

**DOES PUBLIC LISTING AFFECT BANK PROFITABILITY? EVIDENCE  
FROM US BANKS**

by

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## **Abstract**

The purpose of this paper is to investigate the determinants of US bank profitability between 2002 and 2015. Specifically, we divide banks into three size groups, and focus on the impact of public listing on bank profitability. We find that small- and medium-sized public banks are less profitable than private banks of corresponding size. However, large public banks are more profitable than large private banks. Moreover, regression results indicate that loans and diversification have a positive impact on bank profitability in all size groups.

**Keywords:** Bank profitability; US banks; Public listing; Size; Capital; Loans; Deposit; Diversification.

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# **1: Introduction**

Following deregulation in the 1970s, a number of US banks adopted new business models that emphasized high productivity and low costs based on economies of scale.

However, many small banks adhered to the traditional model of high costs and high value to deliver differentiated products to customers (DeYoung et al., 2004). During the 1980s and 1990s, large US banks introduced a new business strategy that focused on increasing the portion of their revenues generated from non-interest sources, i.e. fee-based services.

The financial crisis that began in 2007 caused by defaults in the US residential mortgage market led to large losses in the banking industry, and forced the US government to intervene with measures aimed at stabilizing the financial system (Bech and Rice, 2009; Lee and Rose, 2010; Fleming, 2012)..As a result, it becomes important to examine major internal or external determinants of bank profitability during and after the crisis.

In this paper, we examine the financial statements of US banks for the years 2002 to 2015. We obtained the data from the US Federal Reserve System. Our paper seeks to identify relationships between bank profitability and several major internal determinants including public listing, size, capital ratio, loans, deposits, and diversification. Our focus is on the correlation between public listing, size, and bank profitability.

Although many studies attempt to identify relationships between bank profitability and internal and external determinants, the results of these studies vary across different countries, time periods, and regulatory environments (e.g. Bourke, 1989;

Molyneux and Thornton, 1992; Demirguc-Kunt and Huizinga, 1999; DeYoung et al., 2004; Athanasoglou et al., 2008; Albertazzi and Gambacorta, 2009; Brunnermeier 2009; Keys et al., 2010; Chronopoulos et al., 2015). To the best of our knowledge, no empirical study focuses on comparing the profitability of publicly traded bank holding companies (BHCs) with privately held BHCs for the period 2002 to 2015.

That said, a number of previous studies attempt to identify the impact of bank size on profitability (e.g. Berger et al., 1987; Martinez-Peria and Mody, 2004; Micco et al., 2007; Pasiouras and Kosmidou, 2007; Chronopoulos et al., 2015). Moreover, Shleifer and Vishny (1986), Shleifer (1998), Iannotta, Nocera, and Sironi (2007) and Micco, Panizza, and Yanez (2007) all perform comparison research on government-owned and privately held banks within diverse environments.

Importantly, Fama and Jensen (1983) and DeYoung et al. (2001) advocate for operating efficiency derived from the separation of ownership and control in public firms. However, their arguments are opposed by Molyneux and Thornton (1992) and Akhigbe, McNulty, and Stevenson (2017). In addition, Nichols, Wahlen, and Wieland (2009) also provide a good discussion on the implications of public listing, indicating that publicly traded banks enjoy greater benefits from access to the equity capital market compared with privately held banks, although they encounter higher agency costs because of greater separation of ownership and control.

As such, theory does not give a clear prediction on the impact of public listing on bank profitability. Our report examines US banking samples that are separated into three groups based on size, to discover whether the impact of public listing on profitability depends on bank size.

## **2: Literature Review**

Determinants of bank profitability have been a main theme that a number of banking studies over the past three decades have attempted to identify based on evidence obtained from individual countries or across multiple countries. Examples of the former include Berger et al. (1987), Neely and Wheelock (1997), Mamatzakis and Remoundos (2003), Naceur and Goaid (2008), Athanasoglou et al. (2008), García-Herrero et al. (2009), and Dietrich and Wanzenried (2011). In contrast, Molyneux and Thornton (1992), Demirguc-Kunt and Huizinga (1999), Abreu and Mendes (2002), Goddard et al. (2004), Athanasoglou et al. (2006), Micco et al. (2007), and Pasiouras and Kosmidou (2007) examine panel data sets. The empirical results of these studies often vary due to the different datasets, time periods, regulatory environments, and countries involved.

