CASE STUDY

INFORMATION TECHNOLOGY INVESTMENT AND BANK PERFORMANCE IN PAKISTAN

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ABSTRACT— This paper aims to estimate the effect of information technology investment on commercial banks' performance in Pakistan. The sample of 27 banks from 2007 to 2019 is collected from the State Bank of Pakistan, the World Bank website, and the bank's website. The fixed-effect model and the random-effect model are used to estimate the four regressions. The dependent variables of quantitative models encompass ROA, ROE, ROS, and EPS. The independent variables consist of the ratio of IT expense on the total asset, non-interest expense, and revenue. The control variables of the models are bank size, bank age, and inflation. For robustness check, we use the Generalized Method of Moments approach. The findings give that the significant impact of information technology investment on bank performance, namely the ratio of information technology budget on the expense, is favorable to bank performance. In contrast, the ratio of the information technology budget on revenue is negative. Furthermore, the significant relationship between performance variables and other variables is not consensus in different models.

Keywords — Information technology investment, bank performance, bank profitability, Pakistan.

I. INTRODUCTION

[1] gave that the bank's information technology (IT) investment is computer hardware, software, and service. For example, the bank spends on data storage devices, terminals, memory, personal computer, data communications, packaged software, application, infrastructure, consulting services, training, education employees. [2] supplemented the IT personnel, and the resource for supporting IT capabilities also belongs to IT investment. Based on that, we quickly recognize that IT investment is a fraction of all parts' critical ingredient in the digital era's duration. It occurs in all activities of the bank.

In the finance sector, all financial products are non-physical; thus, IT activities might regard all divisions. Furthermore, the finance sector is significantly impacted by the technology revolution 4.0, which is proven by the evolution of the fintech industry, the new industry of the marriage of finance industry and the technology industry [3], [4]. Indeed, the IT investment inside is being substantial; this is the core vector of business success in the competitive environment of the finance market, especially in the banking segment [5], [6].

The impact of IT investment on bank performance is an interesting topic in academics. It has been attended by [1], [7], [8], [9], and [10]. Using the data from 737 European banks in 1995-2000, [1] found the influence of IT investment on bank performance was different. The IT investment regarding outsourcing providers increases bank profit and bank efficiency, whereas IT activities' acquisition reduces bank performance. [7] gave a positive relationship between IT investment and 12 US banks' IT productivity in 1989-1997. [8] gave that when a changing business environment and proactivity bank IT strategy, the IT investment positively influences bank performance. [9] stated there is a positive influence of IT investment on bank productivity and bank profitability. Moreover, the author gave that the financial innovation which regards the IT investment is going on, and it has brought the best banking products for the customers, which is the crucial factor of enhancing bank performance. [10] found in short-term diffusion of IT investment decreased bank profit, and there was an equilibrium relation between IT investment and bank profitability in the long-term. Based on these studies above, we find that there are inconsistencies between the estimation results. Moreover, we found that the investigation of the relationship between IT investment and bank performance in the emerging countries seems to be missed, especially in the South Asia region like Pakistan. Therefore, in this study, we aim to investigate IT investment's effect on bank performance to interpret IT's role in the banking operation in an emerging country like Pakistan.

II. LITERATURE REVIEW

A. MOTIVE OF INFORMATION TECHNOLOGY INVESTMENT OF THE BANK

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Fintech means financial technology, which indicates the application of information technology to enhance firms' efficiency, including the traditional financial institutions and the fintech company in the finance market [4]. According to [11], the rise of fintech has created a high-pressure for the bank's IT investment because the fintech company is competing with the bank in the finance market. In the digital era, increasing IT investment to reduce operation costs, enhance efficiency, and improve customer experiences is the bank's mandatory requirement [12]. The customer's behavior in using banking products has been changing; they require the banking transaction must meet the convenience, speed, and security more than before [13]. Moreover, [14] suggested utilizing and optimizing the advanced technology increased bank risk management performance. [15] stated that digitalization leads to increasing bank employee satisfaction, which is the crucial factor of bank performance improvement. Therefore, under the high pressure of fintech, the bank has the motive of increasing IT investment for enhancing bank performance.

B. EFFECT OF IT INVESTMENT ON BANK PERFORMANCE

Using the data from 27 banks in 2004-2009 in India, [16] investigated the effect of IT investment on bank performance. The results indicated the positive effect of IT investment on bank profit, namely operating profit and profit per employee. However, the authors did not find evidence of the relationship between IT investment and return on assets. Collected data from 11 Greek commercial banks in 2004-2009, [17] gave that IT investment did not affect bank profitability.

