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ABSTRACT

We investigate whether the value of large banks, defined as banks with assets in excess of the Dodd-Frank threshold for enhanced supervision, increases with the size of their assets using Tobin's q and market-to-book as our valuation measures. Many argue that large banks receive subsidies from the regulatory safety net, so they should be worth more and their valuation should increase with size. Instead, using a variety of approaches, we find (1) no evidence that large banks are valued more highly, (2) strong cross-sectional evidence that the valuation of large banks falls with size, and (3) strong evidence of a within-bank negative relation between valuation and size for large banks from 1987 to 2006 but not when the post-Dodd-Frank period is included in the sample. The negative relation between bank value and bank size for large banks cannot be systematically explained by differences in ROA or ROE, equity volatility, tail risk, distress risk, and equity discount rates. However, we find that banks with more trading assets are worth less. A 1% increase in trading assets is associated with a Tobin's q lower by 0.2% in regressions with year and bank fixed effects. This relation between bank value and trading assets helps explain the cross-sectional negative relation between large bank valuation and size. Our results hold when we use instrumental variables for bank size.

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There is a widely-held view that banks gain from becoming bigger and that this gain comes from having access to a stronger regulatory safety net. As one study puts it, "Subsidies arising from size and complexity create incentives for banks to become even larger and more complex."[1] A number of studies reach the same conclusion as a recent study from the Federal Reserve Bank of New York, namely that the "evidence is consistent with the idea that 'too-big-to-fail' status gives the largest banks a competitive edge."[2] A study from the Federal Reserve Bank of Philadelphia even argues that it is worth it for banks to pay to become large enough to get a "too-big-to-fail" (TBTF) subsidy (Brewer and Jagtiani (2013)). The IMF reaches the conclusion in 2014 that "Banks may also seek to grow faster and larger than justified by economies of scale and scope to reap the benefits of the implicit funding subsidy granted to TBTF institutions."[3]

With this view, large banks should be valued more because they have an asset that other banks do not have, namely a claim on public resources, and the value of this asset grows as these banks become larger. For instance, Kane (2014) states that "Other things equal (including the threat of closure), a TBTF firm's price-to-book ratio increases with firm size." This popular view ignores the possibility that large banks may bear larger costs than other banks because they are TBTF. For example, these costs may be in the form of greater regulatory scrutiny, political risk, or regulatory requirements that force them to pursue suboptimal policies. With these potential higher costs, the issue of whether TBTF banks are valued more highly is an empirical matter.

In this paper, we examine whether the valuation of large banks increases with size. We call banks large when the book value of their total assets exceeds $50 billion in 2010 constant dollars (the threshold for enhanced supervision of Dodd-Frank).[4] We use the consolidated bank holding company data available from the FRY-9C report since 1986. Our main valuation measure is a proxy for Tobin's q, namely the market value of assets divided by the book value of assets, where the market value is estimated by the book value of assets minus the book value of equity plus the market value of equity. We also show results using the

[1] Ueda and Weder di Mauro (2013).
[2] Santos (2014).
[3] IMF (2014).
[4] We use the Consumer Price Index (CPI, base year 2010) as the deflator.

ratio of the market value of equity to the book value of equity. We find no evidence that large banks are valued more highly or that their valuations increase with size. We pay special attention to the sample period ending before the crisis since so many observers have argued that TBTF was an important contributing factor to the crisis.[5] We find that the valuations of large banks are negatively related to their size from 1987 to 2006. The negative relation remains significant if we extend our sample to 2010, but when we add the post-Dodd-Frank years in the sample, the relation becomes weaker in the cross-section and does not hold within banks.

We use a piecewise linear model that relates bank Tobin's q to bank size and allows the relation to differ for banks with total assets above the $50 billion threshold. Estimating this model from 1987 to 2006 and accounting for year fixed effects, we find that the Tobin's q of large banks falls with asset size in such a way that a bank that increases its asset size from the Dodd-Frank threshold to the mean of the assets of the banks exceeding the threshold in 2010, $453 billion, reduces its q by 2.8% of the mean q or by 47.5% of the standard deviation of q for large banks. We also explore the relation between bank asset size and Tobin's q using a non-parametric approach that allows us to extract the form of the relation between Tobin's q and size from the data. We find that Tobin's q is lower for large banks than for small banks and decreases with asset size when a bank exceeds the Dodd-Frank threshold. When we account for bank characteristics, we find that large banks are valued less than small banks in addition to finding that the value of large banks falls with size. Similar results hold when we use market-to-book as our valuation measure. These results are robust to alternative estimation methods, including approaches where we instrument for bank size with employment and lagged assets.

In addition to the argument that the safety net gives banks incentives to become large, it is often argued that it gives them incentives to become riskier. We investigate whether bank risk increases with bank size. We find that both equity volatility and tail risk increase with bank size for small but not for large banks. As a result, large banks do not, on average, have higher equity volatility and tail risk than small banks. Using a bank z-score as a proxy for a bank's probability of distress, we find that distress risk increases with bank

[5] See, for instance, "Lessons from the crisis: Ending too big to fail," by Neel Kashkari, Brookings Institution, February 16, 2016.

size for small banks but decreases for large banks. Yet, in contrast to these results, we find that leverage is unrelated to size for small banks but increases with bank size for large banks. Further, the systematic risk of banks, as measured by a market model beta, increases with bank size for small banks as well as for large banks.

In general, one would expect that if two banks are identical except that one has higher leverage, the bank with higher leverage has higher stock return volatility and distress risk. The fact that tail risk and equity volatility do not increase with size for large banks and that distress risk decreases with size for large banks is consistent with a negative relation between asset risk and bank size for these banks. However, since tail risk and equity volatility are estimated from stock returns, these estimates could be low because adverse shocks are dampened for large banks because of TBTF. This explanation does not hold for the distress risk results since the z-score uses the volatility of earnings, which would not be dampened unless bailout payments were made to banks, and is negatively related to size over the 1987-2006 period, which does not include the various programs used to strengthen banks during the crisis.

Our results relating Tobin's q and market-to-book to bank size are inconsistent with the hypothesis that large banks are valued like other banks except for a premium resulting from their enhanced access to the safety net because of TBTF. We explore next why the value of large banks falls with size. A simple potential explanation is that the performance of these banks is negatively related to size. This explanation does not have support in the data when performance is measured by return on assets (ROA) or return on equity (ROE) in regressions with year fixed effects. In regressions with year and bank fixed effects, ROE falls with bank size for large banks, which helps explain the negative relation between valuation and bank size for large banks in regressions with year and bank fixed effects, but not otherwise. Tobin's q should be lower for large banks if their cash flows are expected to grow less than those of small banks. There is no evidence that ROA or ROE growth falls with bank size for large banks.

In valuation formulas, cash flows are discounted at the firm's cost of capital. Hence, if the cost of capital were higher for large banks than for small banks, large banks would have a lower Tobin's q. Such a result would be surprising in light of the work of Gandhi and Lustig (2015) who find that the largest banks have a lower cost of equity over the period from 1970 to 2013. To address this issue, we examine whether large banks have different stock returns from small banks. We proceed first by simply comparing stock returns. There is no evidence that stock returns differ between small and large banks from 1987 to 2015 in the cross-section. We then turn to returns adjusted for risk. Over our sample period, large banks do not have significantly different risk-adjusted returns from small banks. Using either the Fama and French (1993) three-factor model or the Gandhi and Lustig (2015) five-factor model, we find that neither large nor small banks have a significant intercept. In other words, there is no evidence during our sample period that banks have a cost of equity that differs from the expected return of equity predicted by these models. A portfolio strategy of going long small banks and short large banks earns 22 basis points per month, but that excess return is not significant. Note that if we had a longer sample period, like Gandhi and Lustig (2015), the excess return could be significant as our test would have more power and its magnitude would be consistent with their work. However, if large banks have lower expected stock returns, their cash flows would be valued more, not less, which would make the lower valuation of large banks harder to explain. For instance, Kane (2014) argues that a benefit of TBTF is "the increase in [the bank's] stock price that comes from having investors discount all of the firm's current and future cash flows at an artificially low risk-adjusted cost of equity."

Large banks engage in different activities from smaller banks. In particular, non-interest income increases with asset size. We explore whether these differences in activities can help us understand why large banks are worth less than small banks. We find that taking into account non-interest income increases the negative relation between bank Tobin's q and size for large banks. Specifically, activities associated with non-interest income appear to enhance bank value, but not as much for large banks.

The most important balance sheet difference between large and small banks is that large banks typically have a sizeable portfolio of trading assets. We show that bank value is negatively related to trading assets and that the relation is economically significant. In some regression specifications, the relation between Tobin's q and size for large banks loses significance when trading assets are taken into account, even when trading assets and size are orthogonalized. Importantly, trading assets help explain the relation between Tobin's q and bank size before the global financial crisis (GFC) and hence this relation is not the product of the crisis. However, the ability of trading assets to explain the relation between Tobin's q and size for large banks is sensitive to regression specification.

Following the GFC, regulations for banks changed substantially, mostly because of Basel III and Dodd-Frank. We investigate whether the relation between bank valuation and size changes after the adoption of Dodd-Frank. Using the period of 2011-2015, we do not find that the relation between bank Tobin's q and size is significantly different during that period. However, we show that Tobin's q is related to some bank characteristics differently during that period. Specifically, more capitalized banks are valued less and the market appears to discount non-interest income relative to 1987-2010.

There are almost no papers investigating the relation between bank valuation and bank size. Boyd and Runkle (1993) pursue such an investigation. They use Compustat from 1971 to 1990 and regress Tobin's q on the log of bank assets, finding no significant relation between these variables. However, most of their sample period predates the TBTF statement of the Comptroller in 1984 that is often considered the date that the TBTF policy was formally stated (O'Hara and Shaw, 1990). When they estimate the relation for the 1981-1990 period they actually find a significant negative coefficient of -0.0028 in a panel regression. Demirgüç-Kunt and Huizinga (2013) use an international sample of banks from 1991–2008 and find that market-to-book is negatively related to bank absolute size (assets) and systemic size (liabilities-to-GDP); the latter result is stronger in countries with large government deficits. Recent papers use Tobin's q as a valuation measure, but their focus is not on the relation between Tobin's q and size. For instance, Huizinga and Laeven (2012) examine how Tobin's q relates to the composition of assets of large banks. They do not include total assets as an explanatory variable in their regressions. Calomiris and Nissim (2014) explore how the relation of market-to-book to bank characteristics changed after the crisis in the context of a valuation model of banks that accounts for intangibles. They include the log of total assets in their regressions, but their sample is very different from ours as it is dominated by bank holding companies whose asset size is below the threshold to enter our sample and they are not focused on the relation between size and bank value. In their paper, for banks with assets in excess of $2 billion, there is no significant relation between market-to-book and the log of assets for subsamples starting in 2007.

In contrast to the paucity of studies on the relation between bank value and bank size, there is a large literature investigating whether bank costs are related to bank size. This literature does not rely on the valuation of banks in public markets and, therefore, can examine bank holding companies that are not listed on exchanges. Recent work in that literature, which studies banks shortly before the GFC, finds results that are supportive of the existence of economies of scale. For instance, Wheelock and Wilson (2012) find that "as recently as 2006, most U.S. banks faced increasing returns to scale." In their study, even the largest banks benefit from economies of scale. Hughes and Mester (2013) find important economies of scale for banks of all sizes and conclude that the economies of scale they find for banks with assets in excess of $100 billion, which they use as a TBTF threshold, cannot be explained by possible TBTF subsidies. Kovner, Vickery, and Zhou (2014) find "a robust inverse relationship between the size of bank holding companies and scaled measures of operating costs."

A number of studies examine whether firms gain from being TBTF and some attempt to quantify these gains. Krozner (2016) reviews the literature that evaluates the argument that the cost of funding is less for large banks because of TBTF. Generally, this literature finds that the impact of TBTF on the cost of funding varies across time. Instead of looking at the cost of debt, another literature looks at the cost of equity. Gandhi and Lustig (2015) find evidence that equity of TBTF banks is less risky and as a result the return on equity of these banks should be lower. Event studies conclude that the Comptroller of the Currency's announcement that some banks are TBTF led to increases in the stock price of these banks (O'Hara and Shaw, 1990) and that banks are willing to pay a higher premium to make acquisitions that lead them to exceed the TBTF threshold (Brewer and Jagtiani, 2013).

Other studies examine the impact of bank size and activities on risk. For instance, Demirgüç-Kunt and Huizinga (2010) use an international sample of banks to examine the implications of bank activity and short-term funding strategies on bank risk. They document that expansion into non-interest income-generating activities as well as reliance on non-deposit funding (activities typically associated with large banks) increase risk. Further, Laeven, Ratnovski, and Tong (2014) examine the relation between bank size and risk during the financial crisis. They find that systemic risk increases with bank size and is inversely related to bank capital.

