

**DETERMINANTS OF BANK PROFITABILITY: EVIDENCE  
FROM THE U.S BANKING SECTOR**

by

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## **Abstract**

Using the ordinary least squares estimation technique, this paper analyzes the profitability of the U.S banking sector over the period from 2000 – 2008. Our profitability determinants include bank-specific characteristic as well as macroeconomic factors. Consistent previous studies, we find that the bank-specific determinants, with the exception of size, are significantly positively related to bank performance. For size measure, the impact is uncertain and is depended on the category of bank size. The macroeconomic factors GDP and interest rate change are also significant in explain bank profits.

## **Keywords**

Bank profitability, bank performance, macroeconomic factors

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## 1. Introduction

During the last decade the banking sector has knowledgeable of worldwide major transformation regarding its operating environment. Both internal and external factors have affected its structure and performance. A stable and profitable banking operation has the ability to withstand negative shocks from the economic conditions and the contribution to the stability of the financial system. Therefore, the determinants of bank profitability have brought the interest of investigation by the academic research as well as of bank management team and financial markets.

Many studies on bank performance and profitability, such as Bourke (1989), Molyneux & Thornton (1992) and Goddard (2004), use linear models to estimate the important determinants that may explain bank profits. Although these studies show that a meaningful analysis on bank profitability can be conducted, some inefficiency is brought up. Many of the literatures principally consider the performance determinants at the bank level, which lacking investigation of the effect of the macroeconomic environment.

This paper uses the ordinary least squares with two equations framework which ROA and ROE are separately used as the profitability indicators to test the effect of bank-specific and macroeconomic determinants on bank profitability. We utilize data from the U.S banking sector over the period 2000 – 2008. Bank-specific determinants of profit involve capital ratio, size, loan, and deposits. Macroeconomic variables include GDP, short-term interest rate change and long-term interest rate change.

The empirical results suggest that the bank-specific determinants, excluding size, significantly positively correlated with bank profitability. The impact of size to bank

profit is uncertain and depends on the size category among banks which is distinguished by banks' assets. We also find that the macroeconomic variables GDP and interest rate change significantly affect bank profitability in line with prior expectations. GDP is positively related with bank profit while interest rate change regardless of short-term or long-term is negatively related with bank profit.

The paper is structured as follows. Section 2 discusses the existing literature on bank profitability. Section 3 describes the bank-specific and macroeconomic determinants. Section 4 illustrates the sample and methodology. Section 5 presents the empirical results. Finally, section 6 concluded the paper.

## **2. Literature review**

A number of prior researches have tried to find the major determinants of bank's profitability. Some studies base their analysis on cross-country evidence, such as the researches by Halkos & Georgiou (2005) using panel data from the Western European banking sector and Pasiouras, Tanna, & Zopounidis (2008) research on dataset consisting of commercial banks across 74 countries. While some scholars focus on the banking system of individual countries. For example, the study by Barros & Borges (2011) investigate the Portuguese banking industry, Liu & Wilson (2010) examine the profitability of banks in Japan and Heffernan, Shelagh, & Fu (2010) analyze the determinants of performance in Chinese banking.

The estimation methods vary from the traditional ordinary least squares (OLS) to recent generalized method of moments (GMM). Brissimis, Delis, & Papanikolaou (2008) follow

the technique introduced by Khan & Lewbel (2007), who recommend a two-stage least squares regression analysis for truncated estimation. This technique is an extension of OLS method and is claimed to be “distribution free”, which solve the problem of missing value and correlation occurred in the original OLS estimation. Studies by Liu & Wilson (2010), Brissimis, Delis, & Papanikolaou (2008), apply GMM technique to their research. To capture the possible nonlinearities between performance and explainable variables, Barros & Borges (2011) extend the general estimation model by applying a Fourier approximation, and verify the benefit from inducing this method to their estimation. J. Mukuddem-Petersen, M.A. Petersen, I. M. Schoeman and B.A. Tau (2008) propose a dynamic model for bank profit based on the stochastic dynamics of banks assets (loans, Treasuries and reserves) and liabilities (deposits).

