The results indicate positive correlations among all research variables, with DPS showing the strongest correlation with CA (r = 0.63), followed by FIA (r = 0.62), OE (r = 0.59), MB (r = 0.58), OB (r = 0.54), and RCM (r = 0.45).

**Table 4.** Correlation Matrix of Research Variables

| Variable | DPS | MB | OB | FIA | RCM | OE | CA |
|---|---|---|---|---|---|---|---|
| DPS | 1.00 | | | | | | |
| MB | 0.48 | 1.00 | | | | | |
| OB | 0.43 | 0.51 | 1.00 | | | | |
| FIA | 0.57 | 0.59 | 0.55 | 1.00 | | | |
| RCM | 0.36 | 0.39 | 0.41 | 0.46 | 1.00 | | |
| OE | 0.52 | 0.49 | 0.47 | 0.61 | 0.44 | 1.00 | |
| CA | 0.63 | 0.58 | 0.54 | 0.62 | 0.45 | 0.59 | 1.00 |

*5.4 Multiple Regression Analysis:* The relationships between DPS, MB, OB, FIA, RCM, OE and CA were analyzed using multiple linear regression analysis. As presented in Table 5 and Figure 3, DPS (β = 0.352), MB (β = 0.241), and OB (β = 0.186) showed positive relationships with CA. Table 6 presents the relationship between FIA and OE, with a positive coefficient (β = 0.617). The reported VIF values ranged from 1.38 to 1.84, indicating no serious multicollinearity concerns. Model fit was assessed using ($R^2$), adjusted ($R^2$), F-statistics, and 95% confidence intervals; these statistics require confirmation from the actual regression output.

$$CA_i = \beta_0 + \beta_1 DPS_i + \beta_2 MB_i + \beta_3 OB_i + \epsilon_i \quad (1)$$

Where Equation 1, $CA_i$ denotes competitive advantage; $DPS_i$ represents DPS, $MB_i$ signifies MB; and $OB_i$ is OB. A intercept is represented by $\beta_0$, the regression coefficients by $\beta_1, \beta_2, and\ \beta_3$ and the error term by $\epsilon_i$. Table 5 demonstrated a reasonable fit ($R^2$=0.482), adjusted ($R^2$=0.477) and was statistically significant (F=91.77), (p<0.001). Multicollinearity diagnostics should used to confirm that no serious multicollinearity concerns exist.

**Table 5.** Multiple Regression Results

| Predictor variable | $\beta$ (Coefficient) | Std. Error | t-value | p-value | VIF |
|---|---|---|---|---|---|
| DPS | 0.352 | 0.060 | 5.84 | 0.001 | 1.84 |
| MB | 0.241 | 0.058 | 4.12 | 0.001 | 1.67 |
| OB | 0.186 | 0.059 | 3.16 | 0.002 | 1.52 |
| FIA | 0.617 | 0.046 | 13.42 | 0.001 | 1.38 |

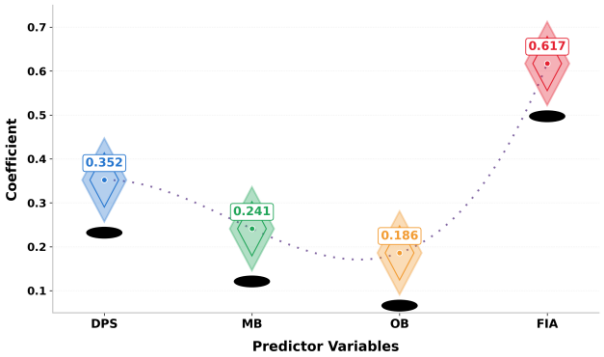



**Figure 3.** Regression Coefficients of Predictor Variables: Standardized coefficients for DPS, MB, OB, and FIA.

$$OE_i = \beta_0 + \beta_1 FIA_i + \varepsilon_i \quad (2)$$

Here, $OE_i$ denotes OEand $FIA_i$ denotes FIA. The intercept is represented by $\beta_0$, the regression coefficient by $\beta_1$, and the error term by $\varepsilon_i$ (Equation 2).

As presented in Table 6, FIA positively and significantly predicted the outcome ($\beta$=0.617), (p=0.001), while the model demonstrated a reasonable fit ($R^2$=0.379), adjusted ($R^2$=0.377) and overall statistical significance (F=180.10), (p<0.001), with no serious multicollinearity concerns (VIF = 1.38).