The paper proceeds as follows. We describe our sample in Section 1. In Section 2, we show that large banks are valued less than small banks and that their valuation falls with size, especially during the sample period ending before the crisis. In Section 3, we investigate whether this lower valuation results from higher risk, lower performance, or different balance sheet composition. In Section 4, we investigate whether the valuation and risks of large banks relative to small banks are affected by Dodd-Frank. In Section 5, we explore alternative estimation approaches using instrumental variables. We conclude in Section 6.

Section 1. The sample.

Our initial sample consists of all large publicly traded bank holding companies (banks) filing the Consolidated Financial Statements for Bank Holding Companies Report (FRY-9C). All banks with consolidated assets exceeding $500 million are required to file the FRY-9C report.[6] We collect financial information from FRY9-C reports for the fourth quarter of each year from the Federal Reserve Bank of Chicago's website for the period from 1986 to 2015. We start in 1986 because that is the first year when the data we use is available.[7] We then merge the sample with CRSP/COMPUSTAT using the link obtained from the Federal Reserve Bank of New York to get stock price data.[8] We drop banks with missing data on total assets and restrict our sample to banks with assets greater than $10 billion in 2010 dollars and those with a deposits-to-assets ratio as of the prior year-end of at least 10%. The $10 billion threshold insures that we are considering banks that are economically significant and engage in activities comparable to those of large banks at least to some extent. The requirement that deposits represent at least 10% of assets is to insure that we are considering deposit-taking banks. Our final sample consists of 171 banks and 1,758 firm-

[6] Prior to March 2006, the threshold for filing the FRY-9C report was $150 million.

[7] Although we collect data starting from the fourth quarter of 1986, our sample period starts in 1987 because we classify banks by size based on their prior year-end assets.

[8] The FRB New York link file covers the period January 1990- September 2013. We match RSSID numbers from the regulatory database with PERMCOs by name for the missing periods. The linkage table can be found at: https://www.newyorkfed.org/research/banking_research/datasets.html.

year observations over the period 1987-2015. The banks in our sample account for 83% of total banking system assets as of 2015.[9]

Table 1 shows descriptive statistics by year for our final sample of banks. The number of banks in our sample varies by year and increases from 64 at the start of the sample period to 68 as of 2015, reaching a peak of 74 in 1989. While the average size of the banks increases steadily from $49.9 billion as of 1987 to $180.3 billion as of 2015, the median size of banks decreases slightly to $26.4 billion from $27.3 billion during the same period. The percent of banks with assets greater than $50 billion in 2010 dollars (reported in the last column) varies by sample year. In the early part of the sample, about 30% of banks exceed this threshold, while about 40% do so during the period from 2005 to 2011 before declining to about 35% during the last four years of the sample.

We measure bank value using a proxy for Tobin's q − the book value of assets minus the book value of equity plus the market value of equity, scaled by the book value of assets. In robustness tests, we use the market-to-book ratio (market value of equity divided by the book value of equity) as an additional measure. We also use several measures of profitability and risk to assess banks' performance during our sample period. In particular, we use two accounting-based measures of profitability: ROA − net income plus interest expense divided by average assets over the prior year, and ROE − net income divided by average equity over the prior year. As an additional measure of performance we use annual buy and hold stock returns. We use four measures of risk: 1) z-score (log) − (ROA + equity-to-assets), scaled by the standard deviation of ROA;[10] 2) tail risk − the negative of the average return on a bank's stock over the 5% worst return days in the year, following Ellul and Yerramilli (2013), and 3) equity volatility − the annualized standard deviation of daily stock returns. A detailed description of all variables used in the study is available in Appendix A.

[9] Total banking system assets represents the total assets of the 6,182 FDIC-insured commercial banks and savings institutions in the US as of December 2015 (FDIC Quarterly banking profile).

[10] The standard deviation of ROA is estimated using quarterly data using a three-year rolling window.

Table 2 shows descriptive statistics of the main variables used in our analyses for the whole sample, for small banks, and for large banks. Importantly, these descriptive statistics do not account for changes in the composition of the sample. The statistics reported in Table 2 are obtained by averaging the variables each year and then taking the average across years. We show first the results for our two valuation measures. It is noteworthy that average Tobin's q during our sample period is higher than the average Tobin's q of Boyd and Runkle (1993). They report the average Tobin's q for banks holding companies from 1971 to 1990 to be 1.002. In our sample, the average Tobin's q for banks with assets in excess of $10 billion is 1.06. We see from Table 2 that, though large banks are valued less on average than small banks, the difference between the averages is not statistically significant. Obviously, looking at the sample as a whole, this comparison provides no support for the view that large banks are worth more than small banks.

Our next two measures are tail risk and equity volatility. Though these measures are slightly larger for large banks than for small banks, they are not significantly so. Next, we see that bank stocks earn 13.6% per year during our sample period. The difference in returns between large and small banks is insignificant. We find no significant differences in return on assets and return on equity. However, small banks have a higher z-score than large banks, which means that they are farther away from the distress threshold. The difference is economically small. As expected, large banks have significantly higher non-interest income and fewer deposits than smaller banks. They also have more trading assets relative to assets.

Section 2. Bank valuation and bank size.

It has been widely noticed that valuations of banks since the crisis have been much lower (e.g., Calomiris and Nissim (2014) and Sarin and Summers (2016)). Figure 1A shows the yearly average Tobin's q for large banks and for small banks. Recent averages for Tobin's q are low compared to the ten years before the GFC, but not compared to averages of Tobin's q at the beginning of our sample. The figure shows that the Tobin's q of banks increases sharply from 1994 to 1997 and then falls steadily first and abruptly during the crisis. Importantly, the figure shows that this pattern holds equally for large and small banks, so that common factors appear to be driving the valuation of banks during our sample period. The difference in means between large banks and small banks is typically negative and never exceeds 3.5% of the average Tobin's q of banks in absolute value. The highest valuation of large banks relative to small banks is in 2000, when the difference is 3.4% of the average Tobin's q of banks. The lowest valuation of large banks relative to small banks is in 1997, when the average Tobin's q of the large banks is lower than the average q of the small banks by 3.5% of the average Tobin's q of banks. The large banks are always valued less than the small banks except for three periods. First, large banks are valued more from 1999 to 2002. Large banks are again valued more highly from 2011 to the end of the sample. Finally, large banks are valued more in 2006.

We show the results for medians in Figure 1B. The results for medians are similar to those for the means except that the median Tobin's q of large banks is never larger than the median q of small banks in the last five sample years, while it is when we use means. The largest median difference is in 2008, when the large bank median is lower than the small bank median by 3.9% of the sample median.

To assess more precisely how Tobin's q is related to size, we report regression estimates in Section 2.1. In Section 2.2., we show results using a non-parametric approach. In Section 2.3., we estimate regressions using market-to-book instead.

Section 2.1. Tobin's q and bank size regressions.

To assess the relation between a bank's Tobin's q and its size, we would like to be able to compare two banks that are exactly the same except that one is larger than the other. Unfortunately, such comparisons are not possible. Banks that differ in size tend to differ in other dimensions as well. Typically, a large bank has different activities than a small bank. For instance, a large bank is more likely to be a global bank and is more likely to be a bank with substantial trading activities. The differences in activities related to bank size raise the concern that large banks might be valued differently not because they are larger but because they have different activities. To address this issue, we estimate regressions with and without controlling for a bank's activities.

The next issue we have to address is how to parametrize bank size. We use book total assets as our measure of bank size. We have three different ways to relate Tobin's q to bank size. The first approach is our main focus and is based on a piecewise linear formula, where we allow for the relation between bank size and Tobin's q to be linear with different slopes depending on whether the respective bank crossed the $50 billion TBTF constant dollars threshold. The second approach ignores the distinction between the large and small banks and simply uses the logarithm of assets. The third approach is non-parametric and allows the data to dictate the relation between q and bank size.

In this section, we estimate first the relation between bank size and Tobin's q for the pre-crisis period (1987 to 2006) and for the whole sample period. In Table 3, Panel A uses the piecewise linear approach and Panel B uses the logarithm of bank size instead. In each Panel, we have two sets of four regressions, one set for the pre-crisis period and one set for the whole sample period. The first two regressions in each panel have no variables describing bank characteristics. We use three different estimation approaches. First, we use what amounts to a cross-sectional approach, in that the only fixed effects included are year fixed effects, so that we effectively eliminate common business cycle effects across all banks. Second, we also add bank fixed effects, so that we estimate the relation between Tobin's q and bank size within banks. We also implement a third approach (untabulated) in which we use both state fixed effects and year fixed effects. This approach removes both common business cycle effects and effects due to the geographical location of banks. The results from that approach support our conclusions. In all regressions, we cluster standard errors by bank.[11]

Regression (1) captures the cross-section relation between Tobin's q and size. In regression (1) of Panel A, we see that the slope of size for assets between $10 and $50 billion is insignificant, while the slope of size for assets greater than $50 billion is significant and negative. In other words, valuations fall with size above $50 billion, but not below $50 billion. The slope coefficient on assets in excess of $50 billion is -

[11] Including year fixed effects and clustering standard errors by firm is a common approach used to address two sources of correlation when panel data have more firms than years (Petersen, 2009). Clustering by both firm and year yields similar results.

0.0742. The average Tobin's q for large banks in the sample is 1.058. Consequently, an increase in size from $50 billion to $453 billion, the average size of large banks in 2010, reduces Tobin's q by 2.8% or by 47.5% of the standard deviation of the q of large banks in the sample. Regression (2) includes bank fixed effects as well as year fixed effects. Now, the slope for assets between $10 and $50 billion is negative and significant, as it is -1.380. The interpretation is that an increase in assets of $10 billion reduces Tobin's q by 0.014. The slope for assets greater than $50 billion is negative and significant as well. The estimate is slightly larger in absolute value than in regression (1) as it is -0.0993. When we use state and year fixed effects, the results are similar to the regression that uses only year fixed effects.

The next two regressions take into account two bank characteristics that differ between small and large banks: non-interest income and equity-to-assets. As before, we use different estimation approaches. In regression (3), we see that the coefficient on assets below $50 billion is negative and significant, so that Tobin's q falls as assets increase between $10 and $50 billion. The coefficient on assets above $50 billion is significant as well and is similar to the same coefficient in regression (1). The coefficient on non-interest income is positive and significant, so that banks that have more non-interest income have a higher Tobin's q. As a result of this correlation, the relation between Tobin's q and size is steeper. The equity-to-assets ratio is positively related to Tobin's q. When we turn to regression (4), which is the same as regression (3) but with the addition of bank fixed effects, we see that the coefficients on the size variables are similar to those of regression (2), so that adding the bank characteristics does not impact the size coefficients in the model with bank fixed effects. Neither non-interest income nor equity to assets is significant in the regression with bank fixed effects.

We now turn to regressions that use the whole sample period. These regressions include the crisis period as well as the post-crisis period. Regressions (5) and (6) are estimates of regressions (1) and (2) for the whole sample period. In regression (5), the Tobin's q of large banks falls with asset size as in regression (1). The estimate of the coefficient is smaller by 2/3rds in absolute value, so that the value of large banks appears to be negatively related to size for the whole sample period but less strongly than before the crisis. With bank fixed effects, the value of small banks falls with size as in regression (2). Now, however, the value of large banks no longer falls with size. Regressions (7) and (8) control for non-interest income and leverage. With these controls, the value of small banks falls with size. The value of large banks falls with size in regression (7) but not in regression (8). It is important to note that with bank fixed effects, as a small bank increases in size, its value falls. Hence, if a bank starts small and becomes large, its value is lower when it is a large bank. However, if a bank starts large and becomes larger, its value does not fall over the whole sample period. This result is in contrast to the results for the cross-section where there is a negative relation between bank value and bank size through the whole sample period.

Though we do not tabulate the results, we also estimate our regressions using the period from 1987 to 2010. With that period, the value of large banks falls significantly with size in regressions similar to regressions (5) to (8). Consequently, the lack of significance of size for large banks in the regressions with bank fixed effects on the whole sample is due to the addition of the years following the adoption of Dodd-Frank.

Panel A of Table 3 shows that before the crisis the value of large banks falls with size irrespective of whether we control for bank characteristics. When we control for bank characteristics or when we control for bank fixed effects, the value of small banks falls with size as well. We now re-estimate these regressions in Panel B using the logarithm of assets instead of the piecewise linear model. For the pre-crisis period, the coefficient on the logarithm of bank size is significantly negative for all regressions. For the whole sample period, the coefficient on the logarithm of bank size is significantly negative for all regressions except in the regression with only year fixed effects.

In summary, the regressions of Table 3 consistently show that the value of large banks falls with size before the crisis. When we include the crisis and the post-crisis period in the sample, the evidence that the Tobin's q of large banks falls with size no longer holds when we use bank fixed effects. However, when we use bank fixed effects, it is clear that bank valuation falls with size for small banks, so that a bank's value falls as its size increases until it reaches the Dodd-Frank threshold and is unaffected by size beyond that threshold. Though we do not report the results in a table, we also repeat the regressions of Panel A using $100 billion as the size threshold as this threshold is used in the literature (Brewer and Jagtiani, 2013, and Hughes and Mester, 2013). Doing so does not change our conclusions. No regression has a positive significant coefficient on size for large banks, so that there is no evidence that bank value increases with size for large banks.