Following the early works, the bank profitability is usually measured by the return on average asset (return on asset) or return on average equity (return on equity), such as recent studies by Kosmidou (2008), Lei Wen (2009), Barros and Borges (2011), DePrince Jr, Ford, & Morris (2011). However, some studies focus on measures of profitability, such as Heffernan, Shelagh, & Fu (2010) evaluating four measures of profitability and suggesting that economic value added and the net interest margin do better than the more conventional measures (ROAA or ROAE). Since financial ratios will provide more accurate information if they are normally distributed, Kargin, Aktas, & Kayalidere (2010) have tested the distributional characteristics of 21 commonly used financial ratios, grouped by capital adequacy, balance sheet structure, quality of assets, liquidity, profitability and income-expenditure structure. The findings demonstrate that ratio Equity/ Total assets, (Equity-Fixed Assets)/Total assets, Liquid assets in domestic



currency/ Total assets, Liquid assets in foreign currency/ Liabilities in foreign currency and Net profit/Paid in Capital conform to non-normal distribution, and transformations significantly improve the normality.

In most studies, the determinants are generally categorized as internal variables and external determinants. The internal determinants, such as capital ratio and bank size, are commonly used to examine the correlation between the profitability and bank internal management. A large body of literature has found that capital ratio has a very close connection with bank's profitability. For example, Brissimis, Delis, & Papanikolaou (2008) have found that the capital plays an important role in explaining bank's profitability. Pasiouras, Tanna, & Zopounidis (2008) find that stricter capital requirement improves the cost efficiency but decreases the profit efficiency. Other scholars provide their observations about bank size, such as Kosmidou (2008) who examined the Greek banks' performances during the period of EU financial integration and found that size positively affected the profitability but statistically significant only when the macroeconomic and financial structure variables were incorporated into the model. Brissimis, Delis, & Papanikolaou (2008) tested a panel of Greek banks during the period 1985-2001 using GMM technique and found that size is not significantly affect bank profitability in the anticipated way. Hendrickson & Nichols (2011) evaluate the bank performance under the interstate branching policy and find that limiting bank size makes bank performance worse. Shehzad, Scholtens & De Haan (2009) analyze the impact of financial crisis on bank earnings volatility varies with bank size. They conclude that larger banks face lower earnings volatility under the crisis situation regardless of bank size definition, bank types and financial crisis types.

Previous works also include the external variables, such as GDP growth rate and interest rate, which are often used to test whether environmental factors have an impact on bank's profitability. Typical study by Arpa, Giulini, Ittner, & Pauer (2001) assess the effects of macroeconomic developments on both risk and earning of Austrian banks for the 1990s. According to their research, macroeconomics plays an important role in banking and supervision. The variables such as interest rates, can explain the profitability of Austrian banks. Furthermore, net interest income appears to be uncorrelated with GDP growth and interest rate development, except that income shrinks at very low interest rate level. Liu & Wilson (2010) find that the impact of GDP growth on bank's profitability is conflicting across the ownership types, but the evidences show that growing GDP growth rate will decrease bank's profitability since the competition is induced. Borja AMOR-TAPIA, Maria T.TASAÓN, José L. FANJUL (2010) suggest that as the country becomes richer, profitability declines, which is possibly caused by increasing competition. Albertazzi & Gambacorta (2009) find that banks with shorter duration assets are less affected by fluctuations of long-term interest rate and are more affected by those of short-term interest rate.

To our knowledge, few previous work conduct research on bank performance based on bank size. Also, important explainable variables such as deposit and loan are not commonly incorporated into the estimation. To fill the gap in the literature, we decide to add loan and deposit into our analysis and make further regressions to see if the results change we divide banks into small, medium and large based on asset sizes.

### **3. Determinants**

#### 3.1 Dependent variables

We use two dependent variables: return on assets (ROA) and return on equity (ROE), to measure the bank performance. On the one side, ROA is defined as the ratio of net income to total assets, indicating the bank's ability to generate profits from the assets. Moreover, these are the definitions used by previous papers such as average returns on assets, ratio of undivided real profit to total real assets and operating income/total assets. On the other side, ROE is the ratio of net income to total equity, reflecting the bank's ability to generate profits from the equity.

