Brexit: The Impact of the Fluctuation of Pound Exchange Rate on the Banking Performance and Profitability

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Abstract

The study investigated the relationship between exchange rate and bank performance or profitability after Brexit. The study uses three performance measures (including return on equity, return on assets, and the ratio of capital to deposit) as dependent variables and five various measures (government expenditure, GDP, inflation rate, and Dummy—Brexit) independent variables. The investigation is performed using data from two levels: one is for a sample of 34 banks in the United Kingdom from 2009 to 2018, another is for the whole country's bank performance. The result indicates a correlation between bank performance and exchange rate during the period of Brexit. However, due to the size and availability of the data, the finding remains to be discussed.

Keywords

Brexit, Exchange Rate of Pound, Bank Performance, Profitability

1. Introduction

On January 23, 2013, British Prime Minister David Cameron first mentioned the Brexit referendum. Since then, the debate about whether to leave Europe has lasted for about three years. It was not until June 24, 2016, that British officials announced the referendum results and decided to withdraw from the E.U., known as Brexit. At present, the United Kingdom leads the EU-28 ranking in banking assets (21% of total EU-28), capitalization (21%), credit (18%), and employment generated (14%). The United Kingdom is home to the world's second-largest Financial Centre (Global Financial Centres Index, 2018), which indicates that the British financial industry plays a significant role in Europe and

even in the world.

With Brexit in 2016, the unprecedented situation had brought new uncertainty to the U.K. and E.U. economy. According to Bloom et al. (2019), during Brexit, there were signs of increased uncertainty, investment losses, and productivity decline. In this case, many international financial institutions are headquartered in the U.K. because they want to take advantage of the U.K.'s developed financial market and the E.U. passport to conduct business in the other E.U. Member States. Therefore, most analysts predicted that the uncertainty of Brexit brought considerable costs to both the E.U. and the United Kingdom, especially the banking sector (Ramiah et al., 2017). From a macroeconomic perspective, Wielechowski & Czech (2016) found that brexit had a negative impact on UK GDP growth rate. As for the banking system in the U.K., Baier and Welfens (2019) have adopted the Gravity models and use locational banking statistics to estimate the negative effect of Brexit on the movement of Foreign direct investment in the U.K. banking system. The significant uncertainty caused the financial market to fluctuate wildly and caused the stock price to drop sharply, especially for financial institutions. More specifically, the Royal Bank of Scotland shares fell by about 18.0%, while Barclays and Deutsche Bank fell by 17.7% and 13.9%, respectively (Bloomberg, 2016b). At the same time, it is worth noting that during the Brexit, the British pound fluctuated wildly, **Figure 1** shows the exchange rate of SDR to pound. The exchange rate decline was even more than twice as much as when the U.K. was forced to withdraw from the European exchange rate system in 1992. The issue attracted our attention strongly. Therefore, our research group focuses on the pound's exchange rate and hopes to explore the possible relationship between exchange rate fluctuations and banking performance.

In this study, ROA, ROE, and capital deposit ratio are used to serve as bank profitability indicators. A controlled variable is also added into three regression

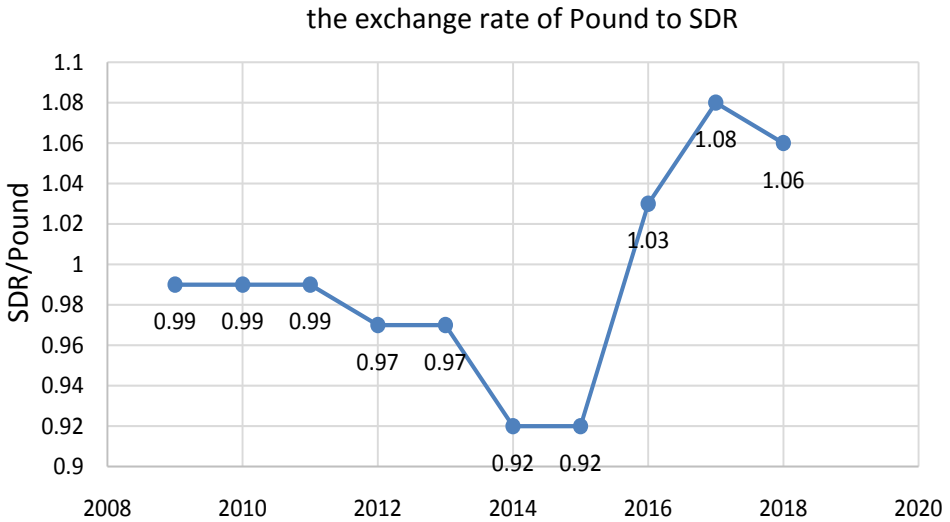

Figure 1. Movement of the exchange rate of pound to SDR from 2009 to 2018, period average source: international monetary fund.

