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The Nonlinearity Between Innovations and Deposits Growth: Evidence From a Transition Economy

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ABSTRACT

Our study is the first to examine the nonlinearity between innovations and the deposit growth of commercial banks in Vietnam, a transition market in Asia. We manually collect data from financial statements from 31 commercial banks in Vietnam from 2010 to 2020. We employ the Random Effect Models and the Generalized Method of Moments steps to analyze a sample of 296 annual bank-year observations. However, the Traditional Least Square violates heteroskedasticity and autocorrelation assumptions, so we mainly discuss the results from the Generalized Method of Moments estimations. Our findings indicate a positive impact of training costs on deposit growth, implying that training and seminars improve service quality to attract higher deposit growth. Moreover, our findings report that banks with mobile banking applications have 10.64% higher deposit growth than banks without mobile banking. However, R&D costs discourage customers from saving money in the banks. It is because technology development reduces the information asymmetry between customers and banks. Therefore, customers receive lower saving rates for online saving products due to lower uncertainty. Unfortunately, our findings fail to report a nonlinearity between innovation and deposit growth. Finally, Our findings contribute practical implications for bank managers and policymakers in Vietnam and other emerging markets. Our findings suggest that commercial banks need to develop a strategy to support the development and exploitation of technology infrastructure to improve efficiency. Commercial banks may also focus on increasing training and seminars to develop their workforce and service quality and diversify their services, empowering the sustainable developments of commercial banks.

INTRODUCTION

Commercial banks are financial intermediaries that connect the borrowers and depositors in the economy. The deposit is crucial in the banking system's stability and fund management. Technology has been proliferating recently, and it helps people save more time and resources. Innovation must be implemented to enhance the fundraising services, such as mobile banking, SMS, training labor force, research, and development costs. In 2012, mobile banking was first released in Vietnam. Since then, 49 banks have applied mobile banking systems for helping customers and providing instant service, and mobile banking plays a prominent role in the banking system. The bank offers a deposit servicer at the counter and provides the same banking service at the Automatic Teller Machines (ATM). Saving money is a safe choice with a reasonable interest rate compared to other investment channels. Banks transform deposits and savings into credit activities that generate profitability. Therefore, commercial banks must compete fiercely to increase deposit growth to foster their performance. Since 2020, the pandemic of COVID-19 has spread worldwide, and it is challenging for banks to provide banking services at the counter. Following the restriction from the government in each stage of the pandemic, commercial banks partly closed due to social lockdown. The new process for banking systems is applied, and more innovations and traditional banking services are conducted online. Consequently, Research and Development (R&D) costs have become an essential factor in the banking system.

Kashmari et al. (2016) indicate that using the facility positively affects customer satisfaction and motivational factors. Innovation requires considerable resources and long-term commitments. One of a bank's most essential objectives and competitive advantages is the share of each bank in attracting deposits. Abubakar (2014) suggests that innovation favorably increases the deposit. They recommended that if the bank wants to increase the deposit growth in operation, it should provide more services related to the innovation of the bank's technology, such as internet banking, SMS banking, and all the products that customers can use on a mobile phone. However, Tahir et al. (2018) argue an insignificant relationship between innovation and deposit growth.

Parameswar et al. (2017) stated that banks should continuously improve their communication technology and adopt new payment and financial solutions to become profitable in the long run. When the technology changes, the deposit on the accounts is consistently the first change on the customers' side. There is a need to look inside the connection between technology and deposit growth. Booth and Dash (1977) stated that non-linear relationships provide goals in the unclear context for the banks. A non-linear relationship between innovation and deposits implies an optimal investment in innovations that maximize the deposit growth.