#### 3.2 Independent variables

We separate the independent variables into two categories: the bank specific determinants and the macroeconomics determinants.

##### 3.2.1 Bank specific determinants

###### ***Capital ratio***

We define the capital ratio as the total equity over total assets. The capital ratio indicates how much risk is covered by bank's capital, which means the bank with higher capital ratio is considered safer than that with lower ratio. The bank's creditworthiness is therefore enhanced, and further benefits bank from reducing the funding cost. Given this point, we believe that the higher capital ratio has positive impact on bank's performance, especially during the economically difficult time.

### *Size*

We use bank's assets to represent size. Generally, bank's size is positively correlated with the performance, maybe because the big bank has more market power and set its favorable interest rate spread. However, as the size becoming extremely large, the effect of size may become negative due to the cost efficiency, operational risk and other reasons.

Although large banks are minority in the capital market, they account for the most profits. The distribution shows significantly positive skewness, for which we need to make adjustments to our data.

### *Loans*

We use loans over total assets to explain the loan's impact on bank's performance. This ratio is regarded as a measure both of bank's credit risk and of lending specialization. For the credit risk, the bank with higher loan ratio is less prepared with unforeseen liquidity emergency. Therefore, the higher the ratio is, the more exposure to the credit risk the bank faces. For the lending specialization, the previous study shows that there's a positive correlation between loan ratio and bank's profitability, since the higher ratio tends to indicate that the bank has more information to determine how to distribute its loans. Lending specialization reduces bank's research costs and intermediation costs, therefore improves bank's profitability. Above all, we have effects favor in opposite direction, the overall effect cannot be anticipated theoretically.

### *Deposits*

The deposit variable is defined as the ratio of total deposits over total assets. The total deposits include the bank's domestic deposits as well as the foreign ones. Intuitively, more deposits enable the bank to expand its business, therefore improve bank's profitability. But as we know, bank's

deposit belongs to the liability. Generating profits from the liability strongly relies on bank's operating efficiency, which suggests that increasing deposit doesn't necessarily mean more profit.

### 3.2.2 Macroeconomics determinants

#### *GDP growth rate*

Generally, GDP growth rate is expected to have positive impact on bank's profitability, since good economic environment favors investment and lending, which contributes to bank's development. We use annual percentage change of real GDP index to examine the extent economic growth contributes to bank's profitability.

#### *Interest rate*

We use the yield on 3-month treasury securities as proxy for the short-term interest rate and the yield on 10-year treasury securities for the long-term interest rate. As the interest rate rise, the bank's borrowing cost increases. The credit crunch has negative impact on bank's profitability.

Table 1 below summarizes the measures and our expected effects of our explanatory variables.

**Table 1**

Definitions and the expected effect of the explanatory variables on bank's profitability

<b>Variable</b>	<b>Measure</b>	<b>Expected effect</b>
Dependent variable		
Profitability	Net income/ Total assets or Net income /Total equity	
Determinants		
Bank-specific		
Capital	Total equity/Total assets	+
Size	Total assets in log	+/-

Loans	Loans/Total assets	+/-
Deposits	Deposits/Total assets	+/-
Macroeconomics		
GDP growth	Year over year real GDP growth rate	+
Interest rate	Yield on 3-month treasury securities or yield on 10-year treasury securities	-

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#### 4. Data and methodology

This section identifies the sources of our data, presents the sample data, and illustrates the regression model we use to examine the determinants of bank profitability.

##### 4.1 Data

Our data source for the bank specific variables is the Federal Reserve's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C). In addition to the bank specific variables, we use two macroeconomic variables to explain bank profitability. The annual real GDP growth rate, one macroeconomics variable to explain the bank performance, is taken from the Bureau of Economic Analysis. The other macroeconomics variable, interest rate changes comes from the Federal Reserve H15 Database. The yield on 3-month Treasury securities is used as the measure of the short-term interest rate change, and the yield on 10-year Treasury securities measures the long-term interest rate change.