[18] investigated the relationship between bank profitability and IT investment of 13 Indian banks in 2006-2013. The findings gave the increase in IT investment reduced bank profitability. The authors considered that this finding consistent with the profitability paradox. With the data collected from 50 banks in India during 2011-2017, [19] used the geometric approach to investigate the effect of IT on bank performance. The findings showed that only 3-9 banks have a positive link between IT and performance, while other banks' links are insignificant. Another sample of 2156 observation from 264 banks in 43 countries gave that bank stability aggressive IT spending. However, the bank became more unstable in allocating more IT spending returns [20].

At the country-level in Asia, [21] gave there is a positive impact of IT investment on bank performance. However, besides the IT investment factor, bank performance is affected by IT employee quality and customer expectation. Analysis of the relationship between IT investment and performance of 444 bank branches in Ghana, [22] indicated that IT investment has a significant factor in bank branch efficiency.

Consequently, there are various findings of the relationship between IT investment and bank performance, but most studies validated a positive effect of IT investment on bank performance. Therefore, in this study, we expect there is a positive link between the two variables.

III. METHODOLOGY

A. MODEL

Based on the study by [1], [16], [17], and [20], we strategy to use the panel data at the bank-level for investigating the effect of IT investment on bank performance. The model is as below:

$$Y_{it} = \alpha + \beta IT_{it} + \varepsilon_{it} \quad (1)$$

Where Y_{it} and IT_{it} are the performance and IT investment of bank i at time t, respectively; and $\varepsilon_{it} = \mu_i + \lambda_{it}$ is the error term while μ_i is the individual specific effect to cover the specific heterogeneity, and λ_{it} is individual time-varying across individuals and over time.

[23] found that firm performance was sensitive with the lagged of IT investment, and in the banking sector, [1] gave there is the effect of lagged one year of IT investment on bank performance; hence, we add the lagged of IT investment into the model (1), the regression model will be as below:

$$Y_{it} = \alpha + \beta_1 IT_{it} + \beta_2 IT_{i(t-1)} + \varepsilon_{it} \quad (2)$$

Where $IT_{i(t-1)}$ is the lagged one year of IT investment of bank i at time t-1. According to [1], the lagged one year of IT investment was positive with bank profitability and bank efficiency. Therefore, we expect to find a positive relationship between bank performance and the lagged one year of IT investment in this study.

For controlling the effect of IT investment on bank performance, [20], [1], and [17] used bank size and bank risk. We also found other control variables such as banks' characteristics and macroeconomic indicators in the study by [9]) and [20]. This study uses bank size, bank age, and inflation indicators to control IT investment's effect on bank performance. We argue a large bank might allocate more funds for IT activities, facilitating bank performance than a small bank. By contrast, a young bank is more absorptive the technology for enhancing bank performance than an old bank. However, we discuss that the excess of bank size or bank age might lead to the

opposite impact of bank size and bank age on performance; thus, the square of age and size are added into the regression model for investigation. It means we expect the effect of bank size and bank age on performance will be the inverse of U-shaped and U-shaped, respectively. Moreover, we expect a positive effect of inflation on the relationship between IT investment and bank performance. Therefore, equation (2) is modified as below:

$$Y_{it} = \alpha + \beta_1 IT_{it} + \beta_2 IT_{i(t-1)} + \gamma SIZ_{it} + \delta AGE_{it} + \rho INF_{it} + \varepsilon_{it} \quad (3)$$

$$Y_{it} = \alpha + \beta_1 IT_{it} + \beta_2 IT_{i(t-1)} + \gamma_1 SIZ_{it} + \gamma_2 SIZ_{it}^2 + \delta_1 AGE_{it} + \rho INF_{it} + \varepsilon_{it} \quad (4)$$

$$Y_{it} = \alpha + \beta_1 IT_{it} + \beta_2 IT_{i(t-1)} + \gamma_1 SIZ_{it} + \delta_1 AGE_{it} + \delta_2 AGE_{it}^2 + \rho INF_{it} + \varepsilon_{it} \quad (5)$$

Where SIZ is the bank size, which is computed by the logarithm of total assets; AGE is the bank age, which is measured from the original launch year to year t; and INF is measure by the definition of inflation of the World Bank "Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly".

B. DATA ANALYSIS

The fixed-effect approach (FE) and the random-effect approach (RE) are used for running the quantitative models above [24]. For choosing the best estimation between the result of FE and RE, the Hausman test is used, if the Hausman test value is significant, the estimation result of FE is considered is better than that of RE, and otherwise [25], [26]. However, the estimation results of FE or RE is not the perfect way to explain the effect of independent variables on the dependent variable; thus, for increasing robustness of the final estimation outcome, we use the Generalized Method of Moments (GMM) for estimating the model (4)-(5). The estimation results of GMM are considered the best of the panel regression model because it fixes the multicollinearity and autocorrelation issues in FE and RE [25], [26], [24].