models can make the research more accurate. Besides, Excel is used to analyze data and run regressions to interpret the results by ANOVA further. Moreover, the finding shows that the pound's exchange rate change impacts bank profitability when the capital deposit ratio functions as a measurement. But, due to a lack of complete data collection and data normalization techniques, the result seems to be contrary to the study of Saeed (2014). Therefore, this research's limitation may lead to differences from others, and the result remains to be discussed. The research contribution is that the regression model and variable selection may reference interested researchers to study banks' profitability.

This research is conducted by the College of Business and Public Management, Wenzhou Kean University.

2. Literature Review

The literature here is divided into three main parts. The first part is about the impact of Brexit on the financial system. Speaking, Brexit has caused fluctuations in stock, instability of currency, overseas trading, and foreign investment reduction. The second part is about the impact of Brexit on the Bank industry. As an important industry in Britain, the banking industry is facing significant challenges. The specific effects include lower stability, less efficiency, and poor profitability of the banking industry. The third part consists of the studies that are closely related to ours. These studies reveal that there is a relationship between exchange rate and bank performance.

In the first part, in terms of the stock market, Brexit made the stock market mess and affected its stability. Kurecic and Kokotovic (2018) examined the impact of British political turmoil in 2016 and 2017 on selected relevant stock indexes. The result indicates that the outcome of Brexit caused a structural break on the stock market, and the breakthrough could be seen in every researched stock index. Also, Arshad et al. (2020) perform a study to examine the relationship between Brexit and volatility and the London stock exchange's effectiveness. The result indicates that the stock volatility is lower, and the efficiency of the stock becomes worse.

In addition to the impact on the stock market, Brexit also seriously affected the banking system and worsened the United Kingdom's economic development. For instance, Ramiah et al. (2017) performs a study to examine the effect of Brexit on several sectors in the United Kingdom. The investigation is conducted using stock prices, index, and sectoral price indices from 2010 to 2016 to analyze the abnormal returns (ARs). The result indicates Brexit had a lousy effect on leisure sectors and the banking sector and the banking industries in the short-term might experienced systematic risk. What is more, the efficiency of the bank in the United Kingdom would be damaged. According to the survey conducted by Fernández et al. (2019), the research discovers that the political and regulatory turmoil in 2016 triggered by the Brexit referendum harmed bank efficiency, and there is a direct relationship between the Brexit process and bank ef-

ficiency. Additionally, the profitability and stability of the bank become worse due to Brexit. According to Cazan (2017), who performs research to examine the implication of Brexit on the England banking system, the significant reduction in the abnormal and cumulative abnormal returns indicates the lower financial stability. Furthermore, the whole bank system will suffer from worsen profitability. Attilio, Miele, & Sulimierska (2018) examine the impact of Vickers' ring-fencing regulation, quantitative easing program, and Brexit on the United Kingdom banking system. It provides evidence that the "Brexit" vote did cause negative abnormal returns across all banks. However, based on the adverse effects of Brexit on the banking industry, Samitas et al. (2018) performs a study to examine the impact of Brexit on the United Kingdom and the EU. The study confirms that the United Kingdom banking industry is enormous enough to recover from any difficulties.