To use the data from FR Y-9C for our regression analysis, we had to make several adjustments to the data in the following ways. For all the variables, we observe existence of large negative values. To solve this, we undergo winsorization which is the transformation of statistics by limiting extreme values in the data to reduce the effect of

possible spurious outliers. Another adjustment arise due to the majority of our data sample are from FR Y-9C are come from small sized banks, which has significant impact to the bank specific variable bank size making the distribution curve skewed to the right. However, it is generally believed that the effects to large sized banks are of a bigger concern. Therefore, in order to capture the importance of large sized banks we should take logarithm of the bank size distribution curve to make it normal distributed.

Some editions also need to be made to the macroeconomic variables. For interest rate change, it is a measure relating interest rate of past year to current year. For year 2000 interest rate change, it is a measure calculating the interest rate change with year 1999.

Our sample consists of 14970 observations in total, which with the number of banks are replicated among different years. For our sample period 2000 – 2008, we can see there is a significant decrease in the number of banks since 2006 in result of the change in the filing requirements of the reporting panel. The report presents aggregate time-series data drawn primarily from the FR Y-9C and the FR Y-9LP (Parent Company Only Financial Statements for Large Bank Holding Companies) regulatory report forms submitted by all reporting bank holding companies to the Federal Reserve each quarter. The change can be observed for the quarter ended March 31, 2006, which the Federal Reserve raised the asset threshold which all bank holding companies are required to file reports to \$500 million from \$150 million (Federal Reserves , 2006). This change to the filing requirements substantially reduced the number of requited respondents. Noticeably, the number of bank holding companies fell by more than 1300 companies. For the years after 2006, the number remains in the near 1000 range. The number of banks and observations can be found in Table 2.

**Table 2**

Number of banks and observations by year

Year	Number of observations
2000	1782
2001	1439
2002	2028
2003	2185
2004	2301
2005	2310
2006	986
2007	966
2008	973
Total	14970

Table 3 reports the summary statistics of the variables used in our regression analysis. Let us describe a number of findings. On average, the banks in our sample have a ROA of 0.984% over the period from year 2000 to 2008. The standard deviation for ROA is 0.617%, which is fairly low and we can conclude that the sample data for ROA tend to be



**Table 3**

## Summary statistics

Dependent variables: bank profitability					
	Observation	Mean	Std. dev.	Min	Max
ROA	14970	0.00984	0.00617	-0.0156	0.02859
ROE	14970	0.11204	0.07239	-0.2244	0.31639
Independent variables					
	Observation	Mean	Std. dev.	Min	Max
Bank-specific variables					
Capital ratio	14970	0.09017	0.02857	0.03863	0.2035
Bank size	14970	13.3458	1.33922	11.9276	18.7339
Deposits	14576	0.78969	0.09818	0.33849	0.91448
Loans	14970	0.66706	0.13059	0.25635	0.90492
Macroeconomic variables					
GDP growth	49891	2.36511	1.19146	0	4.1
Interest rate changes					
Short-term	49891	-0.292	1.67778	-3.08	1.82
Long-term	49891	-0.1915	0.52023	-1.01	0.51

very close to the mean. For ROE, the average return is 11.2%, minimum return is -22.44% and maximum return is 31.639%. The large range difference together with a substantially higher standard deviation of 7.239% confirms that the data points are spread out over a large range of values. On average, the capitalization of banks is 9.017%, but differs among banks. The best-capitalized bank in our sample has a capital ratio of 20.35%. On the other hand, for the least-capitalized bank, capital ratio is only 3.863%. Similarly, for the bank size variable, a large difference among banks can be captured. Bank size in our sample has a mean of 13, with a minimum of 11.92 and a maximum of 18.7339. For deposit to asset ratio, the numbers of observation drop from 14970 to 14576, and the average amounts to 78.969% which indicates majority of assets of banks come from deposits. The range for the deposit ratio is fairly high as well with a minimum of 33.849% and a maximum of 91.448%. On average, loans relative to total assets ratio amounts to 66.706% with a standard deviation of 13.059% which is quite high, indicating that the ratio for loans differ a lot among banks. The index for GDP growth is 2.36511 on average with minimum of 0 and maximum of 4.1. Interestingly, for both short-term and long-term interest rate changes, the mean appear to be negative.

