Has the Relationship between Bank Size and Profitability Changed?

By Kristen Regehr and Rajdeep Sengupta

In recent years, community bankers and industry analysts have raised concerns that smaller community banks need to grow larger to be successful. Today, banks face new and higher costs to both implement complex new regulations, especially those introduced after the 2007–09 financial crisis and recession, and transition to new electronic banking platforms. For small banks, these higher fixed costs are spread over a smaller asset base, which may put them at a competitive disadvantage relative to larger competitors. In addition, if the competitive disadvantage threatens the profitability and long-run viability of smaller banks, smaller communities and rural areas not large enough to support viable banks may lose access to their local banking services. Even if these communities do not lose banking services, a reduction in the number of banks can reduce competition, which may then lead to higher loan rates and lower deposit rates.

However, size is not the only factor that affects a bank's long-run profitability. In fact, profitability depends on the characteristics of both individual banks and the markets in which they operate. For example, bank-specific factors such as business strategies, reflected in the composition of banks' assets and liabilities, can affect profitability. Likewise, market-specific factors, such as growth in the markets in which banks

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operate, can affect banks' long-run profitability. Any analysis that thoroughly examines the relationship between bank profitability and bank size must account for such bank-specific and market-specific factors.

In this article, we analyze how bank profitability changes with bank asset size after accounting for other factors that affect bank profitability. More specifically, we examine whether the size-profitability relationship has made smaller community banks less competitive in the post-crisis recovery. We find that profitability, measured by banks' return on assets, increases with bank size but at a decreasing rate. However, we also find no statistically significant difference in the size-profitability relationship before and after the crisis, suggesting the relationship has not changed in recent years in ways that disadvantage community banks relative to their larger competitors.

Section I describes the factors that affect bank profitability and the size-profitability relationship. Section II conducts a statistical analysis of the relationship between bank size and bank profitability after controlling for other factors. Section III examines whether the size-profitability relationship has remained stable over time by comparing the relationship during the periods before, during, and after the financial crisis.

I. Bank Profitability and Size

The banking industry has undergone significant restructuring over the last three decades. Since the mid-1980s, the number of commercial banks has declined, while the average assets of banks have continued to increase. These changes appear to have had a disparate effect on small banks. From 1984 to 2011, the number of banks with assets less than $100 million declined by over 11,000, largely due to the consolidation of bank charters. And while banks' average assets increased over the same period, most of the growth can be attributed to banks with more than $10 billion in assets (FDIC).

Banks have good reasons to believe profitability and size are related. Increasing bank size can increase bank profitability by allowing banks to realize economies of scale. For example, increasing size allows banks to spread fixed costs over a greater asset base, thereby reducing their average costs. Increasing banks' asset size can also reduce risk by diversifying operations across product lines, sectors, and regions (Mester 2010). Lower risk can promote profitability directly by reducing losses

or indirectly by making liability holders willing to accept lower returns, thereby reducing banks' funding costs. Furthermore, as the scale of operations increases, banks may be able to better use specialized inputs such as loan officers with expertise in commercial and industrial business lines, resulting in greater efficiency. Realizing economies of scale may lead to a healthier banking system by eliminating inefficiencies and reducing risks.

However, scale economies are not the only way size can affect profitability. Small banks may be able to form stronger relationships with local businesses and customers than large banks, allowing them access to proprietary information useful in setting contract terms and making better credit underwriting decisions (Berger and others). Indeed, these informational and pricing advantages may fully offset any loss of scale economies. To determine how size affects bank performance, then, it is important to use a measure such as profitability that summarizes the various costs and benefits of size.

A simple comparison across the various size groups suggests that, on average, larger banks have higher returns. Table 1 shows return on average assets (ROAA) for different bank size groups from 2001 to 2014. The second column of Table 1 shows that average returns are highest for the more than $10 billion group at 1.09 percent and smallest for the less than $1 billion group at 0.77 percent. However, this relationship differs across the three subperiods. Larger banks saw higher returns in the pre-crisis and post-crisis periods, but smaller banks saw higher returns during the crisis. One problem with drawing conclusions about the effect of size on returns from Table 1 is the comparisons do not take other factors that can affect bank returns into account. An analysis that controls for these factors can better determine the relationship between size and profitability and whether this relationship has changed over time.

To determine how bank size affects bank profitability, we develop a simple model where a bank's profitability is a function of its size and characteristics as well as the characteristics of the markets in which it operates. Bank-specific factors include business strategies and other bank characteristics such as organizational structure. Market-specific factors include market competition and local economic conditions. Controlling for the influence of bank- and market-specific factors allows us to isolate the relationship between bank size and profitability.