In the third part, several studies indicate the impact of exchange rate changes on bank performance. Taiwo and Adesola (2013) investigate the influence of unstable exchange rates on bank performance in Nigeria using Ordinary Least Square Regression. It uses two performance measures, including loan loss to total advance ratio and capital deposit ratio, as the dependent variable. Government expenditure, interest rate, and the actual gross domestic product were added to the exchange rate as independent variables. The result indicates that the relationship between the exchange rate and bank performance measured by two indicators is related. Loan loss and total prepayment rate show that exchange rate fluctuations may affect the lender's ability to manage loans, which results in a higher level of non-performing loans. This study improves the models and optimizes the use of variables. Additionally, the exchange rate changes also influence the bank's operations and profitability both in the short term and long term. According to the study by Babazadeh, & Farrokhnejad (2012) performs the error correction model (ECM) can examine the relationship between short-term and long-term foreign exchange rates and the bank's profitability and operation. Meanwhile, some data should be used from the different commercial banks from 2006 to 2010. The result indicates that it is higher than expected when responding to the exchange rate rise in the short-term, while in the long-term, the profit is higher than equilibrium. Also, the result suggests that there are significant stable models of the short and long-term behavior of exchange rates and the impact on bank foreign exchange profits. Furthermore, Ademola et al. (2016) perform a study to estimate the relationship between the fluctuation of the exchange rate and the bank's performance in Nigeria from 2005 to 2014 as well. The study uses the ARCH LM test to indicate the volatility of the exchange rate, uses ROA to test the banks' profitability, and uses LDR to calculate the liquidity of banks. The investigation is performed using all the deposited banks in Nigeria for ten years from 2005 to 2014. The results show that the significant depreciation in Nigerian Naira causes the banks' lower liquidity and the banking sector's importance. Also, the studies indicate policy should re-assess the preservation of the exchange rate. The methodology used in the

study of Ademola et al. (2016) is highly related to ours, and corresponding improvements are made to facilitate the model.

3. Hypotheses Development

British banking plays a vital role in the development of the British economy, but Brexit has a significant negative impact on the British economy and financial market. According to the research of Cazan (2017), the examples of about 11 different financial institutions prove that Brexit has adverse effects on the banking system. Considering that Brexit leads to fluctuations in the exchange rate of the pound and changes in banks' efficiency and profitability across the U.K. According to Taiwo and Adesola (2013), the study indicates a correlation between the exchange rate and bank performance measured by two indicators. Therefore, we presume that the sterling exchange rate fluctuation will impact the U.K. bank's performance and profitability. Since the return on assets (ROA), return on equity (ROE), and capital ratio are the primary indicators of bank profitability and performanc; thesee three indicators can be used as the study's main measurement. Variables such as the pound's exchange rate to SDR, inflation rate, and real government expenditure will affect ROA, ROE, and capital ratio. Therefore, a hypothesis can be put forward according to the research.

Ho: There is no relationship between the pound exchange rate and the performance and profitability of the U.K. Banks.

4. Possible Outcome

Ademola et al. (2016) proves the significant effect of the exchange rate on bank performance, plus Taiwo and Adesola (2013) find that there is a negative relationship between the exchange rate and bank profitability. Based on these reaserch findings, it is believed that there is a negative relationship between the pound exchange rate and the bank's profitability and performance. Here are expectations about the possible outcome of this study: If the *P*-value in the regression is higher than ten percent, indicating an insignificant relationship between the pound exchange rate and bank performance and profitability. However, if the *P*-value is less than or equal to 10 percentage, it infers a significant relationship between the pound exchange rate and the bank's profitability.

5. Data

This section includes the data population, data collection, variables with specific information.

5.1. Data Population

The population of this study is the banks in the United Kingdom. The research focuses on the banking sector data from both country level and industry level to verify the designed model's validity and examine the effect of Brexit on banking performance. The research targets two data populations: The first data popula-

tions is country level data which is the overall data of the whole British banking industry published by the office for national statistics. The second data populations are the industry level data of the UK banking industry, that is, the sample data. According to statistics, there are now more than 40 banks operating in the UK. The data of 33 banks are selected as samples, considering that some banks' data are missing or unpublished.

5.2. Data Collection

In this research, the most of data are collected in the bloomberg laboratory, while the data of the pounds exchange rate to SDR are gathered from the International Monetary Fund databases. Each set of data span from 2009 to 2018. The banking data at the national level, including ROA, ROE, capitals and deposits, are obtained directly from government statistics. Sample banking data at the industrial level, including ROA, ROE, capitals and deposits, are obtained from the official financial reports and specific financial statements of each bank. Macroeconomic variables including inflation rate, GDP and government expenditure are collected directly from the office for national statistics.

5.3. Variables

This section clarifies controllable variables, dependent variables, and independent variables and shows the characteristics and other related information.