Several studies on bank profitability exist that focus on US commercial banking. Chronopoulos et al. (2015) investigate a large sample of US banks over the period 1984-2010 and suggest that competition reduces abnormal profitability, albeit not immediately. After both the Reigle–Neal Act and the GLB Act of 1999 were ratified, many banks opted for high productivity and low cost business models that relied on scale economies. DeYoung et al. (2004) explain that smaller banks have grown, but continued to operate under traditional high unit cost and high value-added business models, which rely on soft information to deliver differentiated products to customers.

Following deregulation, as more banks began to move away from traditional models in favour of the aforementioned strategies, it became instrumental to identify

major determinants that affect bank profitability. Previously, studies analysed bank profitability by measuring the return on average assets, and expressed the results as a function of internal and external determinants: the former include bank-specific variables, while the latter reflect environmental variables that are expected to affect the profitability of financial institutions. Internal determinants are discussed in detail in Table 1 and the next section; however, two key internal indicators – size and the public listing – are discussed in this section.

External determinants of bank profitability include central bank interest rates, inflation, GDP growth, taxation, and variables representing market characteristics. Most studies show a positive relationship between inflation, central bank interest rates, GDP growth, and bank profitability (e.g. Bourke, 1989; Molyneux and Thornton, 1992; Demirguc-Kunt and Huizinga, 1999; Athanasoglou et al., 2008; Albertazzi and Gambacorta, 2009). Demirguc-Kunt and Huizinga (1999) report that taxation reduces bank profitability, while Albertazzi and Gambacorta (2009) indicate that the impact of taxation on banking profitability is small because banks can shift a large portion of their tax burden onto depositors, borrowers, or purchasers of fee-generating services.

*A key internal determinant, size:* our report examines US bank profitability across three different size groups, while considering its relationship with other bank specific variables. Several studies exist that examine the relationship between bank profitability and size. Martinez-Peria and Mody (2004) argue that large banks may benefit from economies of scale and reduced costs, leading to higher profits. Pasiouras and Kosmidou (2007) also find a positive and significant relationship between bank size

and profitability due to the likelihood of increased product and loan diversification for large banks compared to smaller ones, leading to benefits from economies of scale. In addition, Chronopoulos et al. (2015) find that small banks charge a higher risk premium for extending credit to more risky customers. This is reflected in a higher interest-rate margin, which feeds through to higher revenues and profits.

On the other hand, Berger et al. (1987) argue that costs are reduced only slightly as bank size increases, and that very large banks often encounter scale inefficiencies. Furthermore, according to Micco et al. (2007), there is no correlation between the relative bank size and its ROAA, while the coefficient is always positive but never statistically significant. Therefore, our paper seeks to clarify whether the size of a bank affects its profitability, and whether the impact is positive or negative.

*Another key internal determinant, public listing:* Jensen and Meckling (1976) state that since managers of publicly traded banks are not owners, the performance of these publicly traded firms should be weaker, such that shareholders should incur higher costs associated with monitoring managers' performance. Indeed, according to Kwan (2004), small publicly owned BHCs tend to be less profitable compared to privately held BHCs of a similar size. One explanation for this is operating inefficiency in publicly traded BHCs, as the public company operating costs are significantly higher on average as compared to private ones.

On the other hand, Fama and Jensen (1983) argue that specialization makes separation of ownership and control efficient. DeYoung et al.'s (2001) study of 266 samples from the Kansas City Federal Reserve District looks at the effect of granting

outside managers an ownership stake in the firm. They find an inverted U-shaped relationship between managerial ownership and financial performance, suggesting that ownership incentives matter in banking.

However, Molyneux and Thornton (1992) report that the ownership status is irrelevant for bank profitability. Furthermore, Akhigbe, McNulty, and Stevenson (2017) examine the effect of the form of ownership on the profit efficiency of BHCs prior to and during the US financial crisis. For the pre-crisis period, the difference in profit efficiency between privately held and publicly traded BHCs is small, while for the crisis period, there is no statistically significant difference. These results suggest that agency issues do not affect the relative profit efficiency of private and public BHCs. In this paper, we examine whether and how the listing status of a bank affects its profitability using a sample of US banks.