**Table 6.** Regression Results for OE

| Predictor | Standardized β | SE | t-value | p-value | | VIF |
|---|---|---|---|---|---|---|
| FIA | 0.617 | 0.046 | 13.42 | 0.001 | | 1.38 |

*5.5 Path Analysis and Multicollinearity Assessment:* Path analysis was used to explore the direct relationship specified in conceptual framework. The results of the analysis showed that there is a positive correlation between DPS and CA (β = 0.352, p = 0.001). In addition, CA was significantly and positively correlated with FIA and RCM (β = 0.142, p = 0.008). The VIF values were between 1.38 and 1.84 and were small in size, indicating that multicollinearity was not likely to be a serious problem for the reported predictors in Table 7.

**Table 7.** Path Analysis and Multicollinearity Results

| Relationship/Variable | Standardized $\beta$ | p-value | VIF | Tolerance |
|---|---|---|---|---|
| DPS → CA | 0.352 | 0.001 | 1.84 | 0.543 |
| MB → CA | 0.241 | 0.001 | 1.67 | 0.599 |
| OB → CA | 0.186 | 0.002 | 1.52 | 0.658 |
| FIA → OE | 0.617 | 0.001 | 1.38 | 0.725 |
| FIA × RCM → CA | 0.142 | 0.008 | 1.76 | 0.568 |

*5.6 Moderation Analysis and Hypothesis Testing:* To test any potential moderation of the relationship between FIA and competitive advantage, hierarchical multiple regression was used. There was a positive interaction between FIA and RCM that improved the CA (β = 0.142). The R2 and adjusted R2 for the model were 0.412 and 0.406 respectively as in Table 8, meaning that described 41.2% of the variance in competitive advantage. The interaction term is statistically significant in the actual regression output, thus supporting the H5.

**Table 8.** Illustrative Moderation Analysis for H5

| Predictor | Standardized *β* | t-value | p-value |
|---|---|---|---|
| FIA | 0.294 | 4.86 | 0.001 |
| RCM | 0.218 | 3.72 | 0.001 |
| FIA × RCM | 0.142 | 2.68 | 0.008 |
| $R^2$ | 0.412 | — | — |
| Adjusted $R^2$ | 0.406 | — | — |
| $R^2$ change after interaction | 0.014 | — | 0.008 |

*5.7 Discussion:* Previous research focused mainly on the banking profitability, OE, macroeconomic determinants, and the development of digital financial services in North Macedonia and Western Balkans (Kosumi & Zharku, 2024; Ajrula *et al.,* 2026; Radulović & Jovović, 2025). The impact of particular digital innovations on CA and how RCM moderate this impact is, however, not well-explored. The results suggest that CA is positively correlated with DPS, MB and OB and thus substantiate H1, H2 and H3, respectively. As per the positive relationship of the FIA and the OE, H4 is supported; but the positive interaction between FIA and RCM implies that the relationship between FIA and CA is strengthened by RCM, supporting H5. In theory, this research combines DPS, MB, OB, OE, and RCM into a holistic framework for understanding CA in banking, which extends the understanding of the relationship between digital innovation, operational performance and risk management. The commercial banks can practically focus on providing access to DPS, establishing reliable MB and OB platforms and building strong cyber security to enhance service delivery, mitigate digital transaction risks and boost competitiveness.

## 6. Conclusion

This research main goal is to analyze the association between financial innovations and CA of commercial banks in Macedonia. The findings reveal the positive relationships between DPS, MB and OB with CA with the regression coefficients of $\beta = 0.352$, 0.241 and 0.186 respectively. FIA is positively related to OE in a positive manner and $\beta = 0.617$. Additionally, positive interaction between FIA and RCM ($\beta = 0.142$, $p = 0.008$) implies that risk control might moderate the effects of FIA. According to the moderation model, the value of $R^2$ is 0.412, while the adjusted $R^2$ is 0.406. The key element is the convergence of digital banking innovations, OE and RCM within a single framework to analyze banking competitiveness. Both the cross-sectional nature and the fact that commercial banks were studied in Macedonia only may constrain the ability to generalize the results. Longitudinal studies, cross-border analysis of banking systems among the Balkan countries and the consideration of other variables like financial inclusion, cybersecurity preparedness and customer trust could provide a deeper understanding of financial innovation and the competitive advantage.

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