#### 4.2. Methodology

To empirically test the effects of bank-specific variables and macroeconomic variables on bank profitability, we use the ordinary least squares (OLS) as our method of estimation. OLS is a method used to estimate the unknown parameters in a linear regression model. This method minimizes the sum of squared deviations between the dependent variable and one or more independent variables. Since observations are likely to be dependent for

the same bank over time, standard errors are clustered at the bank level thus OLS would be an appropriate estimation. For our estimation, the equations are given by (1) and (2):

$$ROA_{i,t} = \beta_0 + \beta_1 \cdot Capital\ Ratio_{i,t} + \beta_2 \cdot Size_{i,t} + \beta_3 \cdot Loans_{i,t} + \beta_4 \cdot Deposits_{i,t} + \beta_5 \cdot GDP\ growth_t + \beta_6 \cdot Interest\ rate\ change_t \quad (1)$$

$$ROE_{i,t} = \beta_0 + \beta_1 \cdot Capital\ Ratio_{i,t} + \beta_2 \cdot Size_{i,t} + \beta_3 \cdot Loans_{i,t} + \beta_4 \cdot Deposits_{i,t} + \beta_5 \cdot GDP\ growth_t + \beta_6 \cdot Interest\ rate\ change_t \quad (2)$$

Where we separately use  $ROA_{i,t}$  and  $ROE_{i,t}$  as our dependent variable. All the independent variables are time dependent.

## 5. Empirical results

Table 4 reports the regression results. The results consider all banks from our data set regardless of their sizes. The first two columns report the results when using ROA as the dependent variable, while columns three and four accounts for using ROE as the dependent variable. In order to investigate the impact of the length of interest rate on the bank's profitability, we separately estimate the effect of short-term interest rate change and long-term interest rate change. Columns one and three represents when short-term interest rate change is taking into consideration. On the other hand, columns two and four consider long-term interest rate change.

**Table 4**

	(1)	(2)	(3)	(4)
VARIABLES	roa	roa	roe	roe
capital_ratio	0.0740*** (0.002)	0.0745*** (0.002)	-0.2289*** (0.025)	-0.2229*** (0.025)
size	0.0002*** (0.000)	0.0003*** (0.000)	0.0031*** (0.001)	0.0041*** (0.001)
loans	0.0013*** (0.000)	0.0018*** (0.000)	0.0171*** (0.005)	0.0234*** (0.005)
deposits	0.0053*** (0.001)	0.0053*** (0.001)	0.0657*** (0.008)	0.0663*** (0.008)
gdp_growth	0.0014*** (0.000)	0.0021*** (0.000)	0.0166*** (0.001)	0.0252*** (0.001)
short_term_interest_rate	-0.0002*** (0.000)		-0.0019*** (0.001)	
long_term_interest_rate		-0.0024*** (0.000)		-0.0281*** (0.002)
Constant	-0.0087*** (0.001)	-0.0122*** (0.001)	-0.0146 (0.013)	-0.0596*** (0.014)
Observations	14,576	14,576	14,576	14,576
R-squared	0.1530	0.1612	0.0643	0.0731

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

The results for control variables are broadly consistent with predictions. Consider ROA as the profitability measure first, the coefficient on capital ratio is positive and significant. This is consistent with our prediction that high capital ratio improve overall bank's profitability for its ability to enhance credit worthiness while reduce funding cost. This outcome also stands in line with the result of Berger (1995) who found that return on equity and capital-to-asset ratio are positively correlated. The coefficient on size is positive and highly significant, which intuitively suggest that bank size on average still have room to grow bigger until reaching a point which the effect of bank size becomes negative. However, finding suggested by Heffernan & Fu (2008) indicate size is not important in explaining performance, nor can performance difference among different types of banks be attributed to size effects. This study of Chinese banking contrasts sharply with most studies of Western banks, where size has positive impact on profitability, which is accounted from the benefit achieved through economic scales. The coefficient on loans is positive and highly significant. For our previous prediction, we were uncertain about the weights of the opposing effects of loans on profitability so we concluded that the overall effect cannot be anticipated theoretically. Since the coefficient for loan's impact on performance is positive, we conclude that the positive effect of lending specialization outperform the negative effect of increase credit risk. The coefficient on deposits is positive and significant, which indicates that increase in deposits improves bank's profitability for our sample. However, other finding suggests that the yearly growth of deposits has a significant and negative impact on bank profitability and this effect is mainly driven by the market crisis (Dietrich & Wanzenried, 2011).