### **3: Variable Definitions**

We analyse quarterly data on all US bank holding companies (BHCs) for the years 2002 to 2015 based on data obtained from the Federal Reserve System. The data include balance sheets and income statements that each BHC must report on form FRY-9C. We then distinguish between publicly traded banking institutions and privately owned ones, finding 22,398 observations for the former out of a total number of 75,454, indicating the majority of observations are on privately owned banks. The large number of both privately owned and publicly traded banks with detailed financial statements information allows us to conduct powerful statistical analyses.

Furthermore, we perform these analyses by classifying banks into three size groups: small, medium, and large. We expect that the results will differ across size groups. Our main objective is to estimate the effect of public listing on bank profitability, while controlling for other factors affecting bank profitability.

In our analysis, we measure profitability using Return on Assets (ROA) and Return on Equity (ROE). Both are widely employed in the banking literature as dependent variables. ROA is calculated as earnings after taxes divided by total assets, and is a primary indicator of managerial efficiency. ROE has the same numerator with ROA, but a different denominator, which is shareholders equity.

Public listing is an indicator variable that measures whether a bank's stock is traded on an exchange or not. It is set to be equal to 1 if a bank is publicly traded, and 0 otherwise. Thus, in essence, the performance of publicly traded banks is compared with

that of privately held banks. Kwan (2004) finds that smaller publicly owned BHCs tend to be less profitable than similarly sized privately held BHCs, because publicly traded banks have significantly higher operating costs on average, despite publicly owned BHCs' better access to capital.

Size, an indicator for the capacity of banks to invest in different assets, is measured as the natural logarithm of total assets. It is generally acknowledged that large banks are able to reduce costs because of economies of scale, and the average cost curve in banking has a relatively flat U-shape, with medium-sized banks being slightly more scale efficient than either large or small banks (Athanasoglou et al., 2008). However, according to Barros et al. (2007), larger and more diversified banks are more likely to perform poorly, while smaller, specialized banks have an advantage in solving problems associated with asymmetric information.

Capital is an indicator for a quantitative assessment of a firm's capital structure, and is calculated by the ratio of shareholders' equity over total assets. In the banking literature, it is commonly assumed that the cost of equity is the most expensive bank liability in terms of expected return (Garcia- Herrero et al., 2009; Hakenes and Schnabel, 2011). However, Berger (1995) points out that for a bank with capital below its equilibrium ratio, expected bankruptcy costs are relatively high, and an increase in capital ratios raises expected profits by lowering interest expenses on uninsured debt.

Additionally, Berger (1995)'s signalling hypothesis theory states that bank management signals private information that future prospects are good by increasing capital. Thus, we expect that this variable positively influence bank profitability in that the funding cost can be reduced for banks with larger capital due to their higher creditworthiness. Also,

capital can buffer the risk arising from risky assets, from which banks can generate a large volume of revenues.

Loans are the main source of income, and positively impact bank performance according to Ben Naceur and Goaid (2008), who suggest that more loans extended lead to higher interest income. However, Trujillo-Ponce (2013) argues that a greater relative proportion of loans in portfolios of banks is usually coupled with a greater liquidity risk. Thus, a bank holding a low proportion of liquid assets (with greater liquidity risk) is more likely to earn low profits.

Deposits associate with profit opportunities, because a higher share of customer deposits in bank liabilities should increase a bank's profitability, given that deposits constitute a cheap and stable financial resource versus other financing alternatives (Claeys and Vander Vennet, 2008; Garcia-Herrero et al., 2009). On the other hand, according to Trujillo-Ponce (2013), an aggressive commercial policy might cause banks to pay higher rates to attract deposits from competitors (the so-called 'deposit war'), which squeezes bank margins.