There are many reasons why Internet banking should be widely adopted in Vietnam. However, it seems that the scale of this service is not yet large enough to impact banks' performance significantly. In 2019, data from the State Bank of Vietnam showed that most Vietnamese, approximately 69 percent of the adult population, do not have a bank account, which is the highest rate in Southeast Asia. Vietnam had almost 19,000 ATMs and 270,000 points of sale (POS) terminals in place in 2019. Up to 99% of banks in Vietnam offer payment services via internet banking and mobile banking systems. Mobile payment is available at 47 banks, and 29 banks accept QR code payments. Vietnamese banks compete to increase bank users and get financial inclusion. Facilities demand that ATMs and POS terminals are mainly concentrated in cities. There is a lack of suitable products and services for people in remote and rural areas. Moreover, most banking transactions need to occur in physical branches due to the rule of the State Bank; they cannot be executed digitally. The challenges allow financial firms, especially banks, to innovate and bring more digital solutions that serve Vietnam's large under-banked and unbanked population. Our motivation is to focus on how innovation can affect banks' deposits in Vietnam.

We collect data from 31 commercial banks in Vietnam from 2010 to 2020. To estimate the impacts of innovations on deposit growth, we employ various estimation methods such as the Random Effects Model (REM), Ordinary Least squares (OLS), and Generalized Method of Moments (GMM). Our study generates striking results. Firstly, our finding documents a positive impact of training costs on deposit growth. It is reasonable because training and seminar develop workforce and service quality to attract more savings from the public. Moreover, our findings report that banks with mobile banking applications have 10.64% higher deposit growth than banks without mobile banking. However, R&D costs have inverse

impacts on deposit growth. Unfortunately, our findings do not determine a nonlinearity between training costs, R&D costs, and deposit growth. Our findings align with Jones et al. (2012) and Kashmari et al. (2016), Mao et al. (2019), Allen and Carletti (2006), Sarfaraz (2017), Tam and Oliveira (2016), and Di et al. (2013), and prior literature.

This research is unique because of the following reasons. Firstly, we examine a nonlinearity between innovations and Deposit growth. Our study extends Wang et al. (2021) because they employ the linear regression model to evaluate the correlation between fintech and bank deposits. The non-linear model is suitable for banks since it allows them to take advantage of the changes in financial innovations without being affected by the linear model. Secondly, our study is the first to examine the innovation in the Vietnamese banking sector quantitatively. While innovations are widely studied in emerging and developed markets, the data limitations restrain researchers from conducting this topic in Vietnam. Thus, our study is unique because we manually collect the R&D from the supplementary reports of the bank's financial statements.

Our study contributes the following implications for bank managers and policymakers to develop the banking sector sustainably. Firstly, the rapid emergence of various electronic banking platforms has impacted the operations of banks. Adane et al. (2021) indicate that the appearance of automated teller machines (ATM) and mobile banking applications have decreased the number of customers using traditional banking methods. Financial innovation strategies that are effectively adopted have some positive effects on banking efficiency on banks' cost-oriented and Internet-based innovation strategies. Financial innovation fosters competitive advantages to attract more deposit growth. Moreover, financial innovations also improve risk management, product diversification, capital allocation efficiency, and economic growth. Our study recommends that banks should develop mobile banking applications, workforce, and service quality via training and development programs. Our findings are helpful for bank managers in Vietnam and other emerging markets.

Our research is structured as follows. Section 2 provides the literature review. Section 3 describes an overview of the data used in the study. Section 4 provides empirical analysis and discussion, and section 5 concludes with the study's implications.

1. LITERATURE REVIEW

1.1 Deposit growth

In the recent decade, banks have played a significant role in the banking industry with many issues related to the banks, such as channel deposit in monetary policy by Drechsler et al. (2017). Specifically, the banking industry brings many services to customers through deposits and loans. However, one of the prominent roles of the banks is to serve the demand deposits of many firms, corporates, and customers. Ivanovic (2016) examine the monthly Monetary and Financial Statistics data of Banco de Portugal from 2007 to 2013. They report that the deposit growth in the banking sector depends on different purposes, but deposits still have a crucial role in the banks. Abubakar (2014) also reports that the increase in bank deposits is a core dimension of the banking industry, as explained by the saving and consumption theory.

1.2 Innovation and Deposit growth

1.2.1 Training costs and deposit growth

Jones et al. (2012) report that training and development are the most critical factors banks must consider when developing e-banking to attract customers. In addition, Mirza et al. (2012) indicate that banks saved more costs and time by planning and implementing the training evaluation process. Kashmari et al. (2016) indicated the amount of banking facilities and the number of ATMs that a bank has been

associated with increasing its deposits. Therefore, we propose the following hypothesis to test the relationship between training costs and deposit growth:

Hypothesis 1: Training costs have a positive impact on Deposit growth.