In this study, the determinants of bank profitability and bank performance are measured by ROA, ROE and capital deposit ratio. Therefore, the dependent variables are ROA, ROE and capital deposit ratio. The first independent variable is the exchange rate of pound sterling to SDR, which is used as the independent variable to reflect the value of pound sterling. The second independent variable is the dummy-brexit that used to represent the event of pre-Brexit and post-Brexit. Other variables such as real inflation rate, government expenditure, rael GDP are all control variables, because these variables will lead to fluctuations in the exchange rate of the pound against the SDR. The definitions, functions, formulas and sources of these variables are described at **Figure 1**.

6. Methodology

This section shows three regression models used to achieve the goal.

The purpose of this study is to explore the impact of sterling/SDR exchange rate fluctuations on the performance and profitability of British banks before and after brexit in 2013. This study compares two groups of data from 2009 to 2013 and 2014 to 2018 to verify the impact of significant changes in exchange rate on bank performance and profitability in this period. At the same time, through the comparative analysis of the sample data of 34 banks and the national level data published by the British National Bureau of statistics, the deviation of the sample data is measured to verify the accuracy of the regression model.

This research is an exploratory design. Through the improvement of research methods in Ademola et al. (2016) and Taiwo & adenola (2013), the purpose of

better measuring bank performance and profitability can be achieved.

Ademola et al. (2016) use arch LM Test to get exchange rate volatility, use ROA and ROE to test bank profitability, and use LDR to calculate bank liquidity. Similarly, ROA and roe are also selected as indicators to measure bank profitability.

Taiwo and Adesol (2013) used ordinary least squares regression to study the impact of unstable exchange rate on the performance of Nigerian banks. This paper uses its methodology for reference and uses the index of capital deposit ratio to measure the performance of banks.

In the establishment of the model, the ROA index, roe index and capital deposit ratio are used as dependent variables; the exchange rate of pound sterling to special drawing rights and virtual brexit are used as independent variables; GDP, government expenditure and real inflation rate are used as control variables.

In data analysis, Excel and SPSS were used to process and analyze the data, and linear regression model was used to verify the relationship between independent variables and dependent variables.

Here are the three regressional models about bank performance:

Model 1:

$$\begin{aligned}\mathrm{Log}(\mathrm{ROA}) = a_0 + a_1\mathrm{Log}(\mathrm{SDR}) + a_2\mathrm{Log}(\mathrm{Govt}) + a_3\mathrm{Log}(\mathrm{RGDP}) \\ + a_4\mathrm{Log}(\mathrm{InfRt}) + a_5\text{Dummy-Brexit}\end{aligned}.$$

Model 2:

$$\begin{aligned}\mathrm{Log}(\mathrm{ROE}) = b_0 + b_1\mathrm{Log}(\mathrm{SDR}) + b_2\mathrm{Log}(\mathrm{Govt}) + b_3\mathrm{Log}(\mathrm{RGDP}) \\ + b_4\mathrm{Log}(\mathrm{InfRt}) + b_5\text{Dummy-Brexit}\end{aligned}.$$

Model 3:

$$\begin{aligned}\mathrm{Log}\left(\frac{\text{Capital}}{\text{Deposit}}\right) = \beta_0 + \beta_1\mathrm{Log}(\mathrm{SDR}) + \beta_2\mathrm{Log}(\mathrm{Govt}) + \beta_3\mathrm{Log}(\mathrm{RGDP}) \\ + \beta_4\mathrm{Log}(\mathrm{InfRt}) + \beta_5\text{Dummy-Brexit}\end{aligned}.$$

Expected results: Saeed (2014) show that bank size, capital ratio, loan, deposits, liquidity, and interest rate have a positive impact on ROA and ROE, whereas GDP and inflation rate have adverse effects. These results are matched with most of the other researchers, including Bourke (1989), Molyneux and Thornton (1992), Pasiouras and Kosmidou (2007), and Athanasoglou et al. (2008). Therefore, this paper's finding is expected to match the previous results, which means that a_1, b_1, and β_1 in the regression models will be negative. Besides, coefficients of a_5, b_5, and β_5 are expected to expose the impact of Brexit on bank profitability negatively. Also, if the testing probability is larger than the significance level, there is no relationship between the exchange rate and bank performance; otherwise, there is a significant relationship between them.