Considering the external factors related to the macroeconomic environment, our regression results indicate GDP growth is positively correlated with bank's profitability and the result is highly significant. This outcome is consistent with our belief that favourable economic conditions trigger investment and lending, thus contributes in bank's growth. The coefficients on short-term interest rate change and long-term interest rate change are both negative and highly significant. This determination contradicts to the finding suggested by Dietrich & Wanzenried (2011), which the term structure of interest rates positively affects the profitability of Swiss banks overall and particularly during the financial crisis.

As well, we will explore the results when ROE is used as the profitability measure. Interestingly, the coefficient on capital ratio is negative and significant, which challenges our prediction. This estimation result also contradicts to other findings that suggest, for example Liu & Wilson (2010) suggest the positive relationship between capital ratio and ROE implies that management team uses capital strength as a proxy to send signals about expected future profitability. However, one possible explanation as suggested by Hutchison & Cox (2001) is that eliminating the data with negative capital values changes the sign of capital/ROE relationship from positive to negative. The difference in the results reflects the difference in mean ROE values and is driven by the impact of large negative values of income associated with negative capital values in the raw data. Recall that we had to winsorize all the raw data to eliminate the extreme values, which explains the negative sign of capital/ROE relationship. For the other control variables size, loans, deposits, GDP growth, short-term and long-term interest rate changes, the signs of coefficients parallel with those using ROA as profitability indication. This suggests that

regardless of using ROA or ROE as performance measures, the effect are the same considering all the control variables except capital ratio in our estimation.

As to bank size, we separate it into three categories small banks, medium banks and large banks to go into depth on the impacts of the scale of bank size to bank's profitability. We divide banks into three equal-sized groups according to bank size, which small banks are from the smallest bank to 33.34%, medium banks are from 33.34% to 66.67% and large banks are from 66.67% to the largest bank. First, we will examine the results when taking only small banks into consideration, the estimation results are shown in Table 5. When using ROA as our performance measure, the coefficients on capital ratio, size, loans and deposits are positive and significant, consistent with the results when analyzing the effect for all the banks. However, some opposing results are revealed in the macroeconomic variables. For GDP growth and in the case of looking into short-term interest rate change, the coefficient is negative and insignificant. This suggests that GDP growth rate has no significant impact on the profits of small banks. This result may be due to the following reason: small banks operate in local areas, while the GDP growth rate is for the whole country. Thus, the performance of a small bank might be more affected by the economic conditions in its local area, rather than by the economic conditions in the whole country. However, when we consider impacts of large banks looking at table 7 we see GDP growth rate has positive impact on the profit of large banks. This is due to the fact that big banks operate nationwide, and their profits are affected by the overall economic conditions in the whole country. On the other hand, the coefficient on GDP growth is positive but again insignificant when considering long-term interest rate changes. The coefficient on short-term interest rate change is positive and insignificant, which does not

favour our findings when all banks are included in the estimation. However, when long-term interest rate change is exploited, the coefficient is negative and insignificant. The result suggests that interest rate change has no significant impact on the profit of small bank, but has significant impact on large banks comparing the results on table 5 &7. This result may be due to the following reason: large banks have the capacity to take interest rate risk. Thus, changes in interest rates affect the profits of large banks. Small banks may not have the capacity to take interest risk. By actively managing interest rate risk, small banks are able to reduce the impact of interest rate changes on their profit. On the other hand, when ROE is used as performance measure, the signs of coefficient and levels of significance are the same as compared with using ROA as performance measure except the coefficient for capital ratio is nevertheless negative and significant. The explanation for this is accounted for the result from winsorization which was explained earlier.