1.2.2 R&D costs and deposit growth

Due to the modernization of banking technology, banks have started to invest in R&D development to improve their operations and provide more personalized banking services to their customers. Although new financial innovations are not granted patent protection, they can be commonly used concerning certain developments. Innovations have driven the industry's performance due to their potential to enhance the end users' experience. Innovations could help financial institutions fulfill their functions and deliver growth. However, it can also cause the economy to suffer if it is not correctly used. Banks must adopt the proper tools and procedures to ensure that new technologies are used correctly. Mao et al. (2019) found the negative effect of R&D costs on deposit growth. Banks offer customers a lower saving rate for online saving accounts, which is less attractive for deposit growth. Allen and Carletti (2006) pointed out that financial development reduces information asymmetry between banks and customers, reducing the saving interest rate to reflect lower capital raising the risk.

Fatima et al. (2018) suggest that R&D activities positively impact banking performance. Emmanuel et al. (2019) figured out that R&D activities significantly affect deposit growth. It also brings new products and technologies that improve the quality and value of the institution. Therefore, we propose the following hypothesis to test the relationship between R&D costs and deposit growth:

Hypothesis 2: R&D costs have a negative impact on deposit growth.

1.2.3 Mobile banking and deposit growth

Shaikh and Karjaluoto (2015) found a negative relationship between mobile banking and deposit growth. They stated that mobile banking was complicated and unfriendly for users to get used to. Customers had to learn from the start and were already familiar with traditional banking services. Moreover, commercial banks introduce payment services via innovative banking applications, motivating customers to spend rather than save money. Therefore, mobile banking applications' implementations reduce commercial banks' deposit growth.

On the other hand, Di et al. (2013), Tam and Oliveira (2016) and Sarfaraz (2017) report the positive impacts of mobile banking on deposit growth. Mobile banking empowers users to be more active and lets them pay or shop online. Therefore, they must deposit money into current accounts to conduct online payments, increasing the deposit growth. Mobile banking application is portable and, with proper support, can be a friendly transaction method, enabling users to open online saving accounts instantly with flexible saving terms and amounts. Therefore, mobile banking certainly attracts saving and deposits from customers.

As prior studies document mixed impacts of mobile banking on deposit growth, we propose the following hypothesis:

Hypothesis 3: Mobile banking has a positive impact on deposit growth.

2. DATA AND METHODOLOGY

2.1 Data

We collect data from financial statements and notes to the financial statements of 31 commercial banks in Vietnam. Our sampling period is from 2010 to 2020 due to the data collection limitation. Before 2010, unlisted and private commercial banks were not required to publish their financial statements. After 2010, The State Bank required that banks in Vietnam need to update their financial statements regardless

they were listed on the stock exchange or not. To mitigate extreme values issues, we follow Duong et al. (2021) to winsorize all variables at the 5% and 95% levels. We also follow Duong et al. (2022) to remove observations that do not have enough data to calculate relevant variables. Our final sample has 296 annual observations of 31 commercial banks from 2010 to 2020.

2.2 Variable definitions

The variables discussed in our study include Deposit growth, R&D costs, training costs, mobile banking, control variables, bank liquidity, bank size, and macroeconomic factors. All these variables are discussed in Appendix A.

Appendix A. Variable definitions

Variables	Acronyms	Formulas	Reference
Dependent variable			
Deposit growth	DP	$\frac{Total\ deposit_{\ t} - Total\ deposit_{\ t-1}}{Total\ deposit_{\ t-1}}$	Ivanovic (2016)
Independent variables			
R&D cost	RD_COST	Computer software	Fatima et al. (2018)
Training cost	TN_COST	Training expenditures data come from the financial statement notes.	Jones et al. (2012)
Mobile banking	MOBI	If the bank did not have a mobile banking system, MOBI = 0; else, MOBI = 1	Di et al. (2013)
Control variables			
Control variables	CONTROL	The total of all control variables	
Liquidity	LIQUID	Liquid assets to total asset ratio	Barth et al. (2003)
Inflation	INFLA	Obtained from website worldbank.org	John et al. (2001)
GDP	GDP	Obtained from website worldbank.org	Tan et al. (2012)
Interest rate	INTERTEST	Collect from the website webgia.com	Saba Mushtaq et al. (2017)
Bank size	BSIZE	The logarithm of total assets	Laeven et al. (2016)

