Are the Largest Banks Valued More Highly?

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Some argue too-big-to-fail (TBTF) status increases the value of the largest banks. In contrast, we find that the value of the largest banks is negatively related to asset size in normal times, but much less so during the crisis. Further, shareholders lose when large banks cross a TBTF threshold through acquisitions. The negative relation between bank value and bank size for the largest banks cannot be explained by differences in ROA, ROE, equity volatility, tail risk, distress risk, or equity discount rates, but it can be partly explained by the market's discounting of trading activities. (*JEL* G21, G28, G32)

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A widely held view by academics and policy makers goes like this: banks gain from becoming bigger and 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" (Ueda and Weder di Mauro 2013, p. 29). 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" (TBTF) status gives the largest banks a competitive edge" (Santos 2014, p. 29). 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 TBTF subsidy (Brewer and Jagtiani 2013). In their "Global Financial Stability Report," the International Monetary Fund (IMF) (2014, p. 102) concluded that "banks may also seek to grow faster and larger than justified by economies of

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scale and scope to reap the benefits of the implicit funding subsidy granted to TBTF institutions."

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, p. 3) 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 the largest banks may bear larger costs than other banks because they are TBTF. These costs may be in the form of greater regulatory scrutiny, political risk, or regulatory requirements that force them to pursue suboptimal policies. Being TBTF also insulates management from shareholder monitoring, so that agency costs are likely to be higher for TBTF banks. 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 the TBTF banks increases with size from 1987 to 2017. We define TBTF banks to be those with book value of total assets in excess of $50 billion in 2010 constant dollars (the threshold for enhanced supervision of the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, hereafter Dodd-Frank) in most analyses, but conduct some analyses with a larger threshold of $100 billion. We compare the valuation of these banks to the valuation of banks that are not TBTF but could potentially become so. We call the comparison banks small banks and select bank holding companies with assets between $10 billion and $50 billion in 2010 dollars. We use the consolidated bank holding company data available from the FRY-9C reports since 1986.

Our valuation measures are 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 and preferred stock plus the market value of equity and preferred stock, and market-to-book (MB), which is the ratio of the market value of equity to the book value of equity. We find no evidence that TBTF banks are valued more highly or that their valuations increase with size. We pay special attention to the sample period ending before the crisis, because so many observers have argued that TBTF was an important contributing factor to the crisis.[1] We find that the valuations of TBTF banks are negatively related to their size from 1987 to 2006. We also estimate the relation from 1987 to 2017. Over that longer sample period, the economic magnitude and statistical significance of the negative relation are weaker, but, again, no evidence suggests that bank valuations increase with size.

We use piecewise linear models that relate bank valuation to bank size and allow the relation to differ for banks with total assets above the $50 billion threshold. Estimating these models from 1987 to 2006 and accounting for year

[1] See, for instance, Kashkari (2016).

fixed effects, we find that both the Tobin's q and the MB of TBTF banks fall 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 Tobin's q by 2.8 bps, when mean q is 1.063, and its MB by 26.5 bps, when mean MB is 1.735. Within bank results obtained using both year and bank fixed effects show that a bank is worth less when it is larger. Our results hold when we instrument bank size with lagged assets and employment. We also explore the relation between bank valuation and bank asset size using a nonparametric approach that allows us to extract the form of the relation between bank valuation and size from the data. We find that Tobin's q and MB are lower for TBTF banks than for small banks and decrease with asset size when a bank exceeds the Dodd-Frank threshold. Compared to nonfinancial firms, the negative relation between q and asset size, but not the relation between MB and asset size, is less steep for banks than other firms.

We also provide evidence supporting our results that does not rely on the use of valuation metrics. If banks gained from being larger or from becoming systemic, we would expect shareholders to gain from such increases in size through acquisitions. Because nonfinancial firms do not benefit from the safety net, at the very least, we would expect large banks to gain more from acquisitions than nonfinancial firms, especially when they cross a TBTF threshold. Throughout our sample period, acquisitions have negative abnormal returns for bank acquirers and the stock-price reaction to acquisitions for bank acquirers are not more positive than for nonbank acquirers. Using all acquisitions by banks in our sample, we can reject the hypothesis that banks benefit from crossing either the $50 billion of assets or the $100 billion of assets TBTF thresholds. In addition, we find evidence that banks that cross a TBTF threshold experience worse abnormal returns than do acquiring banks that do not cross a TBTF threshold. This evidence is stronger for acquisitions that make the acquirer cross the $100 billion threshold than for acquisitions that make the acquirer cross the $50 billion threshold. Our results are not explained by differences in target size for threshold-crossing acquisitions. Our acquisition evidence is inconsistent with the view that the valuation of banks increases when they become larger or when they cross one or the other of the TBTF thresholds.

In addition to the argument that the safety net gives banks incentives to become larger, 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 banks, but not for TBTF banks. As a result, the largest banks do not, on average, have higher equity volatility and tail risk than smaller banks. Using a bank z-score as a proxy for a bank's probability of distress, we find that distress risk increases with bank size for small banks but decreases for large banks for the whole sample period. In contrast to these results, we find that leverage is unrelated to size for small banks but increases with size 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. That tail risk and equity volatility do not increase with size for large banks and that distress risk, proxied by the z-score, decreases with size for large banks is consistent with a negative relation between asset risk and bank size for these banks. However, tail risk and equity volatility are estimated from stock returns, so these estimates could be low because TBTF dampens adverse shocks for large banks. This explanation does not hold for the distress risk results because the z-score uses the volatility of earnings, which would not be dampened unless bailout payments were made to banks. Distress risk does not increase with size over the period 1987–2006 even though there were no bailout payments to large banks over this period.