Section 2.2. Non-parametric results.

So far, the results shown depend on assumptions about the functional form of the relation between bank size and Tobin's q. We now provide some results about the relation between bank size and Tobin's q without such assumptions. First, we show scatterplots in Figure 2. We obtain these scatterplots by taking residuals of regressions of Tobin's q on year fixed effects. By doing so, we remove the comovement of Tobin's q across banks and can focus on differences in the cross-section. Panel A of Figure 2 shows the residuals of regressions of Tobin's q on year fixed effects plotted against asset size for the period from 1987-2006. We see that there is a large number of banks with positive residuals. However, all banks with assets in excess of $500 billion in constant dollars have negative residuals. This is striking in that the mean residual is zero by construction, so that all these banks are below the mean. In the range from $50 billion to $500 billion in constant dollars, we see that there are banks with positive residuals. However, it is quite clear that most banks over that range have negative residuals. There is no evidence here that supports the view that large banks have higher valuations. Panel B of Figure 2 shows the residuals of the regression of Tobin's q on year fixed effects plotted against asset size for the sample period ending in 2015. We still see that most residuals for large banks are negative.

The scatter plots of Figure 2 show that large banks typically have negative residuals, so that they are valued less than the average bank. We now use a univariate non-parametric regression to show the relation between Tobin's q and size after accounting for year fixed effects. The advantage of this approach is that it makes no assumptions about the parametric relation between Tobin's q and bank assets. The specific approach we use involves local polynomial smoothing. Figure 3 shows the results with a 95% confidence interval. Panel A of Figure 3 shows the local polynomial smoothing for the sample that ends in 2006. We see that the relation is not monotone, but it is clear that 1) large banks are valued less than small banks, and

(2) Tobin's q falls with bank size except for the banks in excess of $1 trillion in constant dollars. Note that there are very few observations for banks with more than $1 trillion in constant dollars. As a result, the confidence interval is quite large. However, the curve for banks in excess of $250 billion is always significantly lower than the curve for banks with assets below $50 billion. In the neighborhood of $50 billion, the relation between Tobin's q and asset size is relatively flat, but it then becomes negative.

Panel B shows the results from the nonparametric regression using the whole sample period. The smoothed curve has a similar shape than in Panel A, but there is a range of asset values between $1 trillion and $1.5 trillion where the confidence interval is large enough that we cannot conclude that the Tobin's q is significantly different from the Tobin's q for small banks. However, past $1.5 trillion, the curve slopes downward and it is again clear that large banks have lower valuations.

The bottom line from Figures 2 and 3 is that there is no evidence that large banks are systematically valued more than small banks. When we do not impose a parametric relation between bank size and Tobin's q, the relation is non-linear. Further, the relation is estimated imprecisely over some range of assets when we use the whole sample period. When we estimate the relation for the sample period ending in 2006, the relation is estimated more precisely and the Tobin's q of large banks along the smoothed curve is always lower than the Tobin's q of small banks.

Section 2.3. Results with market-to-book.

The results so far use Tobin's q as a valuation measure. We investigate whether the results are specific to that measure by estimating regressions similar to those of Table 3 for the market-to-book ratio, which is the ratio of the market value of equity to the book value of equity. These results are shown in Table 4. We find results that are similar to those we found for Tobin's q. In Panel A, we show first results with no controls except for year fixed effects. We see in regression (1) that the market-to-book ratio falls with bank size for large banks but not for small banks over the sample period ending in 2006. As in regression (2) of Table 3, we find that the valuation ratio falls with size both for small and large banks when we have both year and bank fixed effects. In regressions (5) and (6), we show the regression estimates for the whole sample. The results are similar except that the absolute value of the slopes for large banks are smaller. In regression (3), we repeat regression (1) but add controls for equity-to-assets and non-interest income. Now, the coefficients on bank size are significantly negative for both small and large banks. Similar results hold when we also use bank fixed effects in regression (4). Regressions (7) and (8) repeat the regressions for the whole sample period. Again, both size coefficients are significantly negative but smaller in absolute value.

Panel B of Table 4 estimates the relation between market-to-book and the logarithm of asset size. Without controls besides fixed effects, we see that the relation is significantly negative whether we use bank fixed effects or not for the sample period ending in 2006 and for the whole sample period. Adding controls for equity-to-assets and non-interest income does not change inferences about the sign of the coefficient on the logarithm of assets.

Section 3. Why are larger banks valued less?

In an efficient market, the value of a bank for capital providers should be the present value of the cash flows that accrue to capital providers. When capital providers are understood to include all providers of funds to a bank, including the depositors, this value is the numerator of Tobin's q. We would expect larger banks to be worth less than smaller banks if they are riskier than smaller banks. In this case, larger banks are more likely than smaller banks to incur costs of financial distress and their expected cash flows would be discounted at a higher rate. Larger banks also should be worth less than smaller banks if their accounting performance is worse than the accounting performance of smaller banks as they would have lower future expected cash flows. Finally, the market may discount some activities that larger banks engage in more than smaller banks. In this section, we explore these possible explanations for the lower valuation of larger banks.

Section 3.1. Are larger banks riskier than smaller banks?

With a higher probability of poor performance, a bank is more likely to experience some form of costly financial distress. It does not follow, however, that this greater financial distress necessarily reduces bank values because the present value of increased distress costs could be associated with higher cash flows in non-distress states of the world. However, keeping expected cash flows without distress costs constant, a greater probability of distress costs decreases bank value.

We investigate whether larger banks have a higher probability of distress costs than smaller banks by focusing on four variables. We are interested in variables that proxy for the risk of cash flows falling low enough that the bank would suffer from financial distress. Our measures are first the log of a bank z-score. The bank z-score used in the literature is ROA + equity-to-assets scaled by the standard deviation of ROA.[12] The second measure is a proxy for leverage, which is the ratio of book equity-to-assets. The third measure is tail risk, which we define as the negative of the average return on a bank's stock over the 5% worst return days in the year, following Ellul and Yerramilli (2013). Finally, we use an estimate of equity volatility – the annualized standard deviation of daily stock returns.

Table 5 estimates regressions that relate our risk variables to bank size. The regressions are the same as regressions (1) and (2) of Panel A of Table 3, except that the dependent variables are different. Panel A of Table 5 shows estimates of regressions where we use the piecewise linear model for the sample ending in 2006. Regression (1) uses the z-score as the dependent variable for the sample ending in 2006 and has only year fixed effects. We see that the z-score falls with bank size for small banks but then increases for large banks. In other words, as large bank size increases, the probability of distress falls. When we also use bank fixed effects in regression (2), we find that neither size coefficient is significant. The second measure that uses accounting information is the leverage measure. We show estimates in regressions (3) and (4). In regression (3), equity-to-assets falls in large banks as their size increases, so that large banks have more leverage. When we include bank fixed effects, no coefficient is significant.

We turn next to the two measures of total risk that use stock returns. The first measure is the measure of tail risk. Tail risk increases with bank size for small banks. For large banks, tail risk decreases significantly with bank size in regression (6) which uses bank fixed effects. In regression (5), which has

[12] The standard deviation of ROA is estimated using quarterly data using a three-year rolling window.

only year fixed effects, the coefficient for large banks is negative but the t-statistic is only 1.57 in absolute value. When we turn to equity volatility in regressions (7) and (8), the results are similar.

Though we do not show the results in the table, we also estimate the regressions using the logarithm of size as our size measure. Perhaps not surprisingly since risk increases with size for small banks, we find that all risk measures increase with the logarithm of assets when we have only year fixed effects. In the regressions with bank fixed effects, the coefficient on the logarithm of assets is never significant.

In Panel B of Table 5, we show estimates of the regressions of Panel A when we use the whole sample period. In regressions (1) and (2), we see that the z-score falls with bank size for small banks, but then increases for large banks. In regression (3), which includes year fixed effects, equity-to-assets falls with bank size for large banks over the whole sample period. In regression (4), which includes bank fixed effects, equity-to-assets has no significant coefficient. Turning to the measures that use stock returns, none of the coefficients for large banks are significant. All coefficients for small banks are positive and significant. Using the whole sample, it follows that tail risk and volatility increase with bank size, but not after the bank has reached the threshold of $50 billion in constant dollars.

Using our piecewise linear model for size, we find that leverage increases with size for large banks in the cross-section, but all other risk metrics fall with size for large banks before 2006. There is no inconsistency between these results as long as the risk of assets and cash flows of large banks falls with size. In any case, these results are inconsistent with the hypothesis that valuation falls with size because larger banks are more likely to suffer firm-specific distress events.

Section 3.2. Do larger banks perform worse than smaller banks?

If the income of large banks falls with assets, we expect their valuation to fall with assets as well. In Table 6, we explore the relation between size and performance. We consider three performance measures: ROA, ROE, and common stock returns. In Panel A, we use the sample period that ends in 2006. Starting with ROA, we see in regression (1) that performance increases with size for small banks and is unrelated to size for large banks. There is no relation between our performance measures and bank size when we include bank fixed effects in regression (2). Turning to ROE, we find in regressions (3) and (4) that performance is unrelated to bank size when we use only year fixed effects, but it falls with size when we use both year fixed effects and bank fixed effects. Finally, when we consider stock returns, they are unrelated to size when we use only year fixed effects (regression (5)) but are negatively related to size with both year and bank fixed effects (regression (6)).

Panel B of Table 6 shows estimates for the whole sample period. Regressions (1) and (2) lead to similar inferences as regression (1) of Panel A. When we turn to ROE, we find no significant coefficient in the regression with only year fixed effects. ROE falls with size for small banks but not large banks in regression (4) where we use both year and bank fixed effects. Finally, inferences about the relation between returns and size for the whole sample are the same as for the sample ending in 2006.

In unreported regressions, we find that, when we use the log of assets as our measure of size, ROA increases with size when we have only year fixed effects, while ROE and returns fall with size when we have both year and bank fixed effects. The other regressions have insignificant coefficients.

Note that in valuation models, keeping the discount rate constant, an increase in future cash flows increases Tobin's q and market-to-book. By using ROA and ROE, we are not taking into account expectations of future growth. We investigate, but do not tabulate, how growth rates of ROA, ROE and assets differ between small and large banks. To do so, we estimate regressions similar to the ones we use for ROA and ROE. The clearest result is that there is no relation between ROE growth and size irrespective of the sample period and of whether a bank is small or large. With respect to ROA growth, there is no significant relation for the 1987-2015 sample. For the 1987-2006 sample, the coefficient on size for small banks is significantly positive in the regression with only year fixed effects and the coefficient on size for large banks is significantly positive in the regression with bank and year fixed effects. Finally, with respect to growth in assets, the growth in assets falls with size for small banks in all regressions and increases with size for large banks in regressions with year fixed effects only. None of these results can help explain the negative relation between Tobin's q and bank size for large banks.

Using only year fixed effects, we have no reason to believe that the performance worsens with size for large banks using the sample that ends before the crisis. With year and bank fixed effects, the evidence is that the returns to equity holders are negatively related to bank size for the 1987-2006 sample but not for the 1987-2015 sample. This result helps us understand why the valuation of large banks falls with size for the 1987-2006 sample but not for the 1987-2015 sample when year and bank fixed effects are included. However, these results do not help us understand why the valuation of large banks falls with size in regressions with only year fixed effects in both samples.

Section 3.3. Do large banks have higher risk-adjusted stock returns than small banks?

If the risk-adjusted stock returns of large banks were higher than small banks, this would mean that the market would discount future expected cash flows at a higher rate for large banks than small banks. In this case, large banks would be valued less. This potential explanation for our results seems unlikely to hold because Gandhi and Lustig (2015) show that large banks have lower (not higher) risk-adjusted stock returns than other banks. However, it could be that in our sample the results are different. Table 7 shows results for the sample from July 1987 to December 2006 in the first three regressions and results for the whole sample period in the last three regressions.

In Table 7, we estimate the risk-adjusted returns of equally-weighted bank portfolios. We show results using the five-factor model of Gandhi and Lustig (2015). The factors are a market factor (Market), a size factor (SMB), a value-growth factor (HML), LTG (excess returns on an index of 10-year U.S. Treasury bonds), and CRD (excess returns on an index of investment grade corporate bonds). We see that the intercept of regression (1), which is the regression for large banks, is -0.0027 per month and is insignificant. We estimate the same regression for small banks, regression (2), and the intercept is insignificant as well. Regression (3) shows a regression on a portfolio which is long large banks and short small banks. The intercept is -0.0019 and is insignificant. These results are consistent with large banks having lower returns than small banks, but in these regressions the intercepts are not significant. Panel B shows estimates for the whole sample period. Since the Gandhi and Lustig (2015) factors are not available for 2015, we omit these factors. The results are similar except that the intercept for large banks is larger in absolute value and is closer to being significant as the t-statistic is -1.54. When we construct portfolios where the threshold for large banks is $250 billion so that we include only the very large banks, the inferences are similar.