Diversification is measured using the ratio of non-interest income over gross revenue. Nowadays commercial banks attempt to increase diversification by expanding to fee-based businesses. This change can be supported by Tan and Floros (2012), who state that banks with more diversified activities have increased income, and low costs due to economies of scale. However, Stiroh and Rumble (2006) argue that greater diversification of the banking business does not necessarily translate into an improvement in the bank's profitability. In fact, such diversification may be detrimental to profitability. Furthermore, according to Gischer and Juttner (2001), diversification and bank

profitability are negatively related because the competition in fee-based business is higher than in traditional banking business, ultimately leading to lower profitability.

## **4: Summary Statistics**

Table 2 presents the summary statistics of our sample. The details are as follows.

The mean ROA and ROE of our observations are 0.008 and 0.084, respectively, and the standard deviations are 0.011 and 0.159, respectively.

The natural logarithm average size of our samples is 13.722, and the number of observations increased to 75,454 compared to those for ROA and ROE.

Capital has a mean of 0.093 and a small standard deviation of 0.032, which indicates that the majority of banks employ approximately 9% of equity to fund their total assets.

Loans have a mean of 0.661 and a standard deviation of 0.135. This result corresponds to the fact that the main source of income for banks is from lending.

The mean and the standard deviation of deposits are 0.786 and 0.113, respectively, which shows that banks fund most of their assets using deposits.

The average diversification of our sample is 0.174 and the standard deviation is 0.127.

Finally, the mean value of public vs. private indicates that approximately 30% of our observations are publicly traded, while the rest are privately held.

## **5: Tests of the equality of means between public and private banks**

Table 3 compares the means of independent variables for public and private banks. Size is calculated by the natural log of total assets and ranges from 5.88 to 21.67. The average size is 13.72 (from Table 2), where the average for public banks is 14.696 while that of private banks is 13.310. As such, public banks have greater average total assets than do private banks. The difference between the two means is 1.386. T-test results using two tailed tests indicate that the p-value is smaller than the smallest significance level, 0.01. Therefore, we reject the null hypothesis that the difference is not different from zero, and conclude that the difference in mean size is significant.

Capital is calculated as total equity capital divided by total assets. It ranges from 1.63% to 22.4%, and the average is 9.3%. The mean of capital among public banks is 9.8%, while that of private banks is 9.1%. The difference between the two means is 0.6%. The T-test result also indicates that the null hypothesis is rejected such that the capital difference between public and private banks is significantly different.

Loans is the proportion of loans and leases per total assets, and ranges from 20% to 90%. The average of loans and leases among public banks is 66.6%, while that of private banks is 66%. The difference between the two means is 0.6%, which suggests that the difference between the two means is also significant.

Deposits represents the deposits amount in domestic offices divided by total assets. The average deposit is 78.56%, where the average among public banks is 74.4%

while among private banks is 80.3%. Unlike the means of the other independent variables, only deposit has a negative difference in terms of mean between the two means. Size, capital, loans and diversification show higher means for public banks; however, deposits are higher in private banks than public banks. The difference is -5.9% and the t-test result also suggests rejecting the null hypothesis, thereby concluding that the difference between the two means is significant.

Diversification represents noninterest income over total operating income, which assesses how much the bank generates outside of interest income. On average, only 17.4% is from sources other than interest income. Public banks are more diversified, where the mean is 19.3% while that of private banks is 16.6%. The difference between the two means is 2.7%, and hypothesis testing also concludes that the difference in the two averages is significantly different.

## **6: Size group comparison**

Table 4 shows the number of observations by size. Small banks are banks whose total assets do not exceed one billion dollars. Out of the 75,454 total observations, there are 48,754 observations on small banks, which is about 65% of the total observations. For these small bank observations, only 15.54% of them are public banks. This finding is very similar to what Akhigbe et al. (2017) observe: more than half of the banks in their sample are small banks and only a small percentage of small banks are publicly traded.

About 29% of the observations are on banks with total assets between one billion and ten billion dollars, and they are categorized as medium banks. Among the 21,766 medium banks observations, 11,269 observations are for public banks, which is 52% of the total.

Large banks are banks whose total assets are greater than ten billion dollars. Only 6.54% of all banks in the sample are large: 4,934 out of 75,454. From these observations, 3,551 are public, which is about 72% of the total.