C. MEASUREMENT VARIABLES

Through reviewing these studies above, we recognize that there are many measures for calculating bank performance. For example, [16] used operating profits, profits per employee, business per employee, and return on assets for calculating bank performance. [17] used return on average assets and average equity return for calculating bank performance. [18] proposed the bank profitability was the return on assets. Moreover, bank performance was calculated by other measures, namely by Z-score [20], bank efficiency (by the Data Envelop Analysis method) [22]. Like most previous studies, return on assets (ROA), return on equity (ROE), and return on sales (ROS) are used for measuring bank performance. Additionally, we strategy to collect data from the listed banks; thus, the earning per share (EPS) is considered to use as the measure of bank performance. For the listed company, EPS is the crucial indicator that also reflects firm performance.

There is the consistency of [1], [7], [8], [18], and [20] about measuring the IT investment variables. IT investment is the spending (or budget) on computer hardware, software, and services, data processing, outsourced technical support, and staff training. Based on that, in this study, we consider that the IT investment variable consists of the ratio of IT budget on total expenses (ITT), IT budget on non-interest expenses (ITN), and IT budget on revenue (ITR).

D. DATA COLLECTION

The State Bank of Pakistan provides the main components of the dataset. Based on the financial statements and annual reports, the bank performance variables and bank size are computed. Moreover, the State Bank of Pakistan also provides the IT frequently spending of the commercial banks, consisting of spending on purchasing the computer, software, and consulting IT services. We found that the figure excludes the IT staff training spending, IT employee wage, and the opportunity cost of the cooperation between bank and fintech company for improving bank IT performance [27], [28]. However, we believe that the IT frequent spending also reaches the obligation for reflecting nearly the full of IT investment [7], [1]. Therefore, the IT frequently spending is used as the IT investment of the bank. Based on that, ITT, ITN, and ITR are calculated.

Table 1. Descriptive statistics

Variable	Measurement	Obs.	Mean	Std. Dev.	Min	Max
ROA	Profit/return on total assets	351	0.01	0.03	-0.09	0.18
ROE	Profit/return on equity	351	0.15	2.86	-21.60	46.83
ROS	Profit/return on revenue	351	0.07	0.31	-3.06	0.72
EPS	Profit/return on total shares	351	4.24	22.74	-253.72	110.14
ITT	IT budget on total expenses	351	0.03	0.01	0.00	0.06

ITN	IT budget on non-interest expenses	351	0.05	0.01	0.01	0.09
ITR	IT budget on revenue	351	0.03	0.01	0.00	0.07
SIZ	Logarithm of total assets	351	18.92	1.62	15.15	21.86
AGE	Bank year old from the original launch	351	24.67	15.52	1.00	71.00
INF*	The rate of inflation	13	0.09	0.05	0.03	0.20

Note: * INF expresses the inflation from 2007 to 2019, and it is repeated for each bank
Source: The State Bank of Pakistan, the website of Banks, and the World Bank

We find the inflation rate (INF) on the World Bank website to obtain the macroeconomic variables. Furthermore, the bank age is collected by manual method from the announcement of banks, which are published on the bank websites.

The strongly balanced panel data from 27 commercial banks in Pakistan in 2007-2019 is collected. The measurement and descriptive statistics of all variables are shown in detail in **Table 1**.

IV. RESULT

The multi-collinear between variables in the regression model is discussed by the correlation coefficient between pairs of explanatory variables. Table 2 demonstrates that most correlation coefficient values are less than 0.8, except the correlation coefficient is 0.820 between ROS and ROA, but two variables are dependent on the different regression models. Therefore, we can conclude no severe multi-collinear issue across independent variables for regression models above [29].

Table 2. Correlation matrix and variance influence factor

	ROA	ROE	ROS	EPS	ITT	ITN	ITR	SIZ	AGE	INF
ROA	1.000									
ROE	0.052	1.000								
ROS	0.820	0.112	1.000							
EPS	0.401	0.131	0.264	1.000						
ITT	-0.002	0.105	0.093	0.076	1.000					
ITN	0.058	0.014	0.024	0.088	0.410	1.000				
ITR	-0.653	0.048	-0.554	-0.156	0.727	0.308	1.000			
SIZ	0.521	-0.019	0.351	0.157	-0.292	0.056	-0.557	1.000		
AGE	0.258	0.003	0.214	0.184	0.078	0.069	-0.117	0.406	1.000	
INF	-0.142	-0.113	-0.196	-0.006	-0.192	-0.057	-0.014	-0.264	-0.167	1.000

Source: The Authors

Most estimation results by FE and RE of models (1)-(5) are significant at 1%, except that the dependent variable ROE models are insignificant. It means IT investments and other control variables do not associate with ROE. The estimation results are detailed in the Appendix.