2.3 Research methodology

Firstly, we apply Standard Least Square estimations such as the Pooled Ordinary Least Squares (OLS), Fixed Effects Model (FEM), and Random Effects Model (REM) estimations to examine the relationship between independent variables and Deposit growth. We perform the Redundant and Hausman tests to select

the most suitable estimation method among the three. The REM is preferable. The Wooldridge test, Breusch & Pagan multiplier test, and Durbin Wu-Hausman test show problems in the result. To resolve all the problems, we perform Two-step System GMM Estimation. Roodman (2009) suggests that the GMM estimator is designed for (1) "small T, large N" Cross-sectional data; (2) a linear functional association; (3) dynamic dependence variables that are based on its previous realizations; (4) control the endogeneity within variables by using a lag of variables as an instrument; and (5) time and individual fixed effects to reduce the omitted bias issue; and (6) resolve the heteroscedasticity, autocorrelation problem in panels. We follow Roodman (2009) to apply a Two-step System GMM estimator to achieve a better outcome while minimizing potential downward and bias errors. In addition, we implemented the Arellano Bond, and Hansen tests confirmed that the model is free from autocorrelation problems and that the instruments we added are valid. We employed three econometric regression models to calculate the effect of innovation and deposit growth in all the commercial banks in Vietnam.

2.4 Model constructions

We follow Ivanovic (2016) to construct the baseline model to examine the non-linear relationship between the training costs and deposit growth. We demonstrate the formula in model 1:

$$\text{Model 1: } DP_{i,t} = \alpha + \beta_1 TN\_COST_{i,t} + \beta_2 (TN\_COST)^2_{i,t} + \beta_3 \sum CONTROL_{i,t} + \alpha_i + \alpha_t + \varepsilon_{i,t} \quad (1)$$

Fatima et al. (2018) and Emmanuel et al. (2019) suggest that bank R&D costs affect commercial banks' deposit growth. We add this variable to the model to examine whether R&D costs affect deposit growth. Model 2 is as follows:

$$\text{Model 2: } DP_{i,t} = \alpha + \beta_1 RD_{COST\ i,t} + \beta_2 (RD_{COST})^2_{i,t} + \beta_3 \sum CONTROL_{i,t} + \alpha_i + \alpha_t + \varepsilon_{i,t} \quad (2)$$

Finally, we follow Shaikh and Karjaluoto (2015) to construct the entire model, which investigated the impacts of the Mobi, R&D Cost, and Training Cost on deposit growth of commercial banks in Vietnam. We construct the following model:

$$\text{Model 3: } DP_{i,t} = \alpha + \beta_1 TN\_COST_{i,t} + \beta_2 RD\_COST_{i,t} + \beta_3 MOBI_{i,t} + \sum CONTROL\ \alpha_i + \alpha_t + \varepsilon_{i,t} \quad (3)$$

3. EMPIRICAL RESULTS

3.1. Descriptive statistics

Table 1 presents the descriptive statistics of the research sample. Table 1 reports that the banks' deposit growth is around 23%, with a standard deviation value of 25%. The R&D costs from 0.00 to 11.92, with an average value of 7.77 and a standard deviation of around 4.38. Training costs for bank employees are reasonable costs incurred to upgrade the technical skills represented in Table 1. On the other hand, the year that mobile banking was used in the banks (MOBI) (use = 1; have not used = 0). Table 1 also shows the liquidity, interest rate, inflation, GDP, and bank size statistics.