Overall, among the 75,454 total observations, 22,398 are on public banks, which make up about 30% of the entire sample. Thus, there are less public banks than private banks. Moreover, the majority of small banks are private banks, while the majority of large banks are public banks. Medium banks are almost evenly split.

## **7: Regression**

### **7.1 Small Banks**

Table 5 presents the results of the regression conducted on the small bank data generated on a quarterly basis for the period of 2002 to 2015. All coefficients on the six independent variables with respect to our profitability measures, ROA and ROE, appear to be significant at the 1% level; moreover, except for the public listing indicator, all are positively correlated to ROA and ROE.

The public listing variable is negatively correlated to ROA and ROE, which indicates that publicly-traded small banks are less likely to have higher ROA and ROE, i.e., they are less profitable than privately-held small banks. It can be induced from this result that small banks should stay privately held, whereas large-sized banks in general tend to go public, which is also supported by DeYoung and Rice (2004), who indicate that banks of different sizes adopt different business models. The coefficient on this variable for ROA is -0.002, which can be compared to the mean of ROA in Table 2.

Size is positively correlated both to ROA and ROE. Although we divide our sample into three groups in terms of size, in the case of the small bank group, size differences within the group are significant. Thus, in a relative sense, even smaller banks in the small bank group tend to have lower ROA and ROE than larger small banks within the same group. Considering that the number of observations in the small banks group is 48,178, which is greater than 64% of the entire regression observations for the three

groups, the small bank sample is largely dispersed with large differences in terms of size, which leads the size variable to correlate with changes in ROA and ROE.

The coefficients on the capital variable for ROA and ROE are 0.104 and 0.392, respectively, and both coefficients are significant at the 1% level. The correlations of capital with respect to ROA and ROE are positive and highly significant. There appears to be a consensus in the previous literature that more capital reduces the cost of external debt, compensating for the higher costs of owing funds (Trujillo-Ponce, 2013), which ultimately enables banks with more capital to achieve superior profitability.

Loans is also positively correlated to ROA and ROE, and the coefficients for both profitable ratios are 0.006 and 0.079 at the 1% level. By comparing the correlation coefficients of ROA and ROE amongst the three sample groups, we find that small banks have the highest loans-and-profitability correlations. Since it is a common assumption that small banks are less diversified than large banks, and thus highly dependent on loans, the correlations between the loans and profitability measures appear to be high and positive. In addition, small banks that focus heavily on growth strategies tend to take on riskier loans, which usually results in more risk-weighted loans over total assets, and accordingly leads to high correlations between loans and profitability.

Deposits has a coefficient of 0.010 for ROA and 0.095 for ROE, and both independent variables are positively correlated to deposits. Since both coefficients of deposits for small banks are positive and higher than the other groups, we find that small banks are more dependent on customer deposits in terms of financing capital.

The coefficients on the diversification variable are 0.014 and 0.182 respectively, and both are positively correlated to ROA and ROE. Although small banks' profitability

measures are highly correlated to deposits, the coefficients between the profitability measures and diversification for small banks are the lowest amongst the groups. This indicates that small banks are more focused on traditional banking, i.e. increasing customer deposits and loans, than on diversifying their business portfolios, mainly by including fee-based services.

## 7.2 Medium Banks

Table 6 presents the results of the regression conducted on the medium-sized bank data; it includes the coefficients of the six independent variables using ROA in column (1) and ROE in column (2) as the dependent variables. The most notable result is the negative coefficients for public listing for both ROA and ROE, which reflects the result obtained in the small banks regression. This result shows that public banks in the medium-sized pool are negatively associated with profitability; in general, they generate smaller returns on total assets or on total equity than private banks in this pool. When we compare these coefficients with the ROA or ROE means in Table 2, we can conclude the economic magnitude of the public listing's coefficients is significant. In Table 6, column (1), the coefficient of public listing is -0.002, while the ROA mean in Table 2 shows 0.008 in column (1).

The coefficients for size show negative correlations; however, their t-test results indicate that they are not significant at any level. This indicates that the size variable here has no impact on the profitability of medium-sized banks. Note that the same variable has a significant impact in the small sized group. One explanation is that grouping and categorizing the three different sizes did not offer the same range in terms of total asset amount. For example, our sample includes about 50,000 small banks (between zero and one billion dollars of total assets), but only about 20,000 medium banks (between one and ten billion dollars of assets). The small bank group's asset range may be well distributed to affect the regression, while the medium bank group's may be clustered in a small range; even so, this would not significantly impact the profitability regression.