Table 1
ROAA and Size Group

Size group	Sample		Pre-crisis expansion		Crisis		Post-crisis expansion	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
All banks	0.78	1.38	1.04	1.31	0.47	1.58	0.61	1.25
Less than $1 billion	0.77	1.35	1.01	1.31	0.50	1.50	0.59	1.24
$1–$10 billion	0.86	1.69	1.34	1.35	0.15	2.27	0.78	1.38
More than $10 billion	1.09	1.38	1.58	1.11	0.14	1.94	0.93	0.89

Bank-specific factors

Banks' business strategies can affect profitability. We assess banks' business strategies by examining the strategic decisions that affect the composition of banks' balance sheets—the level of earning assets, the proportion of assets allocated to loans and securities, and the proportion of funding generated through core deposits and wholesale liabilities. Banks that focus on loans (as opposed to securities), for example, tend to generate higher interest income but entail higher expense and risk. In addition, we distinguish between funding strategies that rely on core deposits, a safer and more liquid source of funding, and those that rely on brokered deposits, which are more easily obtained but also less stable. Each strategy has advantages and disadvantages; we do not know in advance which strategy leads to higher profitability.

Other bank-specific characteristics, such as organizational structure, can also affect bank profitability. To account for these factors, we first analyze differences between single-market and multimarket banks. Multimarket banks may derive benefits, such as lower funding costs, from diversifying across different markets. In contrast, single-market banks are significantly smaller and therefore more likely to benefit from the advantages of small banks. For example, the geographically undiversified nature of single-market bank loan portfolios encourages banks to increase profitability by building up local lending relationships with a loyal customer base over time.

We also examine differences between banks that file taxes under Subchapter S (S-Corp banks) and banks that file under Subchapter C (C-Corp banks) of the U.S. tax code.[1] S-Corp banks have fewer

owners due to restrictions on the number of shareholders allowed. Such concentrated ownership relative to C-Corp banks may reduce agency problems and subsequently improve shareholder control over management and risk management practices, leading to higher profitability.

Market-specific factors

Market competition can directly affect a bank's profitability. Banks in less competitive markets, for example, tend to offer lower deposit rates and charge higher loan rates, leading to higher returns. In more competitive markets, however, banks may realize lower returns as they bid for funds with higher deposit rates and try to attract borrowers with lower loan rates.

Other market-specific factors affecting profitability include market size and economic conditions. Large markets, as measured by population, may provide banks more opportunities to increase returns but may also be more competitive. Markets with stronger economic conditions, as reflected in lower unemployment rates, tend to raise bank profitability.

The size-profitability relationship

To evaluate the size-profitability relationship appropriately, we must account for other factors that affect profitability. Figure 1 shows a hypothetical bank size-profitability relationship for a given set of bank-specific and market-specific factors. The curve shows that bank profitability increases with bank size but at a decreasing rate. Consider, for example, two banks with the same characteristics operating in the same market that differ only in size—one bank has $300 million in assets, and the other bank has $500 million in assets. Figure 1 shows higher returns for the $500 million bank than the $300 million bank, though the slope of the curve suggests these effects diminish as the bank's asset size increases. Still, when all bank-specific and market-specific factors are accounted for, greater size is associated with higher profitability.

However, changes in bank-specific or market-specific factors can raise or lower profitability for banks of all sizes. Figure 2 shows how the size-profitability curve shifts in response to these changes. The lower curve represents the size-profitability relationship for banks that use the average funding strategy, while the higher curve represents the relationship for banks that use a more profitable core funding strategy. The

Figure 1
The Size-Profitability Relationship

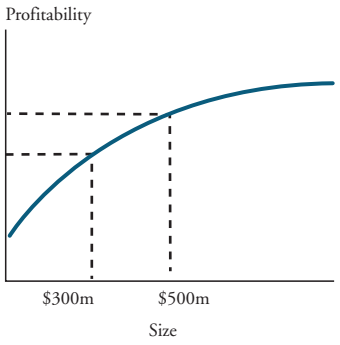
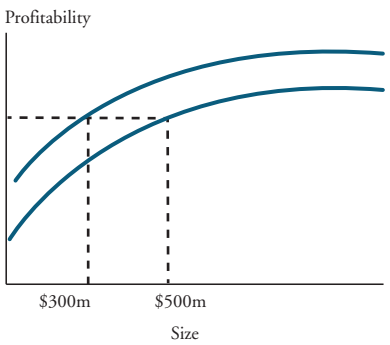


Figure 2
Shift in the Size-Profitability Relationship



difference between the curves illustrates how a $300 million bank with a more profitable funding strategy can generate the same returns as a $500 million bank with the average funding strategy. While greater size is still associated with higher profitability within each funding strategy, Figure 2 illustrates how other factors can enable smaller banks to compete effectively with larger banks.