7. Empirical Results

This section is divided into two parts: one is about the Country-level; another is

about the industry level; the part on the level of Country is to examine the accuracy of the selected industry level. Each piece contains three statistic tables: Table 1—variable description, Table 2—descriptive statistic, Table 3—correlations. For Table 1, it describes the characteristic of all variable. Table 2 reveals the correlations between each variable. Table 3 uses the regression function to obtain some indicators, which is to evaluate the relationship.

7.1. Descriptive Statistic

Descriptive statistics show the quantitative features of variables and indicate whether meeting the standard of normalization.

Table 2 provides descriptive statistics. Excel depicts the data of three dependent variables and six independent variables collected from both country level

Table 1. The description, characteristics, and source of variables.

Variables	Explanations
SDR	SDR, individual drawing right, is an international reserve asset that serves as the IMF's unit of account. It is used to measure the value of the currency in terms of the exchange rate.
Capital deposits ratio	Capital deposit ratio is the portion of the bank's capital to the deposit. It is used to measure the profitability of the bank in many reserches. It can be collected from the profitability ratio sheet in the Bloomberg laboratory.
ROA	ROA is calculated by dividing the net income over total assets and used to measure the profitability of the bank. It can be collected from the profitability ratio sheet in the Bloomberg laboratory. For the weighted level of the industry, ROA index is used, which is the weighted level, to fix the limited observations.
ROE	ROE is also an indicator to measure the profitability of banks and computed by net income over the shareholder's equity. It can be collected from the profitability ratio sheet in the Bloomberg laboratory. For the weighted level of the industry, ROE index, which is the weighted level, to fix the limited observations.
GDP	GDP is the real Gross Domestic Product representing the economic growth of a country. The change in GDP has a closed relationship with banksbank. It can be collected from the United Kingdom Office for National Statistics in Bloomberg Laboratory.
Inflation Rate	Inflation rate indicates the purchasing power of a nation's currency, which is used to measure the rate of changes in the price level. Inflation has an impact on profitability because higher inflation means lower profitability of banks. It is calculated by the CPI collected from the United Kingdom Office for National Statistics in Bloomberg Laboratory.
Government Expenditure	Government Expenditure is the devotion or purchases of public consumption, Public investment, and transfer payments. It can influence the performance of the bank. The United Kingdom Office can collect it for Nation. The statistic in Bloomberg Laboratory.
Dummy-Brexit	Dummy-Brexit is a dummy variable that only uses the value 0 or 1 to indicate the absence or presence of some categorical effect that may influence the outcome. Here we use 0 to represent 2016 pre-Brexit while 1 represents post-Brexit. The use of the Dummy variable is to measure the impact of Brexit on bank profitability.

Table 2. Descriptive statistic.

	ROA (%)	ROE (%)	ROA (Index)	ROE (Index)	Capital Deposit Ratio	SDR	Government Expenditure	GDP (million pounds)	Inflation rate	Dummy-Brexit
Mean	18.7%	321%	0.474	6.782	0.691	0.992	370,287	1895,682	2.272	0.500
Median	21%	351%	0.433	6.560	0.651	0.990	368,504	1,888,561	2.525	0.550
Standard deviation	10%	154%	0.150	2.014	0.096	0.053	10,631	113,575	1.280	0.605
Variance	1%	191%	0.022	4.403	0.010	0.003	100,434,104	10,739,000,000	1.837	0.666
Maximum	36%	553%	0.800	10.513	0.943	1.080	384,153	2,060,494	4.475	0.732
Minimum	2%	38%	0.293	3.397	0.628	0.920	356,197	1,737,448	0.042	0.805
Skewness	9%	−39%	1.168	0.407	2.441	0.266	0.068	0.108	−0.238	0.786
Kurtusis	24%	−32%	1.370	0.539	6.415	−0.5	−1.766	−1.466	0.256	0.764

Notes: ROA is about the return to the asset in percentage; ROE is about the return to equity in rate; ROA index is the weighted level of ROA; ROE is the weighted level of ROE; Capital dividing by the deposit calculates capital deposit ratio; SDR, special drawing right, which is to measure the exchange rate among states; Government expenditure, inflation rate are macroeconomic controllable variables; Dummy-Brexit is dummy variables representing the happening of Brexit.