Another potential reason is explained in recent research on US bank profitability (Chronopulous et al. 2015); they observe that banks with total assets up to about \$470 million show increasing returns, but beyond that asset size the returns decrease. Our small sized bank regression results also imply that size is positively related to profitability. However, medium-sized banks' minimum total assets at least double the stipulated amount (\$470 million), and the size factor becomes insignificant in terms of their profitability.

Capital indicates a positive correlation to both profitability indicators for medium-sized banks. Our results are in line with Djalilov and Piesse (2016) who report better capitalized banks in early transition countries are more profitable. They explain that these banks have sound financial and operating conditions, and their capital ratio positively affects their profit measures. However, several researches report contrasting results. Rumler (2016) finds a negative but significant relation between capital ratio and profitability for Austrian banks, while Chronopulous (2015) and Tregenna (2009) find a negative correlation for US banks.

Loans and deposits also show a significant positive relationship with both profitability indicators. This result is consistent to Saona (2016), who notes that banks are more profitable when they take advantage of economies of scales and increased amount of loans.

The diversification factor shows a significantly positive association with bank profitability. Banks in high-income countries such as the US often have relatively low profit margins from interest operations. Dietrich and Wanzenried (2014) report high-

income countries have good income from fees, commissions and other sources, and these diversified structures boost their profitability.

In sum, public medium-sized banks are less profitable than private medium-sized banks. Size is not a significant factor affecting bank profitability. Other coefficients also indicate that greater reliance on capital, loans, deposits and diversification significantly increases profitability.

### 7.3 Large Banks

The same regression was conducted for the large banks with respect to the same six variables. The important finding in this regression is that both coefficients on public listing variables for ROA and ROE are positive and significant, while both coefficients from small and medium banks are negative and significant. This shows that large public banks are more profitable than large private banks. The economic magnitude of the coefficients for both profit measures is also significant. For example, in Table 7, the coefficient on public listing 0.032 in column (2) can be compared with the mean ROE of 0.084 in Table 2.

The size variable again show no significant impact on either profitability measure. Capital shows no significance on ROE. Also, deposit shows no significance on ROA. Thus, for large banks, an increase in size, capital, or deposits has no impact on profitability.

Loans is positively related to profitability. This is consistent with the results from previous regressions, as well as Saona (2016), who argues that increased loans lead to higher profitability. Diversification also has a positive and significant impact on profitability. As Dietrich and Wanzenried (2014) observe, large banks tend to have other sources of income aside from interest, such as fees and commissions.

Unlike the medium- and small-sized pools, among large banks, public banks are more profitable than private banks. Table 7 also indicates a few insignificant variables in our regression such as size, capital and deposits. Finally, both loans and diversification have positive and significant impacts on profitability.

### ***Public and Size***

When we consider the relationship between bank profitability with their size and ownership status, we notice a clear relationship: public banks are less profitable among small and medium banks, but more profitable among large banks. We conclude that only large banks benefit from being public.

Our results are consistent with the simple model of Doidge, Karolyi, and Stulz (2017). They discuss the costs and benefits of being listed, and argue that larger firms are listed while smaller firms are not because the benefit of public (or being listed) increases with firm size, and more importantly increases faster than the cost. Their model shows that the slope of the benefit graph is steeper than that of the cost graph as firm size increases. As a result, larger firms will enjoy greater benefits in terms of being listed even as costs increase slowly, while smaller firms will not experience this favourable net benefit.

## **8: Conclusions**

In this paper, we examine two profit measures, ROA and ROE, of US banks along with several independent variables during the period 2002-2015. We divide our sample banks into three size groups and focus on the impact of public listing on bank profitability. We obtain two regression results for each size group that show the relationship between profitability and the six independent variables: public, size, capital, loans, deposits, and diversification.