II. How Does Bank Size Affect Profitability?

The hypothetical exercise in Figure 2 illustrates the importance of controlling for other factors in determining the relationship between size and profitability. We use simple regression techniques on bank-level

data to estimate a size-profitability model that controls for bank-specific and market-specific factors. Our results show that size is an important determinant of bank profitability and that its effect increases but at a diminishing rate.

Our sample comprises an unbalanced panel of annual observations for 8,315 community and regional banks with assets less than $100 billion (valued at 2014 U.S. dollars) from 2001 to 2014.[2] We choose the 2001–14 sample period to allow for the pre-crisis and post-crisis comparison in our statistical analysis. We divide the years in the sample into three sub-periods: the pre-crisis expansion from 2001 to 2006 (7,451 banks), the crisis period during 2007–09 (6,510 banks), and the post-crisis recovery period from 2010 to 2014 (6,326 banks).[3]

We measure bank size as the natural logarithm of total assets (valued at 2014 U.S. dollars).[4] We measure bank profitability as the tax-adjusted ROAA, which is a bank's tax-adjusted net income divided by its average total assets over the past year. We also include the square of the logarithm of total assets in the model to capture changes in the size-profitability relationship as bank size changes—specifically, to capture changes in the rate at which profitability increases or decreases as bank size increases. We calculate ROAA, bank size, and other bank financial ratios using annual bank-level data on U.S. commercial banks from the Consolidated Reports of Condition and Income for a bank, popularly known as the Call Reports (see Appendix for a description of the data).

We measure the level of competition within markets using the market Herfindahl Index (HHI). Higher HHIs indicate more concentration and less competition. The HHI for a market is calculated using the market shares of deposits from the FDIC's Summary of Deposits. More specifically, the HHI is calculated using deposit shares at banks belonging to the same bank holding company (BHC). Calculating HHIs at the BHC level rather than the bank level is reasonable since two banks in the same market belonging to the same holding company are unlikely to compete with each other.

We also use data from the Summary of Deposits to distinguish between single-market and multimarket banks.[5] For multimarket banks, we define the market variables to include all areas in which the bank or its branches are located. Accordingly, the market population for a multimarket bank is the sum of the population in every market area in

which the bank has a branch. The HHI and the unemployment rate for multimarket banks are weighted averages for the banks' market areas. The HHI is weighted by the relative size of the population, while the unemployment rate is weighted by the relative size of the labor force.

Base model

The size-profitability model regresses banks' tax-adjusted ROAA on their asset size and the square of the size variable. The regression estimates how bank size affects bank asset returns while controlling for variations in bank-specific and market-specific factors. Bank-specific factors include balance sheet composition variables such as loan to asset ratio, securities to assets ratio, core deposits to total deposits ratio, and binaries for single-market banks and S-Corp banks. Market-specific factors include a measure for bank competition (HHI), population size, and the unemployment rate. The regressions also use other explanatory variables such as bank age, risk, and a binary for rural banks that control for potential variations in profitability. Finally, we use bank-specific, time-invariant binaries (fixed effects) to control for bank-level heterogeneity; the annual GDP growth rate to control for macroeconomic factors; and binary variables for each of the three periods before, during, and after the financial crisis to control for other variations over time (see the Appendix for a complete variable list).

The bank size variables are our principal interest. The estimated coefficients on the size variable capture the change in profitability associated with a 1 percent increase in real assets holding all other factors constant. A positive coefficient indicates that profitability increases with size, whereas a negative coefficient indicates profitability decreases with size. The squared term captures the rate of acceleration or deceleration in profitability associated with a percentage change in real assets. Accordingly, a positive effect on the squared term indicates an increasing rate of change, whereas a negative effect indicates a decreasing rate of change.

The coefficients of the size and size-squared variables, as shown in the second column of estimates in Table 2, are positive and negative, respectively, and statistically significant at the 1 percent level (see Appendix for full regression results).[6] The coefficients indicate that percentage increases in size are associated with increasing conditional ROAA but at a decreasing rate (the ROAA estimated here is conditional on holding bank-specific