Our results relating Tobin's q and MB to bank size and our acquisition results are inconsistent with the hypothesis that TBTF banks are valued more highly than other banks 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. Also, no evidence suggests 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 is higher for large banks than for small banks, large banks should have lower valuation ratios. 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.[2] To address this issue, we examine whether TBTF banks have different stock returns than banks with assets between \$10 and \$50 billion in 2010 dollars. Over our sample period, TBTF banks do not have significantly different risk-adjusted returns from the non-TBTF banks. This result seems difficult to square with the interpretation in Gandhi and Lustig (2015) that the difference in returns between small and large banks is due to TBTF, because the risk-adjusted returns of TBTF banks are not lower than the risk-adjusted returns of banks with assets below the TBTF threshold. In any case, if TBTF banks have lower risk-adjusted stock returns, their cash flows should be valued more, not less, which would make the lower valuation of large banks difficult to explain. For instance, Kane (2014, p. 3) 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."

TBTF banks engage in different activities than small banks. In particular, noninterest income increases with asset size. We explore whether these

2 Using an international sample of financial firms from 31 countries, Gandhi, Lustig, and Plazzi (2017), find that large financial institutions' stocks earn returns that are significantly lower than those of comparable nonfinancial firms.

differences in activities can help us understand why large banks are worth less than small banks. We find that Tobin's q and MB are positively related to noninterest income. However, the negative relation between valuation ratios and bank size is robust to controlling for noninterest income and equity-to-assets. TBTF banks tend to be more diversified and more complex. Laeven and Levine (2007) show that diversified banks are worth less. Controlling for measures of diversification and complexity does not change our results. However, we find that the negative relation between size and valuation is much stronger for the banks with above-median diversification and/or complexity. The value of banks with low diversification and/or complexity does not increase with size, but it does not fall either. An obvious concern with these results is that only a few large banks have below-median diversification and/or complexity.

To better understand how the negative relation between bank value and size for large banks is related to bank characteristics, we consider additional bank characteristics using two recent papers to guide us. Huizinga and Laeven (2012) investigate how bank Tobin's q relates to the composition of bank assets using a sample period from 2000 to 2008. They show that in 2008 bank assets whose value was especially affected by the financial crisis were discounted by the market so that Tobin's q did not give credit to banks for the full book value of such assets. Calomiris and Nissim (2014) explore how the relation between MB and bank characteristics changed after the crisis in the context of a valuation model of banks that accounts for intangibles. Using an approach that builds on these papers, we investigate whether differences in bank balance sheets or activities can explain the negative relation between bank values and size for large banks. In addition to having higher noninterest income, TBTF banks have sizeable trading portfolios, more C&I loans, less real estate loans, and less deposits compared to banks with assets greater than \$10 billion and lower than \$50 billion in 2010 dollars. We show that bank value is negatively related to trading assets (orthogonalized with size) for the precrisis sample as well as for the whole sample period in regressions that control for year fixed effects. Further, an indicator variable for no trading assets has a positive significant coefficient in regressions using Tobin's q. Bank value is negatively related to C&I loans only for MB. When we control for a wide range of bank characteristics, we find that the relation between Tobin's q and size for large banks loses significance. Overall, these regressions show that the market discounts some activities that large banks engage in more than other banks, but at the same time the market values noninterest income other than trading income, which is more important for the largest banks than other banks.

We would not expect the benefits and costs of being a TBTF bank to be constant through time. Many have argued that being a TBTF bank is especially valuable during a crisis. When we look separately at the valuation of TBTF banks during the years of the global financial crisis (GFC), which we define to be 2007, 2008, and 2009, bank value falls significantly less with size above \$50 billion than outside the crisis years. However, it is still the case that bank value does not increase with size for large banks. 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 2011–2017 as the post-Dodd-Frank period, we do not find that the relation between bank valuation ratios and size is significantly different during that period. However, we show that valuation ratios are related to some bank characteristics differently during that period. Specifically, more capitalized banks are valued less and the market appears to discount noninterest income other than trading income relative to 1987–2010. Calomiris and Nissim (2014) also show a change in the relation between equity capital and bank valuation. They find that for small banks, which for them are banks with less than $2 billion of assets, capital becomes more valuable during and after the crisis. It is perhaps not surprising that we find different results for our TBTF banks as these banks are much more constrained by regulatory changes.

The literature investigating the relation between bank valuation and bank size is sparse. Boyd and Runkle (1993) pursue such an investigation. They use Compustat data from 1971 to 1990 and find that the log of bank assets is not significant in a regression of Tobin's q on the log of bank assets. However, most of their sample period predates the TBTF statement of the Comptroller of the Currency 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 to 2008 and find that MB 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. Both Huizinga and Laeven (2012) and Calomiris and Nissim (2014) split their sample into banks with assets below $2 billion and banks with assets greater than $2 billion to investigate whether the relation between bank value and bank characteristics differ between these two types of banks, but they do not investigate the relation between bank value and bank size for TBTF banks.

In contrast to the paucity of studies on the relation between bank value and bank size, a large literature investigates 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, p. 171) 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. They 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, p. 22) find "a robust inverse relationship between the size of bank holding companies and scaled measures of operating costs."

A number of studies examine whether banks gain from being TBTF and some attempt to quantify these gains