A. ESTIMATION RESULTS OF THE IMPACT OF IT INVESTMENT ON ROA

The results of ROA models reveal that independent variables explain approximately 85% of the change of ROA. All IT investment variables' coefficients are significant at 1% and 5%, namely the significant relationship between ITT and ROA, and ITN and ROA are positive, while ITR and ROA are negative. Moreover, the resulting ROA model (4) indicates that the significant relationship between SIZ and ROA has an inverted U-shape pattern. The insignificance of the U-shape pattern between AGE and ROA (model ROA (5)). Hausman values of ROA (1)-(5) are significant level at 1%, 1%, 10%, 1%, and 1%, respectively, it means the results of FE are better than of RE when explaining the effect of IT investment variables and control variables on ROA.

Table 3. Robustness test by GMM model

	ROA		ROE		ROS		EPS	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ITT	1.92*	2.32**	151.02	212.97	38.71***	37.92***	-1090.39	-1563.47
	[1.80]	[2.24]	[0.22]	[0.34]	[3.30]	[3.35]	[-0.19]	[-0.28]
ITN	1.26	1.77	-646.12	-563.29	-2.34	-2.90	-2543.01	-3209.94
	[0.97]	[0.96]	[-0.45]	[-0.46]	[-0.10]	[-0.13]	[-0.24]	[-0.31]
ITR	-3.88***	-4.04***	18.78	-5.44	-35.64***	-35.36***	-2526.09	-2297.21
	[-6.32]	[-6.63]	[0.05]	[-0.02]	[-6.16]	[-6.42]	[-0.84]	[-0.76]
ITT(t-1)	1.75	1.87	-666.74	-633.12	-8.64	-8.58	4361.20	4098.49
	[0.92]	[1.04]	[-0.40]	[-0.41]	[-0.31]	[-0.31]	[0.40]	[0.36]
ITN(t-1)	-0.31	-0.33	523.10	537.10	1.02	0.94	-473.01	-535.52
	[-0.33]	[-0.38]	[0.99]	[1.11]	[0.11]	[0.11]	[-0.11]	[-0.11]
ITR(t-1)	-0.45	-0.38	-37.05	-28.39	2.45	2.23	-1855.84	-1931.14
	[-0.60]	[-0.57]	[-0.08]	[-0.07]	[0.33]	[0.29]	[-0.60]	[-0.56]
SIZ	-0.18	-2.6e-3	-55.95	5.14	0.81	0.04	439.79	19.80
	[-0.70]	[-0.05]	[-0.32]	[0.18]	[0.27]	[0.08]	[0.32]	[0.08]
SIZ²	4.8e-3	-	1.60	-	-0.02	-	-11.01	-
	[0.70]	-	[-0.33]	-	[-0.24]	-	[-0.29]	-

AGE	-2.5e-3	-1.8e-3	-0.45	-0.44	3.9e-3	5.2e-3	-3.40	-3.53
	[-0.37]	[-0.26]	[-0.12]	[-0.12]	[0.06]	[0.08]	[-0.11]	[-0.11]
AGE²	-	1.2e-5	-	3.4e-3	-	-5.1e-5	-	-0.02
	-	[0.67]	-	[0.33]	-	[-0.28]	-	[-0.26]
INF	-0.04	-8.3e-3	-5.82	2.01	0.43	0.34	-133.71	-189.31
	[-0.70]	[-0.12]	[-0.13]	[0.06]	[0.55]	[0.55]	[-0.38]	[-0.66]
N	297		297		297		289	
Value	6.28***	6.23***	0.40	0.45	6.90***	6.97***	0.42	0.36
AR(1) test	-1.59	-1.62	-0.72	-0.91	-0.61	-0.64	-0.39	-0.37
AR(2) test	-0.06	-0.40	0.35	0.58	-0.19	-0.23	-0.08	0.01
Sargan test	0.65	0.59	0.48	0.56	0.16	0.14	0.33	0.29

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

B. ESTIMATION RESULTS OF THE IMPACT OF IT INVESTMENT ON ROS

Similar to the estimation result of the ROA model, the independent variables in the ROS models explain nearly about 80% of the change of ROS, all models are significant level at 1% or 5%, the estimation results of FE is a more suitable to explanation than of RE, and the positive significant between ITT and ROS, and between ITN and ROS, and the significant negative relationship of ITR and ROS.

The results reveal the significant effect of IT investment of lag one year on ROS, namely ITN(t-1) is a significant adverse effect on ROS of the RE 2.6, RE 3.6, and RE 4.6, while ITR(t-1) has a significant positive relationship with ROS for both FE and RE of ROS (2)-(5).

C. ESTIMATION RESULTS OF THE IMPACT OF IT INVESTMENT ON EPS

The independent variables in the model of EPS (1), EPS (2)-(4) explain from 7.69% to 19.86% the change of EPS. The four values of Hausman test the results of RE of EPS (1)-(2) model is more suitable than of FE, and otherwise, for EPS (3)-(5) model, the results of FE are more appropriate than.