It follows from this analysis that no case can be made that large banks are valued less because the market requires a higher risk-adjusted discount rate for these banks.

Section 3.4. Does the market discount the contribution to shareholder wealth of some bank activities?

Large banks engage in different activities in comparison to smaller banks. In Table 8 we explore whether these differences in activities can help us understand why large banks are worth less. Table 8 reports the results of regressions relating Tobin's q to balance sheet measures of bank activities: Trading assets as a fraction of total assets, real estate (RE) loans-to-total assets, commercial and industrial (CI) loans-to-assets as measures of lending activities, and securities as a fraction of total assets. Other variables include non-interest income, equity-to-assets, and an indicator variable (No trading assets) that is equal to one for banks with no trading assets, and zero otherwise. We show results using the piecewise formulation for size as well as the logarithm of assets.

Regressions (1) and (2) of Table 8 show estimates of the regressions for the sample period ending in 2006 using the piecewise linear function for size. In regression (1), which uses year fixed effects, neither coefficient for the size variables is significant. The coefficient that stands out is the coefficient of -0.42 for trading assets that is significant at the 1% level. This coefficient shows that Tobin's q is negatively correlated with trading assets, which is consistent with the existence of a valuation discount for these assets. Huizinga and Laeven (2012) use similar regressions to assess how the market valued assets on bank balance sheets during the GFC. It is important to note that the sample used here ends before the GFC, so that trading assets were associated with lower bank values at a time when markets were more liquid than during the GFC so that valuation of trading assets was not made more difficult by the lack of liquidity. The coefficients on trading assets are economically large. In our regressions, there is no correlation between Tobin's q and securities holdings for the period 1987-2006. Hence, if over that period a bank experiences a reduction of

1% of securities-to-assets and an increase of 1% of trading assets as a fraction of total assets, Tobin's q falls by approximately 0.2% using the coefficient estimates of the regression (2) which has both year and bank fixed effects.

In contrast to the regression with only year fixed effects, the regression with year and bank fixed effects has significantly negative coefficients on the size variables as well as the trading assets variable. When we turn to the whole sample in regressions (3) and (4), we find that the size coefficients for small banks are significant for both regressions but the coefficients for large banks are insignificant for both regressions. The coefficients on trading assets are negative and significant in both regressions as well. Regressions (5) to (8) are the same regressions as regressions (1) to (4) except that we use the logarithm of assets as our size variable. In these regressions, the coefficient on size is insignificant in Regression (5) with year fixed effects, and negative and significant in the remaining specifications (6)-(8).

The logarithm of bank size has a correlation of 0.56 with trading assets to assets. This is not surprising because large banks are more likely to have investment banking operations and such operations have large amounts of trading assets. The correlation creates a concern that the coefficients on size cannot be estimated precisely because of multicollinearity. This does not appear to be the case because the coefficients on trading assets are generally estimated precisely. We re-estimate the regression using the residual of trading assets on size instead of trading assets. When we do so, the Tobin's q of large banks is also not related to size for the sample period ending in 2006, but is negatively related to size for the sample period ending in 2015. If we estimate the regressions of Table 8 without trading assets, the Tobin's q of large banks is always negatively related to size.

We also estimate regressions similar to Regression (1) of Table 3 where we add an indicator variable for whether the bank is active in some activity. These activities are whether the bank is a derivative user, whether it has high market risk, high R&E loans, high C&I loans, high securities portfolio, and high compensation-to-assets.[13] The only case for the sample ending in 2006 where the coefficient on size for

[13] High market risk is an indicator variable equal to one if a bank's total trading activity (trading assets & liabilities) as of the prior year-end exceeds 10% of total assets. High R&E (C&I) loans is an indicator variable that is equal to

large banks is insignificant is for the banks with high market risk, which is a result similar to the one we find in Table 8. When we turn to the whole sample, we find the same result for the regressions with year fixed effects. For the regressions with both year and bank fixed effects, size is not significant when we use the derivatives usage indicator variable.[14]

Section 4. Banks before and after Dodd-Frank

So far, we have shown results for the sample period ending in 2006 and for the whole sample period. We occasionally discussed results for a sample period ending in 2010. In this section, we start by investigating whether the relation between bank value and bank size differs in the post-Dodd-Frank period, which we define to be 2011 to 2015, from the pre-Dodd-Frank period, which is 1987-2010. Though we call the period the post-Dodd-Frank period, it is important to note that important changes in bank regulation took place with Basel 2.5 immediately after the GFC and Basel III during the period. We are not making a judgement as to which regulatory changes are relatively more important and our analysis cannot distinguish between the various regulatory changes. We next investigate whether the relation between bank risk, bank performance, and bank size differs between the pre- and post-Dodd-Frank periods.

In Table 9, we re-estimate regressions (1) and (2) of Table 4 and the regressions of Table 8 with the piecewise linear formulation for size, but now we add an indicator variable for the post-Dodd-Frank period and interact it with all variables. Regressions (1) and (2) have only the size variables, an indicator variable for the post-Dodd-Frank period, and the interaction between them. In both regressions, Tobin's q falls with size for large banks. However, none of the interactions with the post-Dodd-Frank indicator variable are significant.

In regressions (3) and (4) we repeat the regressions of Table 8 with the indicator variable for the Post-Dodd-Frank period and interactions of all variables with that indicator variable. The only interactions that

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one if the ratio of real estate (commercial and industrial) loans-to-loans (3-year rolling window average) is in the top 25% of distribution and 0 otherwise. We define high securities portfolio and high compensation-to-assets in a similar manner using the ratio of securities-to-assets and compensation-to-assets, respectively.

[14] Data for derivatives is only available since 1996.

are significant are the interactions for non-interest income and equity-to-assets in regression (3). In regression (4), none of the interactions are significant. In regression (3), we find that the coefficients on non-interest income and on equity to assets are sharply lower in the post-Dodd-Frank period. The change in the relation between bank value and leverage from before to after the crisis is shown by Calomiris and Nissin (2014) as well.

These results mean that the relation between bank Tobin's q and size is not different between the pre- and post-Dodd-Frank periods. These results are surprising in that the relation between Tobin's q and size is weaker for large banks when we include the post-Dodd-Frank period. Apparently, the relation between Tobin's q and size weakens, but not enough for the change in the coefficient on size for large banks to be significantly different in the post-Dodd-Frank period. Note that the coefficient on size for large banks in Table 4 is insignificant over the whole sample only when we have bank fixed effects. Regression (2) in Table 9 has bank fixed effects. There, the coefficient on size is -0.0286 for large banks and the coefficient is significant at the 1% level. The interaction of the post-Dodd-Frank indicator variable with size for large banks has a coefficient of 0.0148 with a t-statistic of 1.5. Consequently, the coefficient on the size variable effectively drops by half in the post-Dodd-Frank period, but the drop is not statistically significant at the 10% level.

To examine whether bank risk and performance characteristics change with Dodd-Frank, we estimate regressions like those in Table 5, but allowing for size to be related to bank risk and performance differently after Dodd-Frank. We do not tabulate the results. We find no evidence that the relation between bank size and tail risk or equity volatility changes after Dodd-Frank for large banks, but we find evidence that after Dodd-Frank, the coefficient on bank size in the regressions for tail risk and equity volatility falls sharply for smaller banks. As a result of these changes, bank size seems largely unrelated to tail risk and equity volatility after Dodd-Frank.

Section 5. Is it reverse causation?

Two important concerns may affect the interpretation of our results. First, it could be that we are not capturing a relation between Tobin's q and size, but a relation between Tobin's q and some variable for which bank size is a proxy. To mitigate this concern, we show that our results hold with bank fixed effects and when we use a variety of control variables used in the literature. Second, it could be that there is reverse causation, so that q affects size rather than the opposite. The reverse causation concern is that assets depend on market values for large banks, so that a shock to market values that increases Tobin's q also increases the value of assets, but by less than Tobin's q because not all assets are marked to market. To address this concern, we estimate regressions using the number of employees and lagged assets as instrumental variables.

In Table 10, we estimate the regressions of Panel A of Table 3 using instrumental variables for size. We do not reproduce the first-stage regressions, but for regressions (1), (2), (5), and (6), the first-stage regression regresses large bank assets in t on assets in t-1 and the log of the number of employees in t-1 and does the same for small bank assets. The first stage assets have extremely high R-squared and highly significant coefficients. Regression (1) shows estimates when assets are instrumented for the sample period from 1987 to 2006. We find that the coefficient for large banks is significantly negative. The coefficient for small banks is significantly positive at the 10% level. When we turn to Regression (2) which also has bank fixed effects, both coefficients are significantly negative. The next two regressions also include equity-to-assets and non-interest income both in the first and second stages. In Regression (3), the coefficient on small banks is negative and insignificant. The other coefficients on size variables in Regressions (3) and (4) are similar to the coefficients in Regressions (1) and (2). Regressions (5) to (8) re-estimate the coefficients for the whole sample period. The estimates are consistent with the OLS results.

Section 6. Conclusion

In this study, we examine whether larger banks are worth more than smaller banks. We find no evidence pointing in that direction. Most of our evidence actually supports the opposite conclusion, namely that the

Tobin's q and the market-to-book ratio of large banks fall with assets, and we find no evidence that supports the conclusion that larger banks are worth more than smaller banks. An important caveat is that while we show that TBTF banks are not worth more than small banks because of TBTF, we do not demonstrate that TBTF does not add value to large banks, since we cannot exclude that large banks would be valued even less without TBTF. However, similarly, we cannot exclude that TBTF decreases bank value through regulatory and political costs.

We explore potential explanations for why the value of large banks falls with size. The negative relation between bank value and bank size for large banks could be explained if (i) bank performance falls with size for large banks so that the present value of cash flows as a fraction of assets falls with size for these banks, (ii) the riskiness of bank income increases with size for larger banks, so that banks become more likely to incur costs of financial distress as they grow larger, or (iii) the discount rate for cash flows falls with bank size for large banks. None of these potential explanations are consistently supported by the data across regression specifications. Bank risk does not increase with size for large banks. While ROE falls with size for large banks in regressions with bank fixed effects, it does not in the cross-section. Large bank stocks do not have higher expected returns than small bank stocks. We find, however, strong evidence that the value of banks is negatively related to trading assets in that a bank that increases trading assets by 1% of assets and reduces its holding of securities by 1% (in other words, reduces securities held for investment and increases securities held for trading) is associated with a decrease in Tobin's q of 0.19% in regressions where we control for bank characteristics and account for year and bank fixed effects. While Laeven and Huizinga (2012) find evidence that some bank assets are discounted by the market as a result of the crisis, our result holds for the sample period starting in 1987 that ends before the crisis. Hence, our result is more consistent with the view that the market discounts trading activities generally.

References

Boyd, J.H. and D.E. Runkle, 1993. Size and performance of banking firms: Testing the predictions of theory. *Journal of Monetary Economics*, 31(1), 47-67.

Brewer III, E. and J. Jagtiani, 2013. How much did banks pay to become Too-Big-To-Fail and to become systemically Important? *Journal of Financial Services Research,* 43 (1), 1-35.

Calomiris, C.W. and D. Nissim, 2014. Crisis-related shifts in the market valuation of banking activities. *Journal of Financial Intermediation,* 23, 400-435.

Demirgüç-Kunt, A. and H. Huizinga, 2010. Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics 98*(3), 626-650.

Demirgüç-Kunt, A. and H. Huizinga, 2013. Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads. *Journal of Banking & Finance, 37*(3), 875-894.

Ellul, A. and V. Yerramilli, 2013. Stronger risk controls, lower risk: Evidence from U.S. bank holding companies. *The Journal of Finance,* 68 (5), 1757-1803.

Erel, I., T. Nadauld, and R.M. Stulz, 2013. Why did holdings of highly rated securitization tranches differ so much across banks? *Review of Financial Studies, 27(2)*, 404-453.

Fama, E.F. and K.R. French, 1993. Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics,* 33, 3–56.

Gandhi, P. and H. Lustig, 2015. Size Anomalies in U.S. Bank Stock Returns. *Journal of Finance*, 70, 733-768.

Hughes, J.P. and L.J. Mester, 2013. Who said large banks don't experience scale economies? Evidence from a risk-return-driven cost function. *Journal of Financial Intermediation*, 22 (4), 559-585.

Huizinga, H. and L. Laeven, 2012. Bank valuation and accounting discretion during a financial crisis. *Journal of Financial Economics*, 106 (3), 614-634.

International Monetary Fund, 2014. Global Financial Stability Report (April), Chapter 3, "How big is the implicit subsidy for banks seen as too-important-to-fail?" (Washington: International Monetary Fund).