Table 1. Descriptive statistics

	Observation	*Mean*	*STD*	*Minimum*	*Maximum*
DP	296	0.23	0.25	-0.17	2.11
RD_COST	296	7.77	4.38	0.00	11.92
TN_COST	296	3.70	4.77	0.00	11.47
MOBI	296	0.54	0.50	0.00	1.00
LIQUID	296	0.63	0.18	0.00	0.98
INTEREST	296	0.07	0.03	0.04	0.14
INFLA	296	0.08	0.09	0.01	0.32
GDP	296	0.06	0.01	0.03	0.07
BSIZE	296	14.14	0.55	12.92	15.18

Table 1 presents the sample descriptive statistics. We examine 31 commercial banks from 2010 to 2020. The data consists of 296 bank year observations. The dependent variable includes the Deposit growth of the bank (DP), and independent variables include research and development costs (RD_COST), training costs for employees in the banks (TN_COST), and the year that mobile banking was used in the banks (MOBI). Control variables include liquidity (LIQUID), interest rate (INTEREST), inflation (INFLA), GDP (GDP), and bank size (BSIZE).

3.2 Pearson Correlation Matrix

Table 2 reports the Pearson correlation matrix of variables. The coefficient correlations are moderate except for the correlation between Interest and MOBI (-0.5330), GDP, and INFLA variance (-0.836). Therefore, we examine the variance inflation factor (VIF) to test the multicollinearity issue. According to Table 2, the maximum value of VIF is 4.835, and the average is 2.239. The result is that the VIF of all variables is less than five, and there is no multicollinearity issue (Duong et al., 2020).

Table 2. Pearson Correlation Matrix

	DP	*RD_COST*	*TN_COST*	*MOBI*	*LIQUID*	*INTEREST*	*INFLA*	*GDP*	*BSIZE*	*VIF*
DP	1.000									
RD_COST	-0.120	1.000								1.198
TN_COST	-0.032	0.089	1.000							1.137
MOBI	-0.175	0.136	-0.128	1.000						1.673
LIQUID	0.131	0.247	0.073	-0.030	1.000					1.125
INTEREST	0.276	-0.034	-0.145	-0.533	0.133	1.000				2.334
INFLA	0.025	0.107	-0.024	0.036	0.186	0.237	1.000			4.835
GDP	-0.073	-0.044	0.022	-0.076	-0.160	0.027	-0.836	1.000		4.384
BSIZE	-0.146	0.283	0.155	0.141	0.040	-0.301	0.015	-0.034	1.000	1.227

This table consisted of the correlation coefficients of all variables of our analysis. The data sample was gathered from 31 Commercial banks in Vietnam from 2010 to 2020. Furthermore, VIF is examined to test the collinearity.

3.3 Results from OLS and REM estimations

Table 3 reports the estimated results of identifying Vietnamese commercial banks' deposit growth. After using required tests such as the Hausman test, Chow test, and Test Lagrange Multiplier, we use the Random Effects Model (REM) in model 1, model 2, and Ordinary Least Square the model 3. In Model 1, there is a non-linear relationship between TN_COST and deposit growth. The more the training cost is, the more deposit growth increases. However, spending too much training costs on training courses and

seminars reduces bankers' working performance, which also reduces the deposit growth. Model 1 suggests the optimal training costs are around 5.08 billion VND, equivalent to 221,000USD to archive the optimal Deposit growth. This result is consistent with Kashmari et al. (2016). Model 2 indicates that the relationship between RD_COST and deposit growth is not non-linear because the coefficient of RD_COST and RD_COST2 are statistically insignificant. However, Model 3 indicates an inversed relationship between RD_COST and deposit growth. The impact of MOBI on deposit growth is statistically insignificant. Finally, table 3 reports that R-squared ranges from 15% to 17%. It implied that the variation of independent factors explains 15% to 17% variation of the dependent variable.