Table 2
ROAA Regression Results

Variables	Size-profitability model	Post-crisis break model
Size	2.915***	2.064***
Size^2	–0.071***	–0.048***
Loan to asset ratio (one-year lag)	1.112***	1.105***
Security to asset ratio (one-year lag)	1.199***	1.168***
Core deposit to deposit ratio (one-year lag)	0.498***	0.496***
Single-market bank	0.118***	0.118***
Age	–0.401***	–0.408***
Risk	–0.094***	–0.093***
Subchapter S bank	0.066***	0.056**
Rural bank	–0.026	–0.016
Population level	–0.052***	–0.052***
Unemployment rate	–0.121***	–0.121***
HHI	0.269	0.264
Real GDP growth rate	0.050***	0.049***
Crisis binary variable	–0.206***	–7.255***
Size × crisis binary variable		0.862***
Size^2 × crisis binary variable		–0.026***
Post-crisis expansion binary variable	–0.026	–1.707
Size × post-crisis expansion binary variable		0.203
Size^2 × post-crisis expansion binary variable		–0.006
Observations	86,706	86,706
Number of banks	8,315	8,315
Adjusted R^2	0.085	0.089
F-stat	179.73	151.13

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.
Notes: Standard errors are robust and clustered at the bank level. See Appendix for full regression results.

Table 3
Conditional ROAA and Asset Size

Asset size (millions)	Size-profitability model (basis points)	Post-crisis break model		
		Pre-crisis expansion (basis points)	Crisis (basis points)	Post-crisis expansion (basis points)
$100	16.40	19.06	11.70	17.43
$200	6.41	9.02	3.57	7.80
$300	3.13	5.46	1.07	4.48
$400	1.61	3.69	–0.01	2.85
$500	0.79	2.66	–0.55	1.93
$600	0.30	2.01	–0.85	1.37
$700	–0.01	1.55	–1.01	0.97
$800	–0.22	1.23	–1.11	0.70
$1,400	–0.66	0.37	–1.19	0.01
$1,500	–0.67	0.30	–1.17	–0.03
$1,600	–0.69	0.25	–1.17	–0.07
$2,400	–0.70	0.01	–1.03	–0.22
$2,500	–0.69	–0.02	–1.00	–0.23

Note: The values show the change in ROAA given a $100 million increase in asset size for a bank with the initial asset size shown in the first column.

and market-specific variables constant at their mean values). In particular, a 1 percent increase in a bank's real assets is associated with an increase in conditional ROAA of 2.9 basis points minus twice the bank's initial size (measured in logarithm of real assets) times 0.07 basis point.[7] In other words, the change in conditional ROAA associated with a given change in bank real assets varies with the initial size of the bank.

Next, we use the coefficients from the size-profitability model to calculate the change in conditional ROAA associated with a $100 million increase in bank assets. The first column of estimates in Table 3 shows the results for different bank sizes. The estimates suggest the smallest banks experience large increases in conditional ROAA as they grow. Specifically, an increase in bank size from $200 million in assets to $300 million in assets is associated with an increase in conditional ROAA of 6.4 basis points. However, the size of this increase diminishes as bank size increases. Banks with larger asset sizes experience much smaller increases in conditional ROAA.

Conditional returns are maximized at $755 million under the size-profitability model. Increases in size beyond this level are associated with decreases in conditional ROAA. Returns on assets continue to be

positive beyond this size but are lower for larger banks. The returns decline slowly for each $100 million increase in size. As shown in Table 3, increasing size from a $1.5 billion bank to a $1.6 billion dollar bank is associated with a decrease in conditional ROAA of 0.7 basis point.

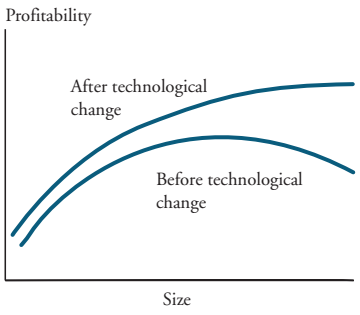
III. How Has the Bank Size-Profitability Relationship Changed in Recent Years?

Changes in technology and regulation have the potential to affect both bank profitability and the size-profitability relationship. Changes in factors that affect the profitability of all banks will shift the size-profitability curve up or down. However, changes in factors that have disparate effects on banks of different sizes will change the size-profitability relationship. Figure 3 illustrates a change in the size-profitability relationship from a technological change that favors larger banks. The lower curve shows the size-profitability relationship before the technological change, and the higher curve shows the size profitability relationship after the technological change. As Figure 3 shows, larger banks experience a greater increase in profitability after the change.

Often, technological and regulatory changes favor larger banks. The Interstate Banking and Branching Efficiency Act (IBBEA) of 1994, for example, paved the way for consolidation, thereby allowing banks to exploit scale economies.[8] Recent studies of scale economies claim that the efficient scale of commercial banking has risen over the past 20 years (Wheelock; Feldman, Mester, and DeYoung). Improvements in information technology have also increased productivity and scale economies in processing electronic payments (Berger). However, technological changes can benefit small banks as well: for example, small banks may be able to benefit from the services of third-party providers without having to develop new banking platforms on their own.