Kane, E.J., 2014. "Statement on measuring the funding advantages enjoyed by large, complex, and politically powerful bank holding companies." Hearing on Debt Financing in the Domestic Financial Sector, U.S. Senate, July 31, 2014.

Kovner, A., J. Vickery, and L. Zhou, 2014. "Do big banks have lower operating costs?" *Economic Policy Review* 20 (2), 1-23.

Kroszner, R., 2016. A review of bank funding cost differentials. *Journal of Financial Services Research,* 49 (2-3), 151-174.

Laeven, L., L. Ratnovski, and H. Tong, 2014. Bank size, capital, and systemic risk: Some international evidence." Working paper, IMF, Washington D.C.

O'Hara, M. and W. Shaw, 1990. Deposit insurance and wealth effects: the value of being “too big to fail”. *The Journal of Finance*, 45(5), 1587-1600.

Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22, 435-480.

Santos, J.A.C., 2014. “Evidence from the bond market on banks’ ‘too-big-to-fail’ subsidy,” *Economic Policy Review* 20 (2), 29-39.

Sarin, N., and L. H. Summers, 2016. “Have big banks gotten safer?” Brookings Papers on Economic Activity, forthcoming.

Ueda, K., and B. Weder di Mauro, 2013. Quantifying structural subsidy values for systemically important financial institutions. *Journal of Banking & Finance,* 37(10), 3830-3842.

Wheelock, D.C. and P.W. Wilson, 2012. Do large banks have lower costs? New estimates of returns to scale for US banks. *Journal of Money, Credit and Banking*, 44(1), 171-199.

Table 1.

Table reports selected descriptive statistics for the publicly traded bank holding companies (banks) in our sample period from 1987 to 2015. A bank is included in the sample if its assets are greater than $10 billion in 2010 constant dollars and its deposits-to-assets ratio as of the prior year-end is least 10%. The last column reports the percentage of banks with total assets greater than $50 billion in 2010 constant dollars.

Sample Description of banks by year								
Total Assets (constant US$ billion)								
	Full sample			$10-$50B		>$50B		% of banks
Year	# of banks	Mean	Median	Mean	Median	Mean	Median	>$50B
1987	64	$49.93	$27.25	$23.38	$18.28	$117.76	$91.23	28%
1988	65	$51.31	$30.37	$25.43	$19.80	$109.55	$83.94	31%
1989	74	$49.21	$28.13	$23.04	$19.76	$107.26	$85.73	31%
1990	73	$46.06	$23.43	$23.48	$19.26	$101.98	$84.75	29%
1991	71	$46.97	$26.83	$23.04	$18.22	$112.48	$78.33	27%
1992	65	$51.71	$32.28	$24.45	$19.76	$113.03	$79.40	31%
1993	67	$54.63	$32.05	$25.19	$19.53	$119.12	$79.27	31%
1994	67	$58.08	$27.31	$22.37	$19.07	$122.05	$84.68	36%
1995	64	$61.98	$29.15	$24.62	$20.79	$133.28	$99.08	34%
1996	59	$69.26	$30.04	$25.04	$22.23	$149.28	$101.73	36%
1997	58	$79.31	$40.21	$25.72	$24.60	$160.85	$102.02	40%
1998	52	$88.04	$40.54	$28.92	$27.09	$199.71	$112.51	35%
1999	55	$84.73	$37.96	$26.78	$21.84	$203.85	$107.91	33%
2000	59	$87.34	$36.17	$23.13	$18.88	$195.31	$97.95	37%
2001	58	$89.36	$32.46	$24.50	$20.51	$222.50	$99.79	33%
2002	62	$109.73	$30.64	$24.25	$19.57	$289.25	$123.12	32%
2003	61	$119.59	$33.85	$25.75	$21.14	$298.34	$109.58	34%
2004	55	$141.86	$34.37	$23.91	$16.65	$348.28	$109.11	36%
2005	59	$143.26	$40.85	$21.00	$16.35	$298.43	$106.54	44%
2006	55	$167.76	$38.22	$22.13	$17.74	$370.38	$131.26	42%
2007	52	$186.93	$29.75	$19.73	$16.72	$433.76	$148.33	40%
2008	50	$203.05	$25.33	$18.24	$15.40	$480.26	$161.00	40%
2009	50	$204.27	$23.58	$17.97	$15.57	$483.73	$163.90	40%
2010	54	$194.95	$22.84	$17.41	$14.87	$453.18	$151.37	41%
2011	51	$204.84	$24.71	$18.56	$17.00	$470.95	$169.24	41%
2012	56	$195.89	$26.96	$20.40	$17.95	$467.11	$155.28	39%
2013	67	$178.33	$24.53	$20.43	$17.38	$480.38	$164.16	34%
2014	67	$182.97	$26.85	$22.11	$19.87	$490.70	$172.07	34%
2015	68	$180.34	$26.43	$22.86	$21.05	$488.45	$175.92	34%

Table 2.

Table 2 reports descriptive statistics of the main variables used in our analyses. For each variable, we first obtain the cross-sectional average and report the time-series descriptive statistics. The last two columns report *p*-values from *t*-tests (Wilcoxon signed rank tests) of differences in mean (median) between large banks (total assets greater than $50 billion) and small banks (assets between $10 and $50 billion). All variables are defined in Appendix A.

	Full sample			Small banks ($10-$50B)			Large banks (>$50B)			Test of differences (p-value)	
	Mean	Median	Std. dev.	Mean	Median	Std. dev.	Mean	Median	Std. dev.	Mean	Median
Tobin's q	1.061	1.039	0.062	1.063	1.043	0.062	1.058	1.036	0.063	(0.770)	(0.822)
Market-to-Book	1.724	1.463	0.736	1.748	1.462	0.737	1.678	1.466	0.765	(0.726)	(0.624)
Tail risk (%)	4.377	3.478	2.406	4.257	3.402	2.256	4.645	4.184	2.693	(0.554)	(0.451)
Equity volatility (%)	31.172	26.575	14.674	30.076	25.929	13.716	33.672	29.413	17.130	(0.381)	(0.397)
Returns	0.136	0.093	0.278	0.135	0.112	0.279	0.136	0.091	0.298	(0.990)	(0.920)
Beta	1.076	1.071	0.314	1.003	1.020	0.299	1.218	1.225	0.362	(0.017)	(0.013)
ROA	0.036	0.039	0.016	0.035	0.039	0.016	0.037	0.041	0.018	(0.567)	(0.519)
ROE	0.110	0.136	0.060	0.108	0.132	0.063	0.112	0.139	0.070	(0.787)	(0.273)
Z-Score	3.147	3.147	0.157	3.182	3.174	0.170	3.080	3.055	0.186	(0.033)	(0.030)
Equity-to-assets (%)	8.694	8.610	1.755	8.750	8.623	1.675	8.544	8.252	1.978	(0.669)	(0.581)
Log (assets)	17.222	17.215	0.370	16.515	16.571	0.194	18.488	18.501	0.552	(0.000)	(0.000)
Non-interest income-to-income	0.357	0.353	0.032	0.314	0.310	0.029	0.433	0.448	0.053	(0.000)	(0.000)
Deposits-to-assets	0.652	0.653	0.036	0.708	0.710	0.032	0.549	0.541	0.040	(0.000)	(0.000)
Trading assets-to-assets (%)	0.017	0.017	0.004	0.005	0.004	0.002	0.038	0.041	0.010	(0.000)	(0.000)
Trading assets- residuals (%)	0.000	0.000	0.006	0.002	0.000	0.005	-0.005	0.006	0.010	(0.003)	(0.005)
RE loans-to-assets	0.316	0.336	0.061	0.353	0.377	0.079	0.253	0.255	0.045	(0.000)	(0.000)
CI loans-to-assets	0.151	0.146	0.029	0.144	0.137	0.024	0.164	0.165	0.044	(0.034)	(0.150)
Securities-to-assets	0.202	0.208	0.025	0.223	0.226	0.031	0.163	0.168	0.023	(0.000)	(0.000)

Table 3. Bank size and Tobin's q.

Table shows results from OLS regressions of Tobin's q on proxies for bank size. In Panel A, we use two piecewise linear size specifications, while Panel B uses the logarithm of assets. The "$10-$50 billion" captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50 billion" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size-$50 billion, 0). The units of the piecewise linear variables are in $ trillions. Control variables include non-interest income-to-income, and equity-to-assets. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A – Piecewise linear specifications								
	Dependent variable: Tobin's q							
	1987-2006				1987-2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$10-$50B	0.0254	-1.3798***	-0.5197*	-1.2126***	0.0020	-1.5041***	-0.6021**	-1.3339***
	(0.11)	(-3.76)	(-1.92)	(-3.71)	(0.01)	(-3.34)	(-2.40)	(-3.05)
>$50B	-0.0742**	-0.0993***	-0.0689**	-0.0975***	-0.0247***	-0.0227	-0.0257***	-0.0214
	(-2.58)	(-3.24)	(-2.35)	(-3.28)	(-3.46)	(-1.53)	(-3.29)	(-1.41)
Non-interest income			0.2190***	0.0793			0.1586***	0.1136
			(4.09)	(1.14)			(3.33)	(1.62)
Equity-to-assets			1.4093***	-0.0576			0.4871	-0.1494
			(3.70)	(-0.20)			(1.47)	(-0.71)
Constant	1.0023***	1.0274***	0.8618***	1.0073***	1.0025***	1.0256***	0.9363***	1.0045***
	(185.50)	(171.02)	(27.26)	(32.66)	(190.49)	(139.00)	(31.80)	(42.63)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,758	1,758	1,758	1,758
R-squared	0.448	0.820	0.591	0.822	0.451	0.787	0.530	0.792
Adjusted R^2	0.438	0.795	0.583	0.796	0.442	0.759	0.522	0.765
# Banks	136	136	136	136	171	171	171	171

Table 3. Bank size and Tobin's q. Continued.

	Panel B – Logarithm of Assets							
	Dependent variable: Tobin's q							
	1987-2006				1987-2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (assets)	-0.0066*	-0.0441***	-0.0139***	-0.0424***	-0.0047	-0.0381***	-0.0130***	-0.0361***
	(-1.74)	(-3.90)	(-3.24)	(-4.17)	(-1.52)	(-3.63)	(-3.57)	(-3.51)
Non-interest income			0.2230***	0.0556			0.1634***	0.1127
			(4.26)	(0.93)			(3.42)	(1.56)
Equity-to-assets			1.3957***	-0.1419			0.4773	-0.1846
			(3.68)	(-0.53)			(1.48)	(-0.92)
Constant	1.1112***	1.7204***	1.0810***	1.6875***	1.0796***	1.6170***	1.1383***	1.5681***
	(17.70)	(9.54)	(16.59)	(10.67)	(21.22)	(9.71)	(21.70)	(9.39)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,758	1,758	1,758	1,758
R-squared	0.444	0.827	0.592	0.828	0.449	0.793	0.534	0.799
Adjusted R^2	0.435	0.802	0.584	0.803	0.440	0.767	0.526	0.773
# Banks	136	136	136	136	171	171	171	171

Table 4. Bank size and market-to-book value.

Table shows results from OLS regressions of the market-to-book ratio on proxies for bank size. In Panel A, we use two piecewise linear size specifications, while Panel B uses the logarithm of assets. The "$10-$50 billion" captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50 billion" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size- $50 billion, 0). The units of the piecewise linear variables are in $ trillions. Control variables include non-interest income-to-income, and equity-to-assets. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A – Piecewise linear specifications								
Dependent variable: Market-to-book								
	1987-2006				1987-2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$10-$50B	-1.1190	-20.0508***	-8.0974***	-18.7616***	-1.0202	-20.4223***	-7.5435***	-19.0030***
	(-0.39)	(-3.18)	(-2.67)	(-3.46)	(-0.39)	(-3.34)	(-2.90)	(-3.40)
>$50B	-0.6643**	-1.1703***	-0.7589**	-1.1464***	-0.2366***	-0.3104*	-0.3147***	-0.2930*
	(-2.07)	(-3.22)	(-2.10)	(-3.21)	(-3.32)	(-1.77)	(-4.12)	(-1.77)
Non-interest income			2.3725***	0.7289			1.6869***	1.1234*
			(5.23)	(1.07)			(4.20)	(1.73)
Equity-to-assets			2.8643	-8.9515*			-2.1237	-7.4127**
			(0.89)	(-1.97)			(-0.87)	(-2.59)
Constant	1.0355***	1.3191***	0.2672	1.6628***	1.0314***	1.2843***	0.7609***	1.4594***
	(15.11)	(12.74)	(1.13)	(3.91)	(15.83)	(13.83)	(3.54)	(5.27)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,758	1,758	1,758	1,758
R-squared	0.488	0.778	0.573	0.786	0.501	0.760	0.566	0.770
Adjusted R^2	0.479	0.746	0.564	0.754	0.493	0.730	0.558	0.741
# Banks	136	136	136	136	171	171	171	171

Table 4. Bank size and market-to-book value. Continued

Panel B – Logarithm of Assets								
	Dependent variable: Market-to-book							
	1987-2006				1987-2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (assets)	-0.0812*	-0.5928***	-0.1920***	-0.6031***	-0.0584*	-0.4999***	-0.1602***	-0.4923***
	(-1.93)	(-4.44)	(-3.92)	(-4.70)	(-1.82)	(-3.94)	(-4.23)	(-4.01)
Non-interest income			2.4132***	0.4631			1.7423***	1.1215
			(5.43)	(0.80)			(4.32)	(1.64)
Equity-to-assets			2.5926	-10.0936**			-2.2480	-7.8852***
			(0.80)	(-2.34)			(-0.94)	(-2.80)
Constant	2.3546***	10.6234***	3.2870***	11.2900***	1.9761***	9.0333***	3.2547***	9.1299***
	(3.39)	(4.98)	(4.00)	(5.37)	(3.73)	(4.50)	(5.48)	(4.52)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,758	1,758	1,758	1,758
R-squared	0.487	0.787	0.576	0.795	0.501	0.768	0.570	0.779
Adjusted R^2	0.479	0.756	0.568	0.766	0.492	0.738	0.562	0.750
# Banks	136	136	136	136	171	171	171	171

Table 5. Bank size and risk.