We find a significant positive relationship between ITT and EPS and a significantly negative relationship between ITR and EPS. The coefficients of ITT(t-1) are significantly negative in RE 2.8, FE 3.7, RE 3.8, RE 4.8, and RE 5.8; the coefficients of ITN(t-1) are significantly positive in RE 2.8, RE 3.8, RE 4.8, FE 5.7, and RE 5.8; the coefficient of ITR(t-1) is significantly positive in FE 2.7, FE 3.7, FE 4.7, RE 4.8, and FE 5.7; the coefficient of INF is significantly positive in FE 3.7, FE 4.7, and FE 5.7; and the significant effect of bank size on EPS is like the U-shaped pattern in RE 4.8.

D. ROBUSTNESS CHECK

Table 3 shows the model's estimation results (4)-(5), processed by the GMM approach. In this study, the result of the GMM is considered the best result for explaining the impact of IT investment on bank performance. The value of AR (1), AR (2), and Sargan test is insignificant. It means the estimation results of the GMM approach are consistent, and there are no multicollinearity and autocorrelation issues.

The results show that while the ROA and ROS models are significant at 1%, the ROE and EPS model is not significant. ITT's coefficients are positive signs from 10% to 1% significant level in the model of ROA and ROS. In contrast, the coefficients of ITR are opposing signs and significantly at 1% (see detail column 1-2-5-6 of Table 3). The rest of the other coefficients are not significant for any models. Overall, the robustness check results validate the ITT variable and ITR variable's significant impact on the banks' ROA and ROS in Pakistan.

V. DISCUSSION

Except for the ROE estimations, the model is insignificant; the rest of all coefficients of the IT expenses on total expense ratio are positive signs and significant. It is not similar to [1] and [9]; the sign of IT spending on total expense is negative. In the case of our sample, we argue that under the pressure of technology innovation on the banking sector in the period 2007-2019, the period of the rise of fintech [4], [6], [5], the larger of the proportion of IT frequent spending on total expenses show that the bank is going on focusing the technology innovation, that is a critical factor of enhancing bank efficiency, and lead to increasing bank performance. Therefore, we support that the IT expenses on total expenses ratio on bank performance are suitable.

The difference from most previous studies, we investigate the effect of the ratio of IT expense on revenue on bank performance. Like ITT's coefficients, the coefficients of ITR are significant in the ROA, ROS, and EPS models. However, the coefficients of ITR are negative; this means when increasing the allocation of revenue for IT spending, the bank performance will be decreased. We argue that the results of ITR are also appropriate in the aspect of the multi-relationship between revenue, expense, and profit. The larger proportion of IT expense on revenue decreases bank profit and negatively influences bank performance.

The FE and RE approach results show that the lag of IT variables does not influence ROA and ROE but significantly influences ROS and EPS. However, the GMM approach results validate that the lag of IT variables and bank performance is insignificant. This outcome is partly consistent with [23], [1], [19], and [17]. We discuss that because we use the IT frequent spending for estimating IT variables; thus, it is absorbed and transfer to the outcome of the bank on the income statement rather than on the balance sheet, and the lag of IT variable might be the signal which reflects the expectation of bank income for the next year. Additionally, we do not find proof of the influence of bank characteristics and macroeconomic conditions on bank performance. In this study, we consider the IT investment as the IT frequent spending. It strongly depends on the bank's IT capacity, expressed by allocating total expenses and revenue for the IT budget. Therefore, in this study, we discuss that the results are more appropriate, although this study result is different from previous studies [30], [2].

VI. CONCLUSION

In this study, we used the data of 27 banks in Pakistan from 2007 to 2019 for estimating the impact of IT investment on bank performance. The database is mostly provided by the State Bank of Pakistan and partly collected by the bank websites and the World Bank website. The bank performance variables are calculated using bank profitability ratios such as ROA, ROE, ROS, and EPS. In contrast, the IT investment variables are presented by the IT budget on total expense ratio, non-interest expenses, and revenue. We formulated five quantitative research models that show the relationship between IT investment, the lag of IT investments, bank characteristics, macroeconomic conditions, and bank performance. We used the FE, RE, and GMM approaches for processing in the estimation of these models. The estimation results of models are consensus with the significant effect of IT investment on bank performance. At the same time, the significance of other explanatory variable coefficients is not consistent in different models. However, in this study, the research outcome is appropriate in the bank in Pakistan.

This study considers the annual IT spending as the proxy of IT investment variables; it does not reflect the bank's long-term IT investment. We argue that the IT strategy also plays the most crucial in bank performance; it facilitates to enhance bank performance in various aspects such as in the internal process, in the customer relationship, or even through the banking distribution [5], [31]. Thus, we propose that the next paper consider the long-term IT investment on bank performance; we believe that its result will provide the holistic impact of IT investment on bank performance.