The small-sized sample consists of about 15% of the public banks, and shows a significantly negative relationship between public listing and both ROA and ROE. On the other hand, all five of the other independent variables show a significantly positive relationship with both profit measures. We conclude that public banks are less profitable than private banks when their total assets do not exceed one billion dollars.

Medium banks make up about 51% of the public banks; the public variable in this pool has a negative impact on profitability. Only the size variable in this regression shows insignificant coefficients, and we assume that since the sample size is relatively small, it does not affect the regression. Other variables such as capital, loans, deposits, and diversification show a significantly positive relationship with both profit measures. We conclude that medium public banks are less profitable than private banks with similar asset sizes.

The large bank sample generates significantly positive coefficients from the public listing variable. We conclude that large public banks are more profitable than large private banks. It appears that the benefit of being listed increases faster than the cost as firm size increases. Both loans and diversification also have a positive impact on the profitability of large banks, while size, capital, and deposits have insignificant impacts.

In summary, our results show the impact of public listing on bank profitability differs across size groups. The results also support previous research on various relevant topics such as different business models for different sized banks.

## Appendix

**Table 1. Variable definitions**

<b>Dependent Variable</b>	
Return on Asset (ROA)	(Net income / Total assets) * 4 We annualize ROAs
Return on Equity (ROE)	(Net income / Shareholders' equity) * 4 We annualize ROEs
<b>Independent Variable</b>	
Public listing	An indicator variable that equals 1 if a bank is publicly traded, and 0 otherwise
Size	Natural logarithm of total assets A variable that indicates the capacity of banks to invest in different assets
Capital	Total equity capital / Total assets Total equity capital is the sum of perpetual preferred stock and related surplus, common stock (par value), surplus (exclude all surplus related to preferred stock), retained earnings, accumulated other comprehensive income, and other equity capital components * Accumulated other comprehensive income includes net unrealized holding gains (losses) on available-for-sale securities, accumulated net gains (losses) on cash flow hedges, cumulative foreign currency translation adjustments, and minimum pension liability adjustments * Other equity capital components include treasury stock and unearned Employee Stock Ownership Plan shares
Loans	Loans and leases / Total assets Loans and leases include loans secured by real estate, loans to depository institutions and acceptances of other banks, loans to finance agricultural production and other loans to farmers, commercial and industrial loans, loans to individuals for household, family, and other personal expenditures, loans to foreign governments and official institutions, loans for purchasing and carrying securities, and lease financing receivables.

Deposits	Deposits in domestic offices / Total assets Deposits in domestic offices incorporate noninterest-bearing and interest-bearing deposits.
Diversification	Non-interest income / Gross revenue Non-interest income includes income from fiduciary activities, service charges on deposit accounts in domestic offices, trading revenue, investment banking, advisory, brokerage, and underwriting fees and commissions etc.
Division of sample into three size groups: Small, Medium, or Large	<ul style="list-style-type: none"> <li>- Small banks: total assets are under \$1 billion.</li> <li>- Medium-sized banks: total assets are \$1 - \$10 billion.</li> <li>- Large banks: total assets are over \$10 billion.</li> </ul>

**Table 2. Summary statistics**

Variables	(1) Mean	(2) Standard Deviation	(3) Percentile 25 <sup>th</sup>	(4) Percentile 50 <sup>th</sup>	(5) Percentile 75 <sup>th</sup>	(6) # of Observations
ROA	0.008	0.011	0.005	0.009	0.013	74776
ROE	0.084	0.159	0.060	0.101	0.143	74776
Size	13.722	1.444	12.763	13.434	14.206	75454
Capital	0.093	0.032	0.074	0.090	0.107	75454
Loans	0.661	0.135	0.589	0.680	0.756	75454
Deposits	0.786	0.113	0.752	0.812	0.856	75454
Diversification	0.174	0.127	0.097	0.147	0.215	74774
Public listing	0.297	0.457	0.000	0.000	1.000	75454

**Table 3. Tests of the equality of means between public and private banks**

	(1) Mean of Public Banks	(2) Mean of Private Banks	(3) Difference in Mean
Size	14.696	13.310	1.386***
Capital	0.098	0.091	0.006***
Loans	0.666	0.660	0.006***
Deposits	0.744	0.803	-0.059***
Diversification	0.193	0.166	0.027***
ROA	0.00693	0.00834	-0.00765***
ROE	0.06723	0.09141	-0.02418***