After the financial crisis and recession of 2007–09, the banking industry underwent significant technological and regulatory changes. Banks introduced new technological innovations in mobile and online banking in the post-crisis period. In addition, the Dodd-Frank Act of 2010 introduced new financial regulations to reduce risks to the banking sector and to enhance overall financial stability. We want to determine whether these changes have significantly altered the size-profitability relationship in the post-crisis period.

Figure 3
Change in the Size-Profitability Relationship



We develop a post-crisis break (PCB) model to examine the relationship between bank size and profitability over three periods: the pre-crisis expansion, the crisis, and the post-crisis recovery. The PCB model allows the coefficients on the size variables in the size-profitability model to vary across the subperiods, allowing us to evaluate whether the size-profitability relationships changed in these periods. The PCB model includes a crisis binary variable indicating whether the sample observation belongs to the crisis period of 2007–09. The model also includes a post-crisis binary variable indicating whether the sample observation belongs to the post-crisis expansion.

The PCB model finds a statistically and economically significant change in the size-profitability relationship during the crisis. The second column of estimates in Table 2 shows the coefficients for the post-crisis binary variables and for the binary variables interacted with the size variables. The estimated coefficients on the interaction terms are statistically significant at the 1 percent level and indicate that while conditional ROAA still increased with size during the crisis, these returns diminished at a faster rate than in the pre- and post-crisis expansions. As a result, the bank asset size associated with the maximum conditional ROAA was significantly smaller during the crisis.

The coefficients on the post-crisis binary and its interactions with size and size-squared variables allow us to compare the size-profitability relationship during the pre- and post-crisis expansions as well. The estimated coefficients on the post-crisis expansion variables again indicate that increasing bank size was associated with higher conditional ROAA, but returns in this period diminished at a slower rate than during the

crisis. However, none of the estimated coefficients on the post-crisis binary variable are statistically significant, suggesting the size-profitability relationship in the two periods was not significantly different.[9] The observed differences in ROAA in the pre-crisis and post-crisis expansions shown in Table 1 are due instead to changes in economic and competitive conditions that shift conditional ROAA downward without changing its sensitivity to size. For example, a high unemployment rate could lower profitability during the post-crisis recovery. The mean post-crisis unemployment rate across all banking markets, 7.3 percent, was significantly higher than the pre-crisis mean of 5.1 percent (see Appendix for summary statistics on the regression variables).

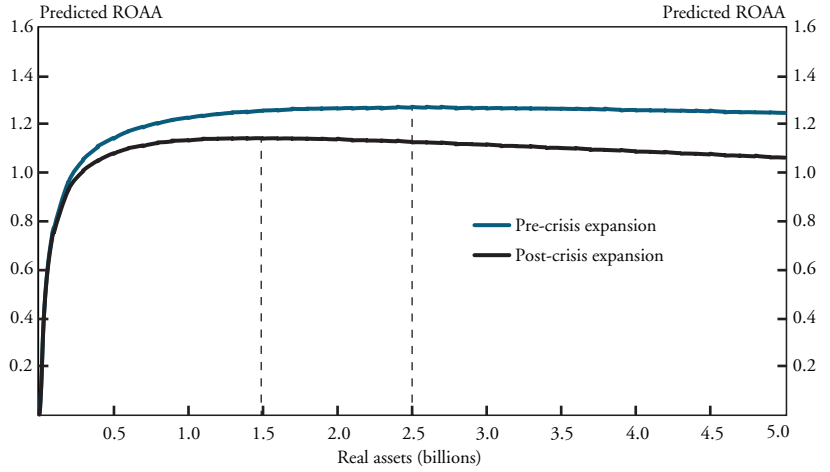
The PCB model columns in Table 3 show how returns change with increases in size under the PCB model. For a benchmark bank—one with bank-specific and market-specific factors at their mean values—conditional asset returns in the pre-crisis expansion are maximized at $2.5 billion.[10] We derive the increases in the post-crisis column from the estimates on the post-crisis binary variable and interacted size variables in Table 2. While the size of the benchmark bank in Table 3 is smaller in the post-crisis period, we calculate the size using estimated coefficients that are not statistically different from zero. For small banks, the increases in returns for a $100 million increase in size are comparable in the pre-crisis and post-crisis periods. For larger banks, the difference in returns between the two periods is less than one basis point.