Table 3. Correlation.

Panel A	Log(ROA)	Log(ROE)	Log(SDR)	Log(Gov)	Log(GDP)	Log(inf)	
Log(ROA)	1						
Log(ROE)	0.988	1					
Log(SDR)	0.201	0.144	1				
Log(Gov)	0.601	0.476	0.395	1			
Log(GDP)	0.646	0.526	0.416	0.987	1		
Log(inf)	−0.067	0.006	0.451	−0.40	−0.342	1	
Dummy-Brexit	0.533	0.413	0.177	0.913	0.895	−0.523	
Panel B	Log(ROA Index)	Log(ROE Index)	Log(Ratio)	Log(SDR)	Log(Gov)	Log(GDP)	Log(inf)
Log(ROA Index)	1						
Log(ROE Index)	0.825	1					
Log(ratio)	0.237	0.097	1				
Log(SDR)	0.638	0.513	0.366	1			
Log(Gov)	−0.009	−0.37	0.538	0.395	1		
Log(GDP)	0.012	−0.35	0.502	0.416	0.987	1	
Log(inf)	0.409	0.697	−0.119	0.451	−0.409	−0.342	1
Dummy-Brexit	0.002	−0.32	0.560	0.177	0.913	0.895	−0.523

and industrial level. By providing descriptive data, it is easier for researchers to obtain the data information of each variable and observe whether these variables meet the standard of normalization.

Table 2 provides the descriptive statistics of ROA, ROE, ROA index, ROE index, SDR, Inflation rate, government expenditure, GDP, Dummy-Brexit obtained from 2009 to 2018. The maximum and minimum values provide indica-

tions of significant variations in the ratios. Among all the data, the mean and median values are almost similar, which shows the accuracy. Although Kurtosis in each variable of Dummy-Brexit is abnormal, the Kurtosis of other variable is either lower or higher than 3, and the whole skewness is also far away from zero. Therefore, the method of the logarithm can normalize all the variables, excluding the Dummy-Brexit.

7.2. Correlations

This section gives information on the correlation value of each variable to test whether relating to each other.

Table 3 provides a correlation rate for all logarithmic variables, from industrial aspect and Country aspect. In country-level data, the correlation analyses are performed by correlating profitability indicators (log(ROA) and log(ROE)) with six factors. As for the industrial level, the correlation analyses are accomplished by individually correlating profitability indicators (log(ROA), log(ROE), and the ratio of capital to deposit) with influencing six factors. Therefore, two correlation matrices are constructed to give information on country-level data and industrial level data, respectively. Besides, log(Gov) represents the logarithm of the Government expenditure; log(inf) is the logarithm of the inflation rate; log(ratio) means the logarithm of the capital deposit ratio. Panel A is about the data on the whole country level, and panel B is about the weighted data on the bank industry level.

Above all, in Table 3, from the aspect of the whole country and some bank sectors, the correlation rate of Log(ROA) and Log(ROE), Log(ROA index), and Log(ROE index) is exceptionally high. It indicates the relationship between ROA and ROE, ROA index and ROE index is close, which matches the survey of Saeed (2014)—the ROA and ROE are both the method to measure the profitability of the bank. Therefore, the adoption of these indicators can capture the bank's performance.

Additionally, comparing the data from country-level with that of industry-level from 34 sample banks, the study shows the correlations of Log(ROA) to Log(inflation) and Log(ROE) to Log(inflation) are significantly different. In country-level data, the correlations of Log(ROA) to Log(inflation) and Log(ROE) to Log(inflation) is respectively −0.066 and 0.005. However, this statistic is respectively 0.4 and 0.69 at the industry level, which means that for whole bank sectors in the United Kingdom, Log(inflation) is almost unrelated to Log(ROA) and Log(ROE) of banks. But for an individual bank, both Log(ROA) and Log(ROE) are affected by Log(inflation rate), which indicates that the profitability of individual banks may be related to the change of inflation rate. Moreover, the positive correlations found in this study are different from the findings of Saeed (2014). In the study, correlations of the inflation rate to ROA and ROE are negative, indicating that the data is incomplete or technique and used to process data is not perfectly matched with the sample data.