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A. APPENDIX 1

Table 4. The results of the model (1)

	ROA (1)		ROE (1)		ROS (1)		EPS (1)	
	FE 1.1	**RE 1.2**	**FE 1.3**	**RE 1.4**	**FE 1.5**	**RE 1.6**	**FE 1.7**	**RE 1.8**
ITT	2.91***	2.97***	87.50**	50.84*	38.03***	37.37***	1365.42***	1120.04***
	[29.09]	[36.43]	[2.29]	[1.80]	[21.66]	[24.39]	[1.38]	[4.74]
ITN	0.28***	0.38***	-26.13	-17.11	2.76	1.74	217.42	318.32
	[2.91]	[4.25]	[-0.71]	[-0.53]	[1.63]	[1.09]	[0.74]	[1.31]
ITR	-3.01***	-3.21***	-37.68	-11.65	-41.97***	-39.67***	-1139.08***	-1041.73***
	[-40.72]	[-51.29]	[-1.34]	[-0.53]	[-32.33]	[-34.07]	[-4.73]	[-5.98]
CONS	-0.01**	-0.01**	-0.09	-0.17	-0.05	-0.05	-15.48	-16.06
	[-2.28]	[-2.51]	[-0.06]	[-0.11]	[-0.79]	[-0.65]	[-1.32]	[-1.43]
N	351		351		351		343	

R^2	0.8492	0.8483	0.0166	0.0149	0.7749	0.7743	0.0776	0.0769
Sta.Val.	602.64***	2718.79***	1.80	3.77	368.44**	1210.83***	8.78*	39.46***
Hau.Val.	25.84***		-		15.85***		0.93	

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

B. APPENDIX 2

Table 5. The results of the model (2)

	ROA (2)		ROE (2)		ROS (2)		EPS (2)	
	FE 2.1	**RE 2.2**	**FE 2.3**	**RE 2.4**	**FE 2.5**	**RE 2.6**	**FE 2.7**	**RE 2.8**
ITT	3.00***	3.10***	100.24*	50.05	42.20***	40.55***	2174.06***	1636.47***
	[21.88]	[23.20]	[1.72]	[0.91]	[17.13]	[16.35]	[6.38]	[4.75]
ITN	0.30***	0.33***	-30.54	-24.62	3.99**	3.15*	-324.75	21.33
	[2.82]	[3.27]	[-0.69]	[-0.58]	[2.12]	[1.66]	[-1.34]	[0.09]
ITR	-3.14***	-3.30***	-42.29	4.31	-48.44***	-45.41***	-1141.87***	-1198.09***
	[-34.01]	[-38.56]	[-1.08]	[0.12]	[-29.17]	[-28.21]	[-5.16]	[-5.61]
ITT(t-1)	-0.08	-0.05	0.2e-2	-7.19	-3.82	-3.22	-372.84	-558.71*
	[-0.60]	[-0.40]	[0.00]	[-0.13]	[-1.56]	[-1.30]	[-1.13]	[-1.66]
ITN(t-1)	0.02	0.05	8.19	14.73	-2.39	-3.28*	231.729	545.90**
	[0.20]	[0.44]	[0.18]	[0.34]	[-1.24]	[-1.69]	[0.93]	[2.14]
ITR(t-1)	0.1e-2	-0.08	-13.58	-6.51	4.31***	5.55***	361.23*	305.25
	[0.01]	[-0.98]	[-0.39]	[-0.20]	[2.96]	[3.77]	[1.87]	[1.54]
CONS	-0.01	-0.01	-0.15	-0.54	0.05	0.05	-21.66	30.76**
	[-1.29]	[-1.40]	[-0.06]	[-0.23]	[0.48]	[0.48]	[-1.60]	[-2.19]
N	324		324		324		316	
R^2	0.8533	0.8526	0.0200	0.0122	0.7884	0.7859	0.1755	0.1422
Sta.Val.	282.18***	2811.34***	0.99	3.58	180.66***	1144.25***	10.04***	56.49***
Hau.Val.	18.44***		-		24.19***		8.49	

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

C. APPENDIX 3

Table 6. The results of the model (3)