Table 5

VARIABLES	(1) roa	(2) roa	(3) roe	(4) roe
capital_ratio	0.0785*** (0.003)	0.0786*** (0.003)	-0.2441*** (0.037)	-0.2432*** (0.037)
size	0.0013*** (0.000)	0.0013*** (0.000)	0.0130** (0.005)	0.0135** (0.005)
loans	0.0028*** (0.001)	0.0028*** (0.001)	0.0303*** (0.008)	0.0312*** (0.008)
deposits	0.0043*** (0.001)	0.0043*** (0.001)	0.0588*** (0.016)	0.0589*** (0.016)
gdp_growth	-0.0002 (0.000)	0.0002 (0.000)	-0.0030 (0.002)	0.0029 (0.003)



short_term_interest_rate	0.0002 (0.000)		0.0030** (0.001)	
long_term_interest_rate		-0.0003 (0.001)		-0.0042 (0.006)
Constant	-0.0174*** (0.006)	-0.0189*** (0.006)	-0.0813 (0.071)	-0.1053 (0.071)
Observations	4,782	4,782	4,782	4,782
R-squared	0.1541	0.1537	0.0343	0.0332

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Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The regression results when only medium-sized banks are included are shown in Table 6.

The signs of coefficient among the control variables are similar with the results when only small-sized banks are included except for few changes. The coefficient for size is negative and significant for both cases of having ROA and ROE as profitability measure. Chen, Skully, & Kym (2005) find that the large state-owned and smaller banks are more efficient than medium sized banks. Similar finding achieved by empirical evidence as supported by Dietrich & Wanzenried (2011) state that larger and smaller commercial banks were more profitable than medium-sized banks before economic crisis. Vujcic & Jemric (2001) raise an explanation for the relative inefficiency for the medium-sized banks which is that it is actually attributes to the fact that many of those banks are regional banks, and the efficiency problems arise from the environment in which they operate rather than size. Nevertheless, smallest banks are generally niche banks which do not guarantee relative efficiency, as the coefficient of variation of efficiency scores the highest among that group. This finding parallels our regression results and we can

observe that the coefficient for small-sized banks is the largest compared with medium-sized and large-sized banks. The regression results for large-sized banks are shown in Table 7. For short-term interest rate change the coefficient is negative and insignificant while for long-term interest rate change the coefficient is negative and significant. This result parallels with the estimation we achieved when all the banks are included in the estimation.

**Table 6**

VARIABLES	(1) roa	(2) roa	(3) roe	(4) roe
capital_ratio	0.0793*** (0.004)	0.0798*** (0.004)	-0.1771*** (0.045)	-0.1701*** (0.045)
size	-0.0006** (0.000)	-0.0002 (0.000)	-0.0087** (0.004)	-0.0036 (0.004)
loans	0.0024*** (0.001)	0.0028*** (0.001)	0.0345*** (0.009)	0.0397*** (0.009)
deposits	0.0092*** (0.001)	0.0091*** (0.001)	0.0954*** (0.014)	0.0939*** (0.014)
gdp_growth	0.0011*** (0.000)	0.0016*** (0.000)	0.0134*** (0.002)	0.0216*** (0.002)
short_term_interest_rate	-0.0001 (0.000)		-0.0003 (0.001)	
long_term_interest_rate		-0.0018*** (0.000)		-0.0220*** (0.004)
Constant	-0.0015 (0.004)	-0.0085** (0.004)	0.1071** (0.051)	0.0119 (0.053)
Observations	4,864	4,864	4,864	4,864

R-squared	0.1620	0.1673	0.0696	0.0755
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Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7**