\*p=0.10; \*\*p=0.05; \*\*\*p=0.01

Notes: This table compares the means of five independent variables of public and private banks for the periods of 2002-2015. Means of public banks show the average of independent variables for public banks; means of private banks show the average of independent variables for private banks. Difference in mean is the difference between two means: mean of public banks minus mean of private banks. The significance level for the difference in means between public and private banks is determined by t-test. \*, \*\*, and \*\*\* indicate significant difference from zero at the 10%, 5%, and 1% levels, respectively, using two-tailed tests.

**Table 4. Size group comparison**

Size group	(1) Number of observations	(2) Number of public banks	(3) Percentage of public banks
Small	48,754	7,578	15.54%
Medium	21,766	11,269	51.77%
Large	4,934	3,551	71.97%
Total	75,454	22,398	29.68%

Notes: This table shows the number of total observations in each size group. Small banks have total assets that do not exceed one billion dollars. Medium banks have total assets that exceed one billion, but not ten billion dollars. Large banks have total assets that exceed ten billion dollars.

**Table 5. Regression results using small banks**

	(1) ROA	(2) ROE
Public listing	-0.002491 *** (0.0001206)	-0.0308018 *** (0.0018528)
Size	0.0018248 *** (0.000099)	0.234916 *** (0.0015206)
Capital	0.1036386 *** (0.0014432)	0.3923929 *** (0.0221771)
Loans	0.0064303 *** (0.0003403)	0.078512 *** (0.0052289)
Deposits	0.0095853 *** (0.0005657)	0.0949189 *** (0.0086933)
Diversification	0.0138016 *** (0.0004135)	0.1816209 *** (0.0063535)
Quarter Fixed effects	Yes	Yes
Observations	48178	48178
R-Squared	0.2678	0.1596

Notes: This table shows coefficients on six independent variables from regressions using small banks. Small banks have total assets that do not exceed one billion dollars. Standard errors are shown in brackets. \*, \*\*, \*\*\* indicates significance levels at 10%, 5%, and 1%, respectively.

**Table 6. Regression results using medium banks**

	(1) ROA	(2) ROE
Public listing	-0.0017015 *** (0.0001496)	-0.0267834 *** (0.002229)
Size	-0.0000263 (0.0001221)	-0.0010744 (0.0018467)
Capital	0.0895599 *** (0.0023658)	0.4935688 *** (0.0357752)
Loans	0.002123 *** (0.0006017)	0.0256218 *** (0.0090986)
Deposits	0.002781 *** (0.0007644)	0.0513141 *** (0.0115593)
Diversification	0.0181424 *** (0.0005838)	0.202977 *** (0.0088278)
Quarter Fixed effects	Yes	Yes
Observations	21690	21690
R-Squared	0.2641	0.1749

Notes: This table shows coefficients on six independent variables from regressions using medium banks. Medium banks have total assets that exceed one billion dollars, but not ten billion dollars. Standard errors are shown in brackets. \*, \*\*, \*\*\* indicates significance levels at 10%, 5%, and 1%, respectively.

**Table 7. Regression results using large banks**

	(1) ROA	(2) ROE
Public listing	0.0022386 *** (0.0003115)	0.0320131 *** (0.0043326)
Size	-0.000165 (0.0001219)	0.0003428 (0.0016952)
Capital	0.0527004 *** (0.0044497)	0.0843016 (0.0618871)
Loans	0.0059666 *** (0.0010121)	0.0556469 *** (0.0140759)
Deposits	0.0004024 (0.0009231)	0.04334 *** (0.0128386)
Diversification	0.0156201 *** (0.0009156)	0.1853972 *** (0.0127347)
Quarter Fixed effects	Yes	Yes
Observations	4906	4906
R-Squared	0.3279	0.2615

Notes: This table shows coefficients on six independent variables from regressions using large banks. Large banks have total assets that exceed ten billion dollars. Standard errors are shown in brackets. \*, \*\*, \*\*\* indicates significance levels at 10%, 5%, and 1%, respectively.

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