Chart 1 shows the estimated relationship between size and the benchmark conditional ROAA for the pre-crisis and post-crisis periods. In the pre-crisis period, the benchmark conditional ROAA is higher than in the post-crisis period for most bank sizes. However, the two curves are similar in that the relationship between profitability and size remains fairly stable during the pre-crisis and post-crisis expansions. Our statistical analysis confirms that while ROAA is lower on average for all bank sizes in the post-crisis period than in the pre-crisis period, the reduction in ROAA cannot be attributed to a diminished effect of size on ROAA.

Our analysis reveals that the difference in the size-profitability relationship between the PCB model and the baseline size-profitability model is statistically significant, largely due to a change in the size-profitability relationship during the crisis period.[11] The PCB model allows

Chart 1

Predicted Conditional ROAA and Bank Size
(Pre-Crisis and Post-Crisis Expansions)



us to isolate the influence of the crisis period and estimate the equilibrium relationship during the pre-crisis and post-crisis expansions. However, the PCB model shows no statistically significant difference between the pre-crisis and the post-crisis periods. We therefore use this equilibrium relationship that remains unaltered over the pre-crisis and post-crisis expansions to examine the effects of bank-specific and market-specific factors on profitability.

The effect of factor variables

We use the PCB model to study the effect of bank-specific and market-specific factors on bank profitability. Specifically, we explore how a 10 percent change from the mean value of select bank-specific and market-specific variables affects profitability. As shown in Table 4, these 10 percent changes are small in terms of our sample—less than the standard deviations of the sample variables. Table 4 estimates the minimum size bank that can achieve the maximum conditional ROAA for the $2.5 billion benchmark bank (benchmark conditional ROAA) given a 10 percent change in a single factor. We focus on two bank-specific factors—the core deposit ratio and whether the bank is a single-market or multimarket bank—and one market-specific factor, the unemployment rate.

Table 4
Benchmark Conditional ROAA and Asset Size

Variables	Mean	Standard deviation	Value after 10 percent change from mean*	Change as a percentage of standard deviation	Real assets (millions)
Loan to asset ratio	0.63	0.16	0.69	40	759.8
Security to asset ratio	0.23	0.15	0.26	15	1,191.2
Core deposit to deposit ratio	0.83	0.10	0.91	79	1,001.6
Population level	5.61	2.27	5.05	25	1,160.7
Unemployment rate	6.01	2.20	5.41	27	736.0
Single-market bank**	-	-	-	-	525.2

*Assumes change in variable increases ROAA
**Asset size needed to achieve maximum estimated ROAA if bank is a single-market bank
Note: Table shows the minimum size bank that can achieve the maximum conditional ROAA for the $2.5 billion benchmark bank (benchmark conditional ROAA) given a 10 percent change in a single factor.

The PCB model column in Table 2 shows that the core deposit to total deposit ratio has a positive and statistically significant effect on conditional ROAA. This implies that increasing core deposits increases bank returns an upward shift of the curve in Figure 2. We quantify this effect by considering a 10 percent increase in the core deposit ratio from 83 percent (the sample mean) to 91 percent. Table 4 shows that this change is less than 1 standard deviation of the variable but would allow a $1 billion bank to achieve the same ROAA as the $2.5 billion benchmark bank.

We obtain similar estimates for market-specific factor variables. Table 2 shows that the estimated coefficient for the unemployment rate is negative and significant under the PCB model. Again, we would expect banks in market areas with a lower unemployment rate to show higher returns. Thus, we consider a 10 percent decrease in the unemployment rate from 6 percent (the sample mean) to 5.4 percent in a given market area. Table 4 shows that this change, which is smaller than one-third of the variable's standard deviation, would allow a $736 million bank to achieve the same ROAA as the $2.5 billion benchmark bank.

Single-market banks are smaller in size and scope, and they lack the advantages of diversification that multimarket banks typically accrue. In the PCB model, the coefficient of the indicator variable for single-market banks is economically and statistically significant (Table 2). The

estimated coefficient shows that, after controlling for size, single-market banks have higher returns than multimarket banks. Table 4 shows that a $525 million single-market bank can achieve the same ROAA as the $2.5 billion benchmark bank.

The comparisons in Table 4 show that favorable market conditions and changes in bank-specific characteristics other than size also increase conditional ROAA. Small changes in bank-specific and market-specific factors can be equivalent to large changes in size in achieving higher ROAA.