Table 3. Panel Least Squares Regression Results

	Model 1 (REM)	*Model 2 (REM)*	*Model 3 (OLS)*
TN_COST	0.0732**		0.0019
	(0.023)		(0.546)
TN_COST2	-0.0072**		
	(0.025)		
RD_COST		0.0085	-0.0064*
		(0.759)	(0.065)
RD_COST2		-0.0016	
		(0.552)	
MOBI			0.0237
			(0.506)
LIQUID	0.1979**	0.2423***	0.1644**
	(0.019)	(0.006)	(0.043)
INTEREST	2.8816***	2.8884***	3.2398***
	(<0.001)	(<0.001)	(<0.001)
INFLA	-1.2624***	-1.2067***	-1.2923***
	(<0.001)	(<0.001)	(<0.001)
GDP	-9.7045***	-9.3433***	-9.9723***
	(<0.001)	(<0.001)	(<0.001)
BSIZE	-0.0217	-0.0063	-0.0089
	(0.570)	(0.875)	(0.747)
N	296	296	296
R-squared	0.1773	0.1769	0.1538
Adjusted R-squared	0.1573	0.1569	0.1302
F-statistic	8.8679	8.8444	6.5191
Prob(F-statistic)	(<0.001)	(<0.001)	(<0.001)

This table represents the Least Squares regression results of deposit growth's determinants. Data collected from 31 commercial banks from 2010 to 2020 consist of 269 observations. The dependent variable includes the Deposit growth of the bank (DP), and independent variables include research and development costs (RD_COST), training costs for employees in the banks (TN_COST), and the year that mobile banking was used in the banks (MOBI). Control variables include liquidity (LIQUID), interest rate (INTEREST), inflation (INFLA), GDP (GDP), and bank size (BSIZE). P-value in the parentheses *, **, *** represent statistical significance at 1%, 5%, and 10% level.

3.4 Main results and discussions

Ullah et al. (2018) argue that OLS and REM are ineffective because of violating the hypothesis and are related to the incidental parameters problem. Therefore, we employ the two-step system Generalized Method of Moments (GMM) estimation to overcome endogenous issues (Ullah et al., 2018). We report the estimation results from the GMM method in table 4.

In model 1, we found no non-linear relationship between Training Cost and Deposit growth. Model 1 also reports an insignificant impact of training costs on deposit growth. Moreover, model 2 fails to report a nonlinearity between R&D costs and deposit growth. Model 3 documents a positive relationship between training cost and deposit growth. Our finding suggests that a 1% increase in the training costs leads to a 0.015% increase in deposit growth. Training courses and seminars improve the service and workforce quality for the entire banking system. Therefore, commercial banks with better consumer services enjoy higher Deposit growth in the competitive market. Our findings align with Jones et al. (2012) and Kashmari et al. (2016). Our finding supports hypothesis 1, indicating a positive impact of training costs on deposit growth.

Model 3 reports a negative and significant relationship between R&D costs and Deposit growth. Our finding implies that a 1% increase in R&D costs reduces the deposit growth by 0.01%. Mao et al. (2019) suggest that consumers receive a lower saving rate for online saving products, which is less attractive for Deposit growth. Allen and Carletti (2006) pointed out that financial development reduces information asymmetry between banks and customers, reducing the saving interest rate to reflect lower capital raising the risk. While our finding aligns with Mao et al. (2019), Allen and Carletti (2006), it is inconsistent with Fatima et al. (2018). Our finding supports hypothesis 2, indicating a negative relationship between R&D costs and deposit growth.

Model 3 documents a positive relationship between Mobile banking applications and deposit growth. Our findings indicate that banks with mobile banking have 10.64% higher deposit growth than banks without mobile banking applications. Banks introduce flexible online saving and payments services, which attract customers' savings and deposits. Although our finding aligns with Sarfaraz (2017), Tam and Oliveira (2016), and Di et al. (2013), it is inconsistent with Shaikh and Karjaluoto (2015). Our finding also supports hypothesis 3, indicating a positive impact of mobile banking on deposit growth.

Table 4. Regression Results from The Two-Step System GMM Method

	Model 1	*Model 2*	*Model 3*
DEPENDENT VARIABLE (-1)	0.098***	0.2088***	0.1340***
	(16.583)	(10.827)	(4.898)
TNCOST	0.0580		0.0150***
	(0.238)		(0.010)
TNCOST2	-0.0038		
	(0.434)		
RDCOST		0.0213	-0.0102**
		(0.461)	(0.026)
RDCOST2		-0.0031	
		(0.275)	
MOBI			0.1064*
			(0.095)
LIQUID	0.0665	0.0919	0.1111
	(0.391)	(0.564)	(0.396)
INTEREST	2.6489**	3.9041***	3.7435***
	(0.022)	(0.004)	(0.007)
INFLA	-1.3064**	-1.8506***	-1.6455***
	(0.025)	(0.001)	(0.009)
GDP	-13.3129***	-12.9075***	-12.3213***
	(<0.001)	(<0.001)	(<0.001)
BSIZE	-0.0410	0.2501	0.0187