Table shows results from OLS regressions of various proxies for bank risk on bank size. In Panel A, we show results for the period 1987-2006, while Panel B shows results for the full sample period: 1987-2015. As dependent variables, we use four proxies for bank risk: 1) z-score – the log of z-score, measured as (ROA+equity/assets) /σ(ROA); 2) Equity-to-assets; 3) Tail risk– the negative of the average return on a bank's stock over the 5% worst return days in a given year; 4) Equity volatility– the annualized standard deviation of daily stock returns. We use two piecewise linear size specifications: 1) "\$10-\$50 billion", which captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion); 2) ">\$50 billion", which captures asset size in excess of \$50 billion, taking the value: max (bank asset size- \$50 billion, 0). The units of the piecewise linear variables are in \$ trillions. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A – 1987-2006								
Dependent variable:	z-score		Equity-to-assets		Tail risk		Equity volatility	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
\$10-\$50B	-4.2719***	-2.7825	-5.6520	-3.1994	19.1390**	23.6880***	203.2419**	172.3610**
	(-3.87)	(-1.27)	(-0.85)	(-0.17)	(2.58)	(3.06)	(2.31)	(3.10)
>\$50B	0.1895*	0.1126	-1.4771***	-0.0331	-0.5585	-1.0948**	-5.2287	-14.4788**
	(1.87)	(0.34)	(-3.06)	(-0.08)	(-1.57)	(-1.96)	(-1.32)	(-2.14)
Constant	3.3161***	3.3528***	5.9325***	6.1944***	4.8019***	4.6504***	31.2334***	30.3511***
	(58.25)	(56.12)	(35.35)	(20.67)	(23.31)	(19.30)	(16.63)	(13.77)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243
R-squared	0.139	0.506	0.361	0.768	0.366	0.675	0.309	0.683
Adjusted R^2	0.124	0.435	0.350	0.735	0.355	0.628	0.297	0.638
# Banks	136	136	136	136	136	136	136	136

Table 5. Bank size and risk. Continued.

Panel B – 1987-2015								
Dependent variable:	z-score		Equity-to-assets		Tail risk		Equity volatility	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
\$10-\$50B	-4.4807***	-2.6784	-1.4672	-5.3341	13.2851**	29.3180***	131.3974*	217.4759**
	(-4.18)	(-1.09)	(-0.22)	(-0.29)	(2.15)	(4.21)	(1.96)	(3.78)
>\$50B	0.1730***	0.1986***	-0.8088***	0.2048	-0.0003	-0.1433	-0.1651	-3.1781
	(2.78)	(3.94)	(-3.04)	(0.59)	(-0.00)	(-0.29)	(-0.07)	(-0.62)
Constant	3.3202***	3.3755***	5.8483***	6.3908***	4.9119***	4.6620***	32.5936***	30.4860***
	(55.69)	(51.26)	(34.48)	(26.64)	(25.65)	(19.58)	(21.35)	(14.03)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Year, Bank	Year	Bank
Observations	1,757	1,757	1,758	1,758	1,758	1,758	1,758	1,758
R-squared	0.160	0.464	0.499	0.812	0.627	0.791	0.476	0.733
Adjusted R^2	0.146	0.396	0.491	0.788	0.621	0.764	0.467	0.698
# Banks	171	171	171	171	171	171	171	171

Table 6. Bank size and performance.

Table shows results from OLS regressions of various performance measures on bank size. In Panel A, we show results for the period 1987-2006, while Panel B shows results for the full sample period: 1987-2015. As dependent variables, we use three performance measures: 1) ROA – net income plus interest expense divided by average assets over the prior year, 2) ROE – net income divided by average equity; 3) Returns– annual buy and hold stock returns. We use two piecewise linear size specifications: 1) "$10-$50 billion", which captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion); 2) ">$50 billion", which captures asset size in excess of $50 billion, taking the value: max (bank asset size- $50 billion, 0). The units of the piecewise linear variables are in $ trillions. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A. 1987-2006						
Dependent variable:	ROA		ROE		Returns	
	(1)	(2)	(3)	(4)	(5)	(6)
$10-$50B	0.0979**	0.0645	-0.1010	-2.0323***	-0.2941	-6.5191***
	(2.51)	(1.44)	(-0.49)	(-4.47)	(-0.51)	(-4.12)
>$50B	-0.0011	-0.0006	-0.0026	-0.0613**	0.0163	-0.2705***
	(-0.33)	(-0.25)	(-0.12)	(-2.35)	(0.63)	(-2.78)
Constant	0.0478***	0.0491***	0.0466***	0.0820***	-0.1212***	-0.0631*
	(53.25)	(46.54)	(2.69)	(4.56)	(-4.42)	(-1.92)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,243	1,243	1,243	1,243
R-squared	0.616	0.858	0.203	0.438	0.421	0.472
Adjusted R^2	0.609	0.837	0.189	0.358	0.411	0.396
# Banks	136	136	136	136	136	136

Table 6. Bank size and performance. Continued.

Panel B. 1987-2015						
Dependent variable:	ROA		ROE		Returns	
	(1)	(2)	(3)	(4)	(5)	(6)
$10-$50B	0.0847**	0.0128	0.0407	-2.1837***	0.1634	-5.4197***
	(2.43)	(0.29)	(0.18)	(-5.22)	(0.37)	(-4.58)
>$50B	-0.0010	0.0008	0.0036	-0.0136	-0.0001	-0.0912***
	(-1.16)	(0.70)	(0.40)	(-0.64)	(-0.00)	(-4.59)
Constant	0.0481***	0.0498***	0.0438**	0.0777***	-0.1300***	-0.0975***
	(53.23)	(50.09)	(2.44)	(4.05)	(-5.05)	(-3.41)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,758	1,758	1,758	1,758	1,758	1,758
R-squared	0.753	0.891	0.279	0.512	0.453	0.508
Adjusted R^2	0.749	0.877	0.266	0.450	0.443	0.445
# Banks	171	171	171	171	171	171

Table 7. Risk-Adjusted Returns.

This table presents estimates from OLS regressions of monthly equally-weighted excess returns of portfolios of large (total assets greater than $50 billion) and small banks (assets between $10-$50 billion) on a five-factor model that includes: the market factor (Market), a size (SMB) factor, a value-growth (HML) factor, and two bond factors: LTG (excess return on an index of long-term government bonds), and CRD (excess returns on an index of investment-grade corporate bonds). Banks are sorted based on asset size as of December *t-1*, and portfolios are formed starting in July of year *t*. ∗, ∗∗, and ∗∗∗ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are adjusted for heteroskedasticity and autocorrelation using Newey-West (1987) with three lags.

Panel A – July 1987 – December 2006			
	(1)	(2)	(3)
	Large banks	**Small banks**	**Difference**
α	-0.0027	-0.0008	-0.0019
	(-0.94)	(-0.35)	(-0.84)
Market	1.4132***	1.1857***	0.2275***
	(18.63)	(19.09)	(4.90)
SMB	-0.2197**	-0.1352*	-0.0845
	(-2.15)	(-1.72)	(-1.16)
HML	0.8712***	0.7815***	0.0897
	(7.06)	(9.22)	(1.04)
LTG	-0.0330	-0.0484	0.0154
	(-0.16)	(-0.36)	(0.10)
CRD	0.1858	0.2086	-0.0228
	(0.66)	(1.13)	(-0.10)
Observations	234	234	234
R-squared	0.640	0.690	0.085

Panel B – July 1987 – December 2015			
	(1)	(2)	(3)
	Large banks	**Small banks**	**Difference**
α	-0.0036	-0.0015	-0.0022
	(-1.54)	(-0.72)	(-1.06)
Market	1.4400***	1.0841***	0.3558***
	(18.17)	(14.34)	(5.68)
SMB	-0.1567*	-0.0203	-0.1364*
	(-1.72)	(-0.26)	(-1.75)
HML	1.0633***	0.8154***	0.2479***
	(8.88)	(9.26)	(2.80)
Observations	340	340	340
R-squared	0.655	0.633	0.162

Table 8. Bank size, Tobin's q and bank activities.

Table shows results from OLS regressions of Tobin's q on proxies for bank size. We show results for two periods: 1987-2006 and 1987-2015. Trading-to-assets is the ratio of trading assets-to-assets. The "$10-$50 billion" captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50 billion" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size- $50 billion, 0). The units of the piecewise linear variables are in $ trillions. Log(assets) is the natural log of total assets (in US$000s). Control variables include non-interest income-to-income, real estate (RE) loans-to-total assets, commercial and industrial (CI) loans-to-assets, securities-to-assets, equity-to-assets, and an indicator variable (No trading assets) that is equal to one for banks with no trading assets, and zero otherwise. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	1987-2006		1987-2015		1987-2006		1987-2015	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trading-to-assets	-0.4254***	-0.2088*	-0.4853***	-0.2928***	-0.4232***	-0.1691	-0.4521***	-0.1750*
	(-3.61)	(-1.81)	(-4.21)	(-3.10)	(-3.81)	(-1.61)	(-4.23)	(-1.85)
RE loans-to-assets	-0.0688	-0.0222	-0.1518**	-0.0344	-0.0689	-0.0218	-0.1538**	-0.0425
	(-0.95)	(-0.46)	(-2.35)	(-0.77)	(-0.96)	(-0.46)	(-2.42)	(-0.98)
CI loans-to-assets	-0.1382	-0.1876*	-0.1774**	-0.1653	-0.1366	-0.1790**	-0.1835**	-0.1797*
	(-1.62)	(-1.95)	(-2.23)	(-1.63)	(-1.62)	(-2.06)	(-2.36)	(-1.87)
Securities-to-assets	-0.0212	0.0417	-0.1053	0.0598	-0.0247	0.0312	-0.1080*	0.0558
	(-0.27)	(0.66)	(-1.60)	(1.08)	(-0.32)	(0.48)	(-1.68)	(1.08)
Non-interest income	0.2145***	0.0671	0.1114**	0.1075*	0.2156***	0.0476	0.1097**	0.1005
	(4.18)	(1.17)	(2.48)	(1.73)	(4.39)	(0.90)	(2.52)	(1.54)
No trading assets	1.1171***	-0.0226	0.1944	-0.0929	0.0172	-0.0111	0.0144	0.0121
	(3.19)	(-0.08)	(0.73)	(-0.41)	(1.39)	(-0.86)	(1.32)	(0.95)
Equity-to-assets	0.0180	-0.0097	0.0151	0.0116	1.1102***	-0.0978	0.1889	-0.1142
	(1.48)	(-0.75)	(1.42)	(0.95)	(3.16)	(-0.34)	(0.72)	(-0.52)
$10-$50B	-0.1420	-1.1589***	-0.4449**	-1.2726***				
	(-0.61)	(-3.57)	(-2.10)	(-3.55)				
>$50B	-0.0145	-0.0732**	-0.0071	-0.0185				
	(-0.58)	(-2.31)	(-0.60)	(-1.24)				
Log(assets)					-0.0042	-0.0381***	-0.0083**	-0.0337***
					(-1.08)	(-4.03)	(-2.30)	(-3.79)
Constant	0.9214***	1.0436***	1.0503***	1.0259***	0.9876***	1.6542***	1.1818***	1.5573***
	(15.57)	(24.07)	(21.62)	(27.63)	(10.26)	(10.75)	(14.15)	(10.31)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,243	1,243	1,758	1,758	1,243	1,243	1,758	1,758
R-squared	0.623	0.828	0.581	0.802	0.623	0.833	0.582	0.807
Adjusted R^2	0.614	0.802	0.572	0.776	0.615	0.808	0.573	0.781
# Banks	136	136	171	171	136	136	171	171