7.3. Regression Analysis

This section demonstrates the results of five regressions and a detailed analysis. In the country-level data, the regression model considers ROA and ROE as the two dependent profitability indicators, which depend upon six independent variables, while in industrial level data, the regression model considers ROA, ROE plus ratio of capital to deposit as profitability indicators.

Table 4 and Table 5 summarize two regression models at the country level, revealing the variability percentage among all predictor variables. In the table, the R square represents an association between dependent and independent variables. "R" is the square root of R square, indicating the relationship between influencing factors and banks' profitability. Besides, the adjusted R squared refers to the rigor of additional predictors with statistical shrinkage. Simply put, the adjusted R squared is the proportion of the independent variable and dependent variable.

In models one and model two, the R square is high enough to prove the fair relevancy between bank profitability and other variables at the national level. The difference between the fair value of R and the adjusted R (shrinkage level) is 0.5065 and 0.614. According to Slavkin (2000), the interval is acceptable from 10 percentage to 15 percentage. In this case, it indicates the relationship between the ROE and other variables seems to be unacceptable.

As for data at the industrial level, the shrinkage level between R's fair value and the adjusted value is 0.42 and 0.21 in models one, two. In this case, it seems that the ROE and ROA have weak relationships with other variables. As for the third model, the shrinkage level is close to the acceptable interval of about 16%. What is more, the R square is high enough, which indicates a relationship between capital deposit ratio and the other variables. However, according to Osborne and Waters (2002), there is no standard interval shrinkage level to test whether data is acceptable or not. Therefore, it remains a discussion for the acceptance of the data.

Besides, Table 6 and Table 7 exhibit the Analysis of Variance (ANOVA) at the national and industry levels, where *P*-value shows the statistical significance

Table 4. Summary of models (Country Level).

	R Square	Adjusted R Square	Observations
Model 1	0.5927	0.0835	10
Model2	0.5048	−0.1141	10

Table 5. Summary of models (Weighted Level).

	R Square	Adjusted R Square	Observations
Model 1	0.6646	0.2453	10
Model2	0.8320	0.6219	10
Model 3	0.8713	0.7104	10

Table 6. ANOVA country level.

		df	*F*	*Significance F*
model 1	Regression	5	1.16	0.454
	Residual	4		
	Total	9		
model 2	Regression	5	0.816	0.595
	Residual	4		
	Total	9		

Table 7. ANOVA weighted level of industry.

		df	*F*	*Significance F*
model 1	Regression	5	1.585	0.338
	Residual	4		
	Total	9		
model 2	Regression	5	3.961	0.103
	Residual	4		
	Total	9		
model 3	Regression	5	5.416	0.0633
	Residual	4		
	Total	9		

of the independent factors over dependent variables. According to Frost (2018), "the F-test of overall significance indicates whether the linear regression model provides a better fit to the data than a model that contains no independent variables. F-tests can evaluate multiple model terms, which allows them to compare the fits of different linear models. In contrast, t-tests can evaluate just one term at a time."

For Table 6, ANOVA on country-level data, the significance level or *P*-value in model 1 is 0.45, which is much larger than 0.1 levels, indicating there are non-linear relationships between dependent variables (Log(ROA)) and independent variables. Also, the significance level of 0.59 in model 2 is much more than 0.1 levels, showing a non-linear association between Log(ROE) and independent variables.

For Table 7, ANOVA on industrial level data, the significance level or *P*-value in model 1 is 0.33, which is much larger than 0.1 levels, indicating there are non-linear relationships between dependent variables (Log(ROA index)) and independent variables. On the other hand, the significance level of 0.103 in model 2 is extremely close to 0.1 levels, which means a linear association between Log(ROE index) and independent variables. Similarly, the significance level of 0.06 in model 3 is less than 0.1 levels, showing that dependent variables (Log(ratio of capital to deposit)) and independent variables have a linear association.

Table 8. Coefficient (Country level).

	ROA		ROE	
	Coefficient	*P*-value	Coefficient	*P*-value
Intercept	−172.1689	0.5539	−168.4629	0.5799
Log(SDR)	7.6424	0.6856	7.8267	0.6927
Log(Gov)	10.8407	0.8976	12.0674	0.8914
Log(GDP)	17.7285	0.6038	16.2501	0.6490
Log(inf)	0.2207	0.5516	0.2509	0.5208
Dummy-Brexit	−1.0164	0.4529	−1.0777	0.4486

Table 9. Coefficient (Weighted level of industry).