	(0.769)	(0.124)	(0.876)
Cross-section fixed (first differences)	Yes	Yes	Yes
The period fixed (dummy variables)	Yes	Yes	Yes
N	240	240	240
J-statistic	22.3861	21.2213	20.8957
Prob(J-statistic)	0.3199	0.3842	0.3426

This table represents the two-step system GMM regression results of deposit growth's determinants. Data collected from 31 commercial banks from 2010 to 2020 consist of 269 observations. The dependent variable includes the Deposit growth of the bank (DP), and independent variables include research and development costs (RD_COST), training costs for employees in the banks (TN_COST), and the year that mobile banking was used in the banks (MOBI). Control variables include liquidity (LIQUID), interest rate (INTEREST), inflation (INFLA), GDP (GDP), and bank size (BSIZE). P-value in the parentheses *, **, *** represent statistical significance at 1%, 5%, and 10% level.

The interest rate has a positive impact on deposit growth. These results are consistent with Akhtar et al. (2017) since increasing saving rates are attractive from the depositor's perspective. However, table 4 reports a negative and significant relationship between inflation and deposit growth. Table 4 also reports an inversed impact of GDP on deposit growth. The increase in GDP makes people spend more money and take fewer savings than usual to decrease deposit growth. Our finding is consistent with Horioka and Wan (2007) but contrasts with Akhtar et al. (2017).

Table 4 reports an insignificant relationship between liquidity and deposit growth. Customers prefer popular banks with reliable brand names to save money rather than focus on the bank's liquidity ratio. Therefore, liquidity is not a determinant of deposit growth. This result is consistent with Ally (2014) and inconsistent with Laeven et al. (2016).

Table 4 also reports that bank size has an insignificant impact on deposit growth. As depositors receive compulsory deposit insurance for saving money, the bank size does not affect the saving decision. While our finding is consistent with Ally (2014), it is inconsistent with Laeven et al. (2016).

CONCLUSIONS

The increasing demand for deposits from customers significantly impacts the bank's development because savings and deposits are foundations for banks to offer credit activities. Therefore, commercial banks develop their technology, workforce, and service quality to attract deposit growth. Our study examines the impacts of innovations on deposit growth of 31 commercial banks in Vietnam from 2010 to 2020.

Our study generates striking results. Firstly, our finding documents a positive impact of training costs on deposit growth. It is reasonable because training and seminar develop workforce and service quality to attract more savings from the public. Mobile banking applications attract deposits and savings because banks introduce flexible online saving and payments services. However, R&D costs have inverse impacts on deposit growth. Unfortunately, our findings do not determine a nonlinearity between training costs, R&D costs, and deposit growth. Our findings align with Jones et al. (2012) and Kashmari et al. (2016), Mao et al. (2019), Allen and Carletti (2006), Sarfaraz (2017), Tam and Oliveira (2016), and Di et al. (2013), and prior literature.

Our findings are important for bank managers in Vietnam and other emerging markets. Our findings suggest that commercial banks need to develop a strategy to support the development and exploitation of technology infrastructure to improve efficiency. Moreover, commercial banks may focus on increasing training and seminars to develop their workforce and service quality to enjoy higher deposit growth. Although the R&D and innovative banking applications discourage deposit growth, they are helpful for banks to foster their competitive advantages in the information transformation era. Finally, training and mobile banking application allow banks to diversify their products and services quality, supporting sustainable developments of commercial banks.

Although our study has a marginal contribution, it has the following limitation. Firstly, we have data limitations from 2010 to 2020 because data is not fully available before 2010. Secondly, the research mainly focuses on Vietnam, where the banking system is less developed than in emerging and developed countries. Therefore, our findings may not apply to these markets. We suggest future studies apply our idea in crossed-country analysis to generalize the reliable outcomes.

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