Table 9. The Impact of Dodd-Frank

Table shows results from OLS regressions of Tobin's q on proxies for bank size for the sample period 1987-2015. Post-Dodd Frank is an indicator variable that is equal to one for years after 2010 and zero otherwise. We interact all independent variables with the Post-Dodd Frank indicator. Trading-to-assets is the ratio of trading assets-to-assets. The "$10-$50 billion" captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50 billion" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size- $50 billion, 0). The units of the piecewise linear variables are in $ trillions. Control variables (not shown to conserve space) include non-interest income-to-income, real estate (RE) loans-to-total assets, commercial and industrial (CI) loans-to-assets, securities-to-assets, equity-to-assets, and an indicator variable (No trading assets) that is equal to one for banks with no trading assets, and zero otherwise. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent variable:	Tobin's q			
	(1)	(2)	(3)	(4)
Post-Dodd Frank x $10-$50B	0.4886	-0.7100	-0.4599	-0.5344
	(0.81)	(-1.58)	(-1.00)	(-1.17)
Post-Dodd Frank x >$50B	0.0032	0.0148	-0.0148	-0.0017
	(0.24)	(1.50)	(-0.90)	(-0.08)
Post-Dodd Frank x Trading-to-assets			-0.2443	-0.0379
			(-0.86)	(-0.13)
Trading-to-assets			-0.4476***	-0.2993***
			(-3.75)	(-2.89)
Post-Dodd Frank x RE loans-to-assets			-0.1598	-0.0960
			(-1.52)	(-1.09)
Post-Dodd Frank x CI loans-to-assets			-0.0900	0.0253
			(-0.61)	(0.27)
Post-Dodd Frank x Securities-to-assets			-0.1625	-0.0690
			(-1.18)	(-0.82)
Post-Dodd Frank x Non-interest income			-0.1767***	-0.0826
			(-3.16)	(-1.52)
Post-Dodd Frank x Equity-to-assets			-1.2972***	-0.0699
			(-3.85)	(-0.25)
Post-Dodd Frank x No trading assets			-0.0076	0.0236
			(-0.45)	(1.50)
$10-$50B	-0.0660	-1.4534***	-0.4015*	-1.1840***
	(-0.30)	(-3.38)	(-1.75)	(-3.36)
>$50B	-0.0287***	-0.0286*	0.0080	-0.0113
	(-3.14)	(-1.85)	(0.47)	(-0.55)
Post Dodd-Frank	-0.0207	0.0790***	0.2898***	0.1327*
	(-1.46)	(2.67)	(2.74)	(1.90)
Constant	1.0038***	1.0241***	0.9681***	1.0048***
	(197.06)	(137.25)	(17.81)	(24.26)
Controls	No	No	Yes	Yes
Fixed effects	No	Bank	No	Bank
Observations	1,758	1,758	1,758	1,758
R-squared	0.452	0.788	0.607	0.806
Adj. R^2	0.442	0.761	0.596	0.779
# Banks	171	171	171	171

Table 10. Regressions with size instrumented

Estimates from 2LS regressions of Tobin's q on proxies for bank size. We use two instruments: 1) Employees – the natural logarithm of the number of employees, and 2) Lagged assets- the lagged value of the natural log of total assets. The "$10-$50 billion" captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50 billion" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size- $50 billion, 0). The units of the piecewise linear variables are in $ trillions. Control variables include non-interest income-to-income, and equity-to-assets. We report p-values from the 1st-stage partial F-tests of the null hypothesis that the instruments are jointly zero. Heteroskedascticity-robust *t*-statistics with standard errors clustered at the bank level are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	1987-2006				1987-2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$10-$50B - IV	0.695*	-1.977**	-0.181	-1.906**	0.583	-2.191*	-0.292	-2.258**
	(1.86)	(-2.56)	(-0.65)	(-2.45)	(1.55)	(-1.82)	(-0.86)	(-2.05)
>$50B - IV	-0.084***	-0.099***	-0.067***	-0.099***	-0.037***	-0.029	-0.032***	-0.030
	(-2.72)	(-3.28)	(-2.68)	(-3.31)	(-3.95)	(-1.45)	(-3.91)	(-1.64)
Equity-to-assets			1.383***	-0.086			0.486	-0.186
			(3.68)	(-0.33)			(1.46)	(-0.92)
Non-interest income			0.204***	0.057			0.148***	0.109
			(4.05)	(0.93)			(3.20)	(1.49)
Fixed effects	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year	Year	Bank, Year
Observations	1,230	1,230	1,230	1,230	1,728	1,728	1,728	1,728
R-squared	0.455	0.573	0.590	0.575	0.455	0.593	0.531	0.602
Partial R^2	0.652	0.177	0.624	0.176	0.658	0.178	0.619	0.187
1st stage F-stat p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 1.
Figure 1A (1B) shows the yearly average (median) Tobin's q for the full sample of banks, and for large banks (total assets greater than $50 billion) and small banks (assets between $10 and $50 billion).

Figure 1A.

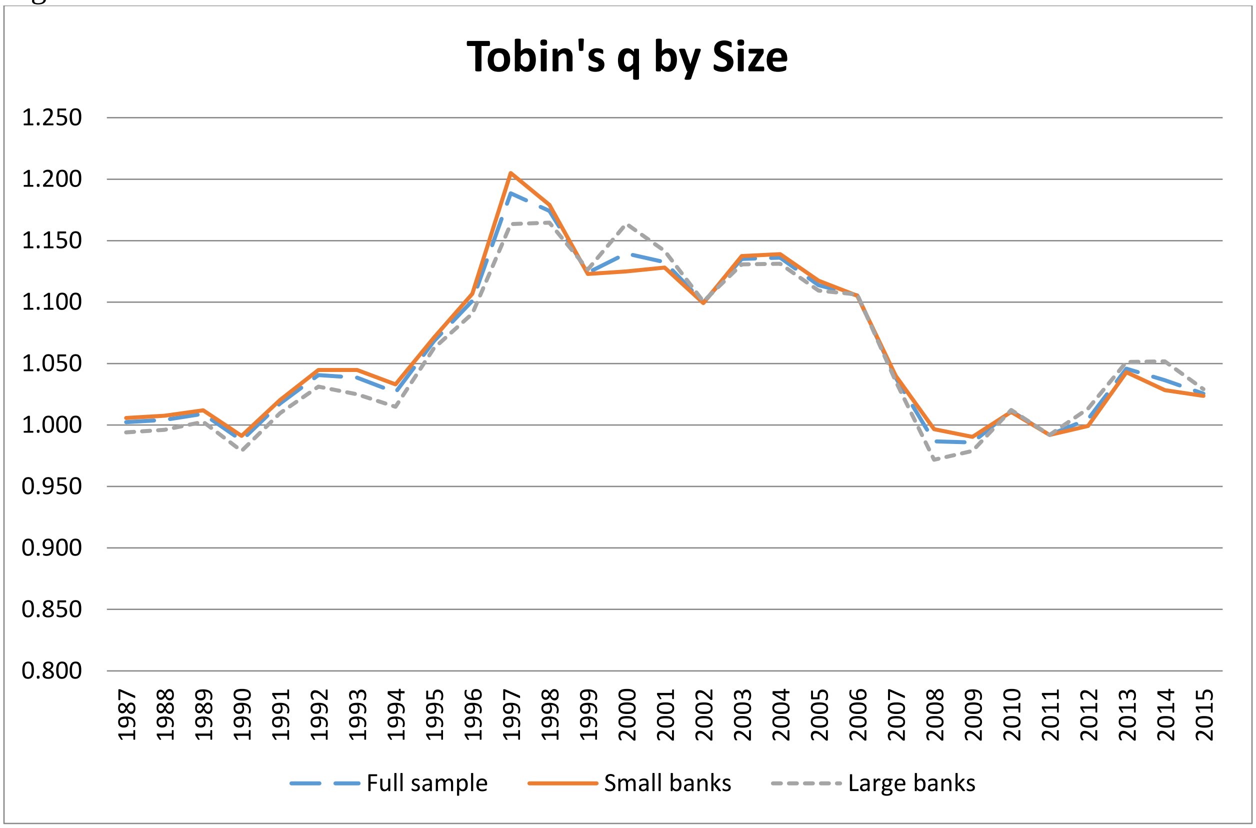


Figure 1B.

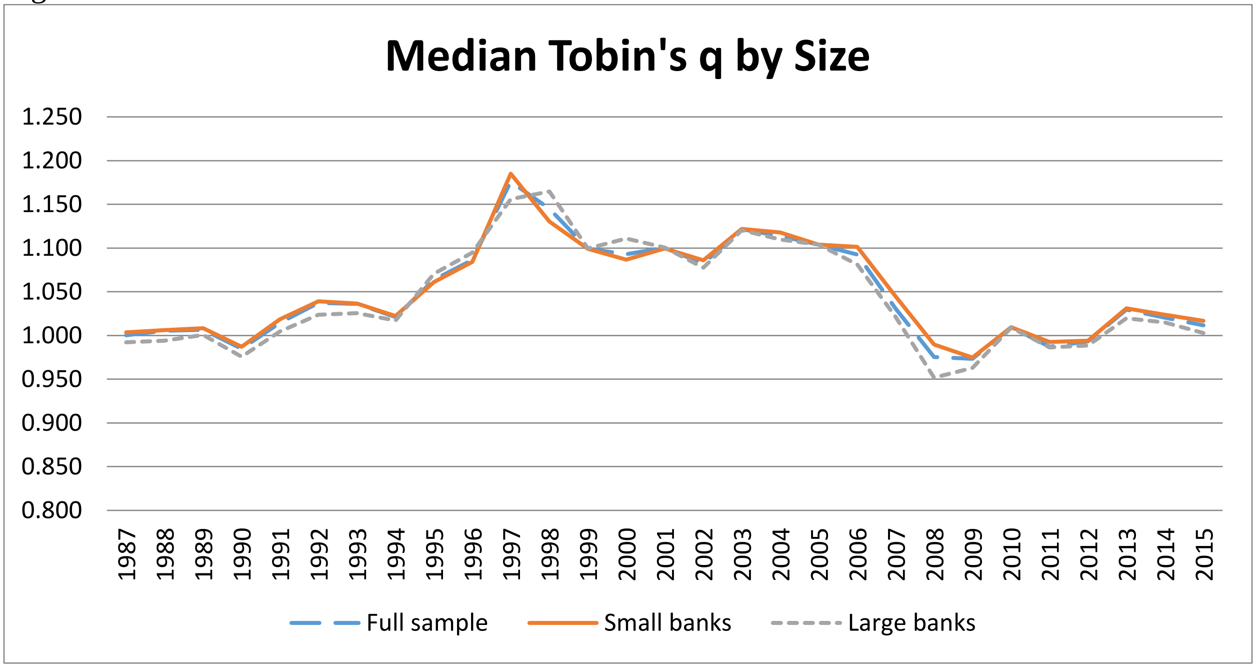
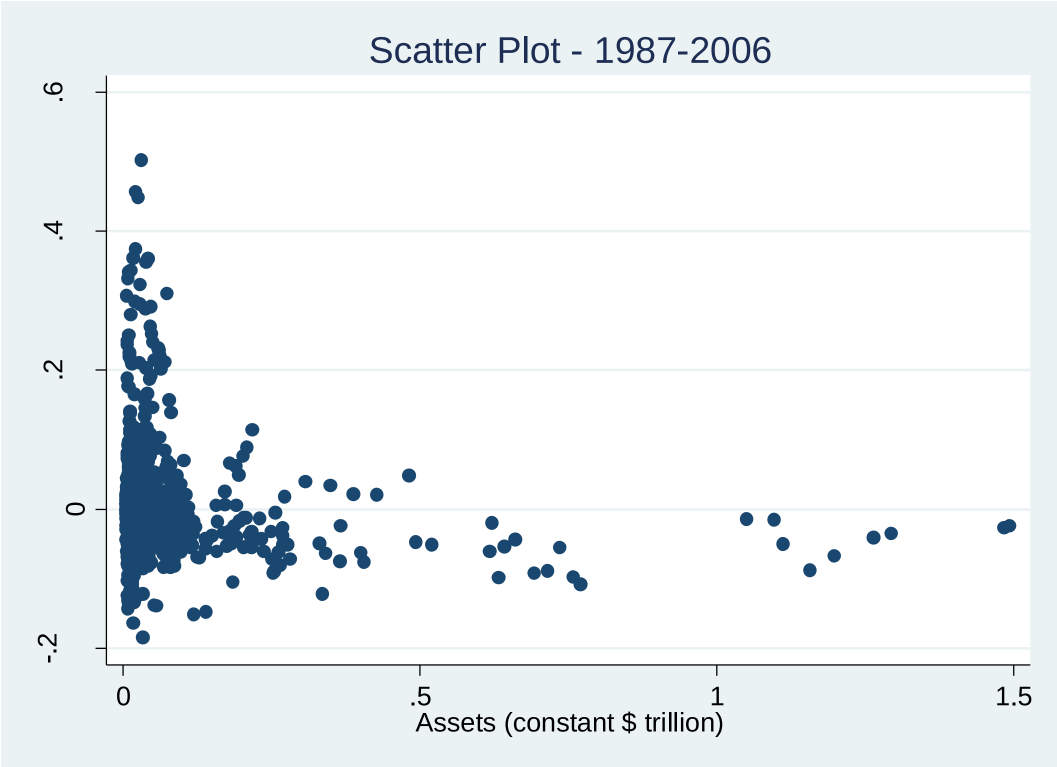


Figure 2. Scatter Plots. The graphs show scatter plots of residuals from regressions of Tobin's q on year fixed effects on asset size (in constant US$ trillion). Panel A shows scatter plots for the period 1987-2006, while Panel B shows graphs for the full sample period (1987-2015).