	ROA (3)		ROE (3)		ROS (3)		EPS (3)	
	FE 3.1	**RE 3.2**	**FE 3.3**	**RE 3.4**	**FE 3.5**	**RE 3.6**	**FE 3.7**	**RE 3.8**
ITT	3.10***	3.22***	77.03	24.73	42.78***	39.89***	2564.69***	1764.17***
	[19.87]	[22.65]	[1.16]	[0.42]	[15.15]	[14.90]	[6.70]	[4.92]
ITN	0.24**	0.27***	-17.69	-15.07	3.51*	3.48*	-475.44*	-25.56
	[2.16]	[2.58]	[-0.37]	[-0.34]	[1.73]	[1.76]	[-1.85]	[-0.10]
ITR	-3.16***	-3.31***	-37.83	9.44	-48.28***	-45.46***	-1222.18***	-1240.85***
	[-33.69]	[-38.01]	[-0.94]	[0.27]	[-28.44]	[-27.61]	[-5.36]	[-5.54]
ITT(t-1)	-0.03	-0.10	-24.12	5.96	-4.15	-3.20	-603.91*	-654.75*
	[-0.21]	[-0.74]	[-0.37]	[0.11]	[-1.51]	[-1.27]	[-1.66]	[-1.92]
ITN(t-1)	-0.1e-2	0.08	20.60	4.83	-2.27	-3.38*	399.34	597.02**
	[-0.01]	[0.74]	[0.42]	[0.11]	[-1.09]	[-1.73]	[1.51]	[2.33]
ITR(t-1)	-0.02	-0.07	-8.35	-4.79	4.39***	5.57***	342.14*	300.42
	[-0.19]	[-0.92]	[-0.24]	[-0.14]	[2.98]	[3.74]	[1.76]	[1.47]
SIZ	0.2e-2	0.5e-3	-0.72	-2.4e-3	0.02	-4.7e-3	0.02	-0.41
	[1.36]	[1.09]	[-0.98]	[-0.02]	[0.65]	[-0.48]	[0.01]	[-0.42]
AGE	-0.4e-3	1.2e-4	0.15	-3.9e-3	-0.9e-3	0.7e-3	0.62	0.10
	[-1.42]	[-0.30]	[1.23]	[-0.32]	[-0.18]	[0.82]	[0.88]	[1.39]
INF	0.01	0.02**	-1.91	-6.05	0.09	-0.12	69.25**	35.41
	[0.85]	[2.52]	[-0.32]	[-1.60]	[0.36]	[-0.66]	[2.16]	[1.61]
CONS	-0.04	-0.02**	9.63	0.34	-0.31	0.14	-46.89	-28.55
	[-1.50]	[-1.96]	[0.81]	[0.09]	[-0.62]	[0.67]	[-0.70]	[-1.22]
N	324		324		324		316	
R^2	0.8558	0.8543	0.0291	0.0170	0.7889	0.7859	0.1900	0.1444
Sta.Val.	189.95***	2776.95***	0.96	6.37	119.56***	1138.85***	7.30***	61.57***
Hau.Val.	16.24*		-		28.13***		20.26**	

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

D. APPENDIX 4

Table 7. The results of the model (4) - nonlinear of size

	ROA (4)		ROE (4)		ROS (4)		EPS (4)	
	FE 4.1	**RE 4.2**	**FE 4.3**	**RE 4.4**	**FE 4.5**	**RE 4.6**	**FE 4.7**	**RE 4.8**
ITT	3.60***	3.21***	68.84	22.91	42.93***	39.91***	2553.59***	1970.60***
	[20.05]	[22.76]	[1.04]	[0.39]	[15.16]	[14.91]	[6.65]	[5.67]
ITN	0.24**	0.27***	-18.11	-14.98	3.52*	3.51*	-475,50*	-42.65
	[2.19]	[2.60]	[-0.38]	[-0.34]	[1.73]	[1.77]	[-1.85]	[-0.17]

ITR	-3.15***	-3.31***	-35.65	13.36	-48.32***	-45.62***	-1219.09***	-1357.71***
	[-34.41]	[-38.23]	[-0.89]	[0.38]	[-28.43]	[-27.67]	[-5.34]	[-6.26]
ITT(t-1)	0.03	-0.05	-12.47	-4.47	-4.37	-2.85	-587.18	-919.35***
	[0.18]	[-0.34]	[-0.19]	[-0.08]	[-1.58]	[-1.12]	[-1.60]	[-2.76]
ITN(t-1)	-0.06	0.04	9.28	10.06	-2.05	-3.59*	385.74	691.34***
	[-0.51]	[0.41]	[0.19]	[0.23]	[-0.98]	[-1.82]	[1.44]	[2.79]
ITR(t-1)	4.6e-4	-0.08	-5.23	-0.89	4.33***	5.49***	344.53*	324.04*
	[0.01]	[-1.02]	[-0.15]	[-0.03]	[2.94]	[3.68]	[1.77]	[1.65]
SIZ	0.05***	0.02**	8.98*	-3.24	-0.17	0.12	11.52	-79.88***
	[4.11]	[2.54]	[1.67]	[-1.32]	[-0.72]	[0.80]	[0.40]	[-5.01]
SIZ²	-1.3e-3***	-5.0e-3**	-0.27*	0.09	0.01	-3.5e-3	-0.31	2.31***
	[-3.96]	[-2.48]	[-1.82]	[1.32]	[0.82]	[-0.83]	[-0.40]	[4.99]
AGE	-8.0e-5	2.9e-5	0.22*	-0.01	-2.2e-3	1.0e-3	0.70	-0.08
	[-0.27]	[0.64]	[1.70]	[-0.83]	[-0.40]	[1.05]	[0.96]	[-1.05]
INF	0.01	0.02**	-1.32	-5.86	0.08	-0.13	70.07**	33.00
	[1.09]	[2.35]	[-0.22]	[-1.55]	[0.32]	[-0.70]	[2.18]	[1.56]
CONS	-0.49***	-0.19***	-79.55	29.84	1.39	-1.04	-152.84	711.74***
	[-4.21]	[-2.74]	[-1.58]	[1.32]	[0.65]	[-0.72]	[-0.56]	[4.74]
N	324		324		324		316	
R^2	0.8633	0.8590	0.0402	0.0086	0.7893	0.7851	0.1905	0.1202
Sta.Val.	181.24***	2747.99***	1.20	8.13	107.54***	1138.32***	6.57***	91.30***
Hau.Val.	28.76***		-		27.04***		26.86***	