	ROA		ROE		Capital deposit Ratio	
	Coefficient	*P*-value	Coefficient	*P*-value	Coefficient	*P*-value
Intercept	116.2787	0.2576	108.0595	0.1759	27.8241	0.2900
Log(SDR)	−2.2838	0.7137	−3.7117	0.4394	−4.9853**	0.0294
Log(Gov)	−25.7435	0.3801	−19.7738	0.3679	−3.0592	0.6746
Log(GDP)	4.2311	0.7053	0.4242	0.9591	−1.7681	0.5480
Log(inf)	−0.0490	0.6853	0.0402	0.6567	0.0096	0.7590
Dummy-Brexit	0.5667	0.2336	0.5878	0.1233	0.4125**	0.0170

Notes: * represents 10%, 0.05 < *P*-value < 0.1; ** represents 5%, 0.01 < *P* < 0.05; *** represents 1%, *P* value < 0.01.

Table 8 reveals standardized beta coefficients of both regression models on the country level; Table 9 shows standardized beta coefficients of both regression models industrial level. Besides, log(Gov) represents the logarithm of the Government expenditure; log(inf) is the logarithm of the inflation rate; log(ratio) means the logarithm of the capital deposit ratio.

At the country-level, the coefficients of log(SDR) in log(ROA) and log(ROE) are 0.68 and 0.69, which are higher than our 10% confidence level, so the null hypothesis is not rejected. Similarly, in the industry level data, the coefficients of log(SDR) in log(ROA) and log(ROE) are 0.71 and 0.43, respectively, which are also higher than the 10% confidence level, so it is also not rejecting our null hypothesis statistically. However, in the log(ration of capital to deposit), the log(SDR) coefficient is 0.029, which is less than the 10% confidence level. Therefore, the outcome rejects the null hypothesis statistically, which means that in the industry level data, log(SDR) has a specific impact on the log(ratio of capital to deposit). Meanwhile, when using the ratio of capital to deposit as the measurement, the fluctuation of the pound's exchange rate against SDR has a significant impact on the bank's profitability.

8. Conclusion and Limitation

At the national level, the coefficient of each independent variable is positive for

the bank profitability in model 1 and model 2. Besides, it indicates that the logorithms of the separate variable (SDR), log(government expenditure), log(expansion rate), and log(GDP) have a positive relationship with ROA and ROE. In contrast, the event of Brexit has a negative effect on both ROA and ROE. Most importantly, based on models 1 and 2, there is no significant relationship between exchange rate and bank performance.

However, as for the industry level, the coefficient of each independent variable is quite different from the results of the national level for the bank profitability indicator log(ROA), log(ROE), and log(capital deposit ratio). It reveals the positive relationship between Brexit and bank performance, while the relationship between exchange rate and bank performance is negative. Concerning the exchange rate, the results from model 1 and model 2 are the same as the weighted level of industry; however, model 3 reveals a relationship between the exchange rate and bank performance.

Beside the difference between country-level and industrial-level, previous research papers show different results with these findings. Saeed (2014) uses ROA and ROE to represent the bank's profitability. The work shows the positive relationship between bank size, capital ratio, loan, deposits, liquidity, interest rate, ROA, and ROE; however, GDP and inflation rate negatively affect bank performance. Similarly, the survey of Bourke (1989), Molyneux and Thornton (1992), Pasiouras and Kosmidou (2007), and Athanasoglou et al. (2008) show the same result. Besides, Ademola et al. (2016) use the ARCH LM test, LDR, and ROA methods to find the significant relationship between the exchange rate and the bank performance; it is opposite to the results—there is no meaningful relationship between the exchange rate and bank performance.

Although the experimental results seem to be contrary to the other research findings, such deviation may come from incomplete data collection, improper use of normalization and limited controlled variables. Therefore, the accuracy of the research results remains to be discussed. However, when the capital deposit ratio is used as the bank profitability measurement, the fluctuation of the pound to SDR, during the Brexit, has a significant impact on the profitability of banks. As for the contribution, the adoption of the model and the selection of variables may have reference value for interested researchers.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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