IV. Conclusion

Our results support industry analysts' view that there are significant scale economies in banking, especially for the smallest community banks. However, this is not merely a post-crisis phenomenon. Throughout our sample period, small community banks have exhibited significant scale economies. While the smallest banks can benefit significantly from growth, the advantages of growth become progressively smaller until they are exhausted. For most midsized community banks, the increase in returns relative to size is modest; these banks would need large increases in size to realize significantly higher returns. The relationship between size and profitability remains unchanged between the pre-crisis and post-crisis expansions. In other words, we find the post-crisis economic and regulatory environment has not disproportionately affected the size-profitability relationship for small community banks.

An important caveat is that our results are not causal: higher returns are associated with larger banks, but increases in size do not necessarily *cause* increases in returns. Indeed, banks with higher returns may simply be better positioned to grow.

Regardless, our analysis suggests the competitive disadvantage of community banks in the post-crisis period may be overstated. The decline in profitability during the post-crisis recovery cannot be attributed to size or any change in the size-profitability relationship. Rather, changes in economic and competitive conditions lowered post-crisis profitability without affecting its sensitivity to size. In particular, our analysis shows that factors other than size, such as large differences in banking market unemployment rates between the pre-crisis and post-crisis expansions, can account for the lower profitability of community banks in the post-crisis recovery.

Finally, our results show that favorable market outcomes and changes in other bank-specific characteristics also increase returns. In achieving higher profitability, small changes in bank-specific and market-specific factors are equivalent to large changes in size. Therefore, banks need not grow larger to be successful: business strategies and local economic growth are no less important in determining bank profitability than size.

Appendix

Data Description and Variable Definitions

The primary data sources are the FDIC's Summary of Deposits (SOD) and the FFIEC Call Report (031/041). The SOD data are as of second quarter (the FDIC conducts the survey annually at the end of the second quarter), while the Call Report data are as of fourth quarter to match annual bank profitability to the annual macroeconomic data available for the geographic regions. The regression data are an unbalanced panel of annual observations from 2001 to 2014. The sample excludes banks with real assets of $100 billion or more, de novo banks (defined as banks less than five years of age), and other nontraditional banks, such as credit card banks and banks that do not take deposits or make loans.

The variables are divided into six different categories and are defined as follows:

Dependent variable

ROAA: Annual net income divided by average total assets over the year. For S-Corp banks net income is adjusted to account for differences in tax treatment.

Bank-specific variables

Size: Natural logarithm of real assets measured in 2014 dollars.

Size-squared: Square of the natural logarithm of real assets measured in 2014 dollars.

Age: Number of years that the bank has been operating.

Risk: Volatility of bank earnings measured by the standard deviation of quarterly ROAA for prior three years.

The following variables are ratios and do not require any inflation adjustment. In the regression analysis, lagged values of the variables are used.

Loan to asset ratio: Total loans divided by total assets

Security to asset ratio: Total securities divided by total assets.

Core deposit to deposit ratio: Sum of transactions accounts, money market deposit accounts, time deposits of less than $100,000, and other non-transaction savings deposits divided by total deposits.

Competition variable

HHI: Sum of squared bank deposit shares in a market. For multimarket banks, HHI is weighted by the relative size of the population.

Market variables

Population: Natural logarithm of annual market population from the Census Bureau. For multimarket banks, population is the sum of the population in every market area in which the bank has a branch. (Source: Census Bureau)

Unemployment Rate: Annual market unemployment rate from the Bureau of Labor Statistics. For multimarket banks, unemployment rate is weighted by the relative size of the labor force.

Macroeconomic variable

Real GDP Growth: Annual growth rate of real GDP from the Bureau of Economic Analysis.

Binary variables

S-Corp bank: Bank that has elected to be taxed under subchapter S of the tax code.

Single-market bank: Bank that has at least 99 percent of its deposits in a single market.

Rural bank: Bank that has at least 90 percent of its deposits in counties located outside of metropolitan or micropolitan statistical areas.

Table A-1

Regression Results

Variables	Size-profitability model	Post-crisis break model
Size	2.915*** 0.616	2.064*** 0.678
Size^2	−0.071*** 0.016	−0.048*** 0.018
Loan to asset ratio (one-year lag)	1.112*** 0.284	1.105*** 0.285
Security to asset ratio (one-year lag)	1.199*** 0.218	1.168*** 0.218
Core deposit to deposit ratio (one-year lag)	0.498*** 0.163	0.496*** 0.162
Single-market bank	0.118*** 0.031	0.118*** 0.031
Age	−0.401*** 0.079	−0.408*** 0.078
Risk	−0.094*** 0.023	−0.093*** 0.023
Subchapter S bank	0.066*** 0.023	0.056** 0.023
Rural bank	−0.026 0.040	−0.016 0.040
Population level	−0.052*** 0.013	−0.052*** 0.013
Unemployment rate	−0.121*** 0.005	−0.121*** 0.005
HHI	0.269 0.169	0.264 0.169
Real GDP growth rate	0.050*** 0.004	0.049*** 0.004
Size × crisis binary variable		0.862*** 0.248
Size^2 × crisis binary variable		−0.026*** 0.006
Size × post-crisis expansion binary variable		0.203 0.206
Size^2 × post-crisis expansion binary variable		−0.006 0.005
Crisis binary variable	−0.206*** 0.016	−7.255*** 2.407
Post-crisis expansion binary variable	−0.026 0.018	−1.707 2.001
Constant	−27.590*** 5.979	−19.960*** 6.510