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

E. APPENDIX 5

Table 8. The results of the model (5) – nonlinear of age

	ROA (5)		**ROE (5)**		**ROS (5)**		**EPS (5)**	
	FE 5.1	**RE 5.2**	**FE 5.3**	**RE 5.4**	**FE 5.5**	**RE 5.6**	**FE 5.7**	**RE 5.8**
ITT	3.11***	3.22***	71.56	29.38	43.24***	39.85***	2614.05***	1750.01***
	[19.70]	[22.56]	[1.06]	[0.50]	[15.15]	[14.85]	[6.84]	[4.87]
ITN	0.24**	0.28***	-16.70	-21.90	3.43*	3.38*	-480.31*	0.79
	[2.13]	[2.59]	[-0.35]	[-0.50]	[1.69]	[1.69]	[-1.88]	[0.00]
ITR	-3.17***	-3.30***	-34.95	11.08	-48.53***	-45.31***	-1251.95***	-1250.16***
	[-33.43]	[-37.83]	[-0.86]	[0.32]	[-28.35]	[-27.42]	[-5.50]	[-5.57]
ITT(t-1)	-0.03	-0.10	-23.40	10.39	-4.21	-3.13	-631.98*	-677.43***
	[-0.22]	[-0.76]	[-0.36]	[0.18]	[-1.53]	[-1.24]	[-1.74]	[-1.98]
ITN(t-1)	0.3e-2	0.08	18.70	-1.59	-2.11	-3.50*	438.77*	622.03**
	[0.03]	[0.76]	[0.38]	[-0.04]	[-1.01]	[-1.78]	[1.66]	[2.41]
ITR(t-1)	-0.02	-0.07	-6.27	-3.57	4.22***	5.65***	321.94*	296.80
	[-0.24]	[-0.91]	[-0.18]	[-0.11]	[2.85]	[3.77]	[1.66]	[1.45]
SIZE	2.5e-3	5.2e-4	-0.78	-0.01	0.03	-5.2e-3	1.85	-0.38
	[1.42]	[1.12]	[-1.06]	[-0.08]	[0.83]	[-0.53]	[0.44]	[-0.40]
AGE	-5.4e-4	-4.6e-5	0.21	0.05	-5.7e-3	2.1e-3	-0.45	-0.11
	[-1.42]	[-0.35]	[1.30]	[1.17]	[-0.84]	[0.77]	[-0.49]	[-0.47]
AGE²	1.9e-6	5.0e-7	-9.0e-4	-7.9e-4	7.7e-5	-2.1e-5	0.02*	3.2e-3
	[0.50]	[0.26]	[-0.55]	[-1.32]	[1.11]	[-0.52]	[1.73]	[0.92]
INF	0.01	0.02**	-1.98	-5.22	0.01	-0.10	69.63**	31.94
	[0.86]	[2.42]	[-0.33]	[-1.36]	[0.39]	[-0.57]	[2.18]	[1.43]
CONS	-0.04	-0.02*	10.35	0.14	-0.37	0.14	-69.36	-27.31
	[-1.54]	[-1.94]	[0.86]	[0.04]	[-0.73]	[0.65]	[-1.02]	[-1.17]
N	324		324		324		316	
R^2	0.8559	0.8544	0.0301	0.0192	0.7898	0.7852	0.1986	0.1439
Sta.Val.	170.54***	2723.86***	0.89	8.14	107.81***	1136.70***	6.92***	62.38***
Hau.Val.	15.89***		-		32.97***		28.70***	

Note: *, **, and *** are the significant level at 10%, 5% and 1%, respectively
Source: The Authors

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