Panel A.



Panel B. Full sample period.

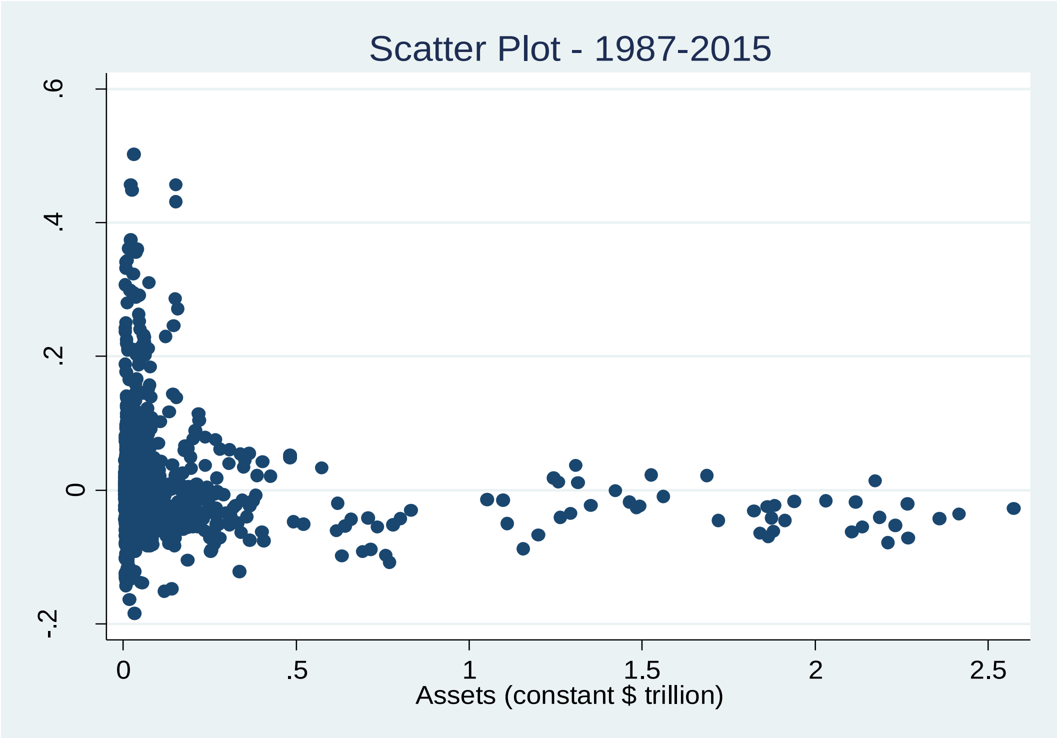
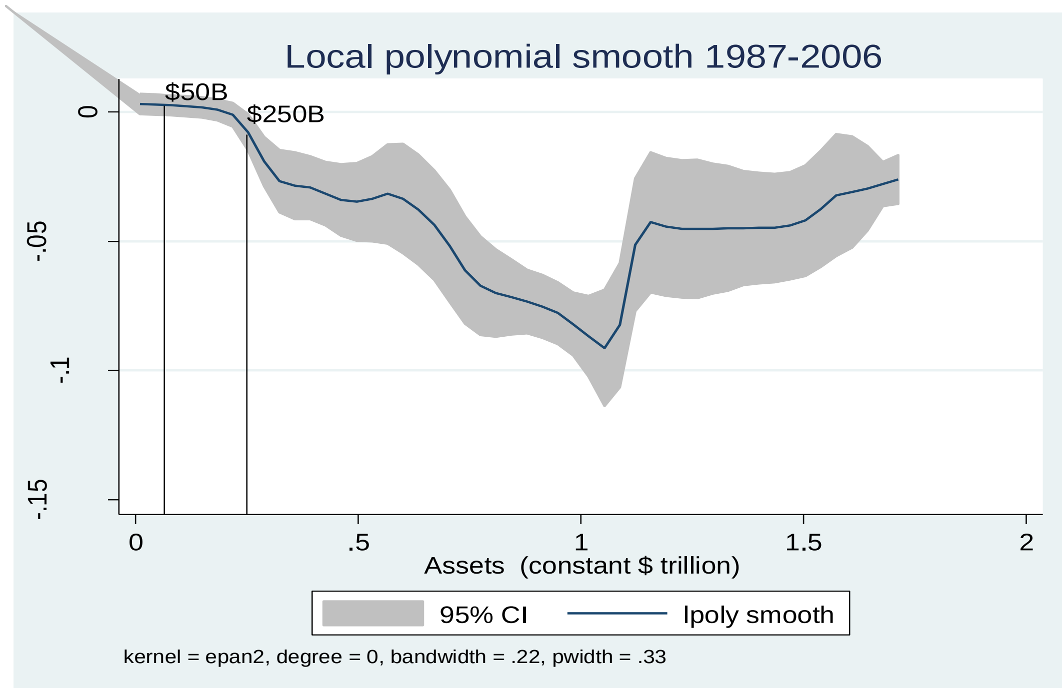


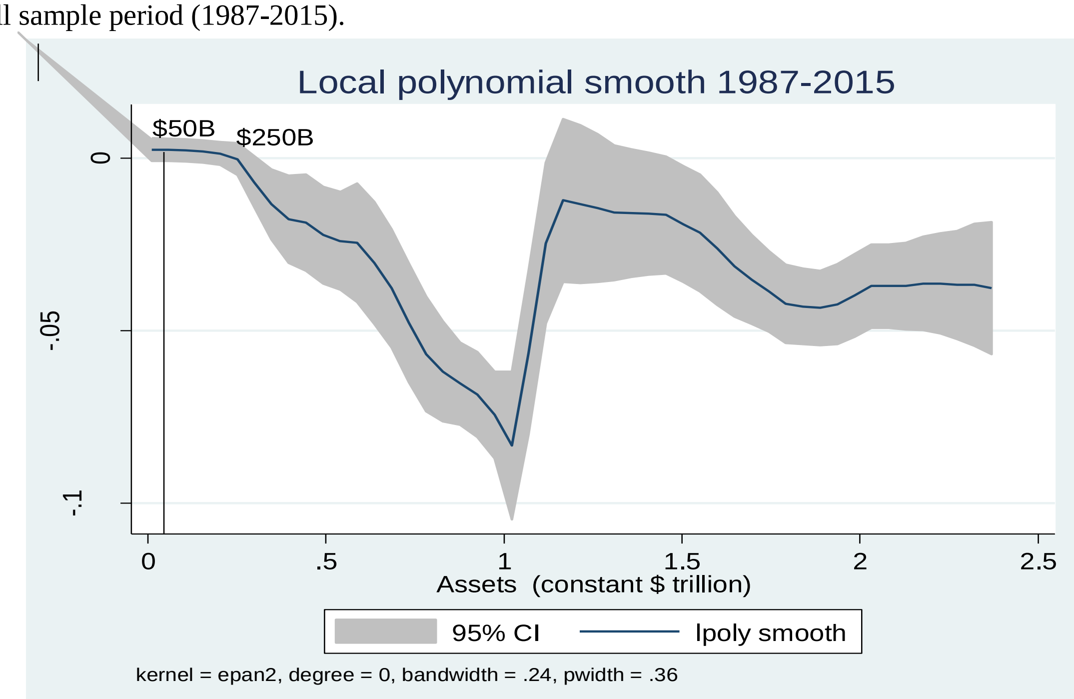
Figure 3. Tobin's q and Size.

The figure shows the relation between Tobin's q and size implied by nonparametric regressions. We first obtain residuals by estimating OLS regressions of Tobin's q on year fixed effects. The solid lines in the figures are obtained from local polynomial regressions of these residuals on asset size using an Epanechnikov kernel function with a "rule-of-thumb" bandwidth estimator and local-mean smoothing. The shaded area shows the 95% confidence interval. Panel A shows graphs for the period 1987-2006, while Panel B shows graphs for the full sample period, 1987-2015.

Panel A. 1987-2006.



Panel B. Full sample period (1987-2015).



Appendix A. Variable definitions

Variable name	**Definition**
\$0-\$50 billion; >\$50 billion	Piecewise linear specification breaking up asset size into two variables, following Erel, Nadauld, and Stulz (2013). "\$10-\$50 billion" captures the first \$50 billion in assets and takes the value: min (BHC asset size, \$50 billion). The ">\$50 billion" captures the asset size in excess of \$50 billion, taking the value: max (BHC asset size- \$50 billion, 0).
CI loans-to-assets	Commercial and industrial loans divided by total assets. Source: FRY9C: (BHCK1763+BHCK1764)
CRD	The excess returns (raw return minus the one-month Treasury bill rate) on an index of investment grade corporate bonds. Source: The Dow Jones Corporate Bond Return Index from Global Financial Data. One-month T-bill rate (R_f) obtained from Kenneth French's website.
Equity-to-assets	Total book value of equity divided by total assets. Source: FRY9-C: BHCK3210.
Equity volatility	The annualized standard deviation of daily stock returns. Source: CRSP.
HML	HML is the Fama French High minus low factor. It is the average return on the two value portfolios minus the average return on the two growth portfolios. Source: Kenneth French's website.
Log (assets)	The natural logarithm of total assets (in US \$000s). Source: FRY9C: BHCK2170.
LTG	The excess returns (raw return minus the one-month Treasury bill rate) on an index of 10-year bonds issued by the U.S. Treasury. Source: U.S. 10-year Government Bond Total Return Index from Global Financial Data. One-month T-bill rate (R_f) obtained from Kenneth French's website.
Market	Market is the excess return on the market, R_m-R_f, where R_m is the value-weighted return on all CRSP firms incorporated in the US and R_f is the one-month Treasury bill rate. Source: Kenneth French's website.
Market-to-book	Market value of equity divided by the book value of equity. Source: CompuStat: PRCC_C x CSHO ; FRY9C: BHCK3210.
Non-interest income	Noninterest income divided by the sum of noninterest income and interest income. Source: FRY9C: BHCK4079; BHCK4107.
No trading assets	Indicator variable that is equal to one if the bank reports no trading assets and zero otherwise.

Appendix A. Variable definitions. Continued.

Variable name	**Definition**
RE loans-to-assets	Loans secured by real estate divided by total assets. Source: FRY9C: BHCK1410; BHCK2170
Returns	Annual buy and hold returns computed from monthly stock prices. Source: CRSP.
ROA	Net income plus interest expense divided by average assets over the prior year. Average assets are computed from the quarterly FRY-9C reports. Source: FRY9C: (BHCK4340+ BHCK4073)/BHCK2170.
ROE	Net income divided by average equity over the year. Average equity is computed from the quarterly FRY-9C reports. Source: FRY9C: BHCK4340/BHCK3210.
Securities-to-assets	Total securities. Source: FRY9C: BHCK0390 (1986-1993); (BHCK1754+BHCK1773) beginning March 994
SMB	SMB is the Fama French Small minus big factor. It is the average return on the three small portfolios minus the average return on the three big portfolios. Source: Kenneth French's website.
S-T funding	Short-term debt (as defined above) scaled by total liabilities. Source: FRY9-C: (BHCK3409 + BHCK2332+ BHCK3298)/ BHCK2948.
Tail Risk	Following Ellul and Yerramilli (2013), tail risk is the negative of the average return on BHC's stock over the 5% worst return days in a given year. Source: CRSP.
Tobin's q	The market value of assets scaled by book value of assets. Market value of assets is the sum of book value of assets minus the book value of equity plus market value equity.
Total trading	The sum of trading assets and trading liabilities. Source: FRY9-C: BHCK2146 (1986-1994); BHCK3545 (since March 1995); BHCK3548
Trading assets	Total trading assets. Source: FRY9-C: BHCK2146 (1986-1994); BHCK3545 (since March 1995).
Trading-to-assets	Total trading assets as defined above divided by total assets.
Trading liabilities	Total trading liabilities. Source: FRY9-C: BHCK3548 (available only since March 1995).
Z-score	The log of Z-score. Z-score is estimated as: (ROA+equity/assets) /σ(ROA); the standard deviation of ROA, σ(ROA), is estimated as a 3-year moving average using quarterly data from the FRY9-C reports. Source: FRY9C: BHCK4340; BHCK4073; BHCK2170; BHCK3210.