VARIABLES	(1) roa	(2) roa	(3) roe	(4) roe
capital_ratio	0.0656*** (0.004)	0.0660*** (0.004)	-0.2379*** (0.051)	-0.2315*** (0.051)
size	0.0003*** (0.000)	0.0003*** (0.000)	0.0033*** (0.001)	0.0032*** (0.001)
loans	0.0009 (0.001)	0.0013 (0.001)	0.0068 (0.010)	0.0116 (0.010)
deposits	0.0036*** (0.001)	0.0036*** (0.001)	0.0517*** (0.013)	0.0517*** (0.013)
gdp_growth	0.0023*** (0.000)	0.0027*** (0.000)	0.0274*** (0.002)	0.0326*** (0.002)
short_term_interest_rate	-0.0004*** (0.000)		-0.0041*** (0.001)	
long_term_interest_rate		-0.0024*** (0.000)		-0.0281*** (0.003)
Constant	-0.0097*** (0.002)	-0.0111*** (0.002)	-0.0264 (0.022)	-0.0450** (0.022)
Observations	4,930	4,930	4,930	4,930
R-squared	0.1827	0.1900	0.1222	0.1297

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Furthermore, regression is conducted when only large-sized banks are included; again the results are demonstrated in Table 7. The signs of coefficient are identical with when all the banks are included in the regression. As compared with medium-sized banks, the coefficient for size once again changed to positive, the same as when only small-sized banks are included and when all the banks are included. Dietrich & Wanzenried (2011) found empirical evidence that larger and smaller banks were more profitable than medium-sized banks. This might indicate that larger banks are able to benefit from higher product and loan diversification possibilities, and/or economic scales. However, when banks become extremely large, the effect of size might be negative due to bureaucratic and some other reasons (Athanasoglou, Brissimis, & Delis, 2008). Hence, the size-profitability relationship may be expected to be non-linear (Athanasoglou, Brissimis, & Delis, 2008). This illustrates the reason behind we had to take the logarithm of the banks' real assets to capture this possible non-linear relationship. After going into depth of the effect of the distinction of bank size to the relationship between the control variables and the profitability measure, we see that size is being most affected. The degree to which size has positive or negative impact on bank's profit is uncertain and is influenced by the category of the size of banks. This uncertainty is consistent with our earlier prediction.

## **6. Conclusion**

This paper examines the determinants of bank profitability for a large sample of U.S. banks between 2000 and 2008. We use ordinary least squares to examine the determinants of bank's profit which is measured by ROA and ROE as a linear function of various bank-specific and macroeconomic variables. To account for the effect of bank

size as measured by bank's assets, we separate banks to three categories small, medium and large to investigate the changes that might occur to the relationship between the control variables with the performance measures.

We find that various factors are found to be statistically significant indicators of bank profitability. Consistently with the literatures we reviewed, we find that the bank-specific variables such as capital ratio, loans and deposits are positively related to bank performance as measure by ROA regardless of whether it is small, medium or large banks. However, when ROE is used as performance indication, there exist to be a negative relationship between capital ratio and ROE. This can be explained by the winsorization we undergo which results in changing the signs of the coefficient. Secondly, we find that the relationship between size and ROA/ROE is uncertain after take into consideration the separation of banks into three size categories. For both small-sized and large banks, size appears to be positively correlated with bank profitability, and is evidenced by other literature studies. However, for medium-sized banks, we find a negative relationship between size and bank profit. This is possibly due to small and large banks are more likely to be benefit from economic of scale and less impacted by deregulation. Deregulation is another factor that influences bank performance which is worth investigation. Thirdly, for the macroeconomic variables, GDP is found to be positively correlated with bank's profitability while short-term and long-term interest rate changes are negatively correlated with ROA and ROE. In general, the results suggest the control variables that we believe are important in determining the bank's profitability are statistically significant.

Overall, our regression results provide some interesting insights into the mechanisms that determine the profitability of U.S banks. Our findings are relevant for several reasons. First, our estimation results confirm with former literatures on determinants of bank profitability. Second, we consider both bank-specific and macroeconomic variables, which extend our knowledge of bank profitability with respect to both internal and external dimensions. Finally, by dividing banks to small, medium and large to investigate the impact on bank's size, we gain additional insights into the relationship between bank size and profitability.

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