Table A-1 Continued

Observations	86,706	86,706
Number of banks	8,315	8,315
Adjusted R^2	0.085	0.089
F-statistic	179.73	151.13

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.
Notes: The dependent variable is the annual return on average assets for U.S. commercial banks during 2001–14. All regressions include bank- and year-fixed effects. Standard errors are clustered by bank.

Table A-2

Summary Statistics of Regression Variables

	Sample		Pre-crisis expansion		Crisis		Post-crisis expansion	
Variable	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Adjusted ROAA	0.78	1.38	1.04	1.31	0.47	1.58	0.61	1.25
Real assets (millions)	589	3,300	608	3,730	570	3,020	573	2,790
Loan to asset ratio	0.63	0.16	0.63	0.16	0.66	0.16	0.60	0.16
Security to asset ratio	0.23	0.15	0.24	0.15	0.21	0.14	0.23	0.16
Core deposit ratio	0.83	0.10	0.84	0.10	0.81	0.10	0.82	0.11
Single-market bank	0.61	0.49	0.65	0.48	0.59	0.49	0.56	0.50
Age	73	40	72	38	73	40	75	42
Risk	0.62	1.10	0.49	0.95	0.57	1.19	0.85	1.20
Subchapter S bank	0.33	0.47	0.28	0.45	0.37	0.48	0.38	0.49
Rural bank	0.23	0.42	0.25	0.43	0.23	0.42	0.21	0.41
Population (thousands)	1,998	4,744	1,790	4,164	2,016	4,607	2,279	5,521
Unemployment rate	6.01	2.20	5.10	1.36	6.07	2.45	7.26	2.36
HHI	0.18	0.12	0.18	0.12	0.18	0.12	0.19	0.12
Real GDP growth rate	1.76	1.59	2.56	0.94	-0.39	1.86	2.05	0.43
Number of banks	8,315		7,451		6,510		6,326	

Endnotes

[1]S-Corp banks are able to pass their federal corporate income tax obligations through to their shareholders. The profitability measure used in this analysis is the ROAA adjusted for tax effects of S-Corp status and tax-advantaged investments.

[2]We also conduct the statistical analysis on a sample of banks with assets less than $50 billion, but the results are not materially different.

[3]The sample is affected by survivorship bias, as banks that fail during the period drop out of the sample. This tends to bias the results toward higher returns post-crisis because poorly performing banks are no longer in the sample.

[4]The distribution of bank assets are positively skewed (long right tail). A logarithmic transformation gives us a symmetric distribution more suitable for regression analysis.

[5]We define banks holding at least 99 percent of their deposits in a single market area as single-market banks. We define banks that do not meet this criterion as multimarket banks.

[6]The size-profitability relationship could be better described by a higher degree polynomial in size. To test this hypothesis, we include size-cubed as an explanatory variable. However, its estimated coefficient is not statistically significant.

[7]The F-test of the estimated coefficient on size plus twice the estimated coefficient on size-squared is statistically significantly different from zero. We apply this F-test throughout the analysis to test whether size has a significant influence on returns in any period.

[8]IBBEA permitted banks and BHCs to expand across state lines. However, individual states were granted powers to restrict entry by out-of-state banks using different means, such as restricting de novo interstate branching (Strahan and Rice). States took advantage of these powers and in some cases have progressively deregulated entry and competition in banking even in recent years.

[9]We also estimate a fully interacted model in which all variables in the size-profitability model are interacted with the crisis and post-crisis binary variables. The fully interacted model yields the same result: the size-profitability relationship is not significantly different in the pre-crisis and post-crisis periods.

[10]The large difference in sizes at which conditional returns are maximized under the size-profitability model and the PCB model can be attributed to the effect of the crisis. If we estimate the size-profitability model for a subsample that includes only the pre-crisis and post-crisis periods, conditional returns are maximized at a bank size of $1.9 billion.

[11]An F-test rejects the null hypothesis that the interaction terms are all zero. The F-statistic gives a p-value equal to zero, so we can reject the null hypothesis at the 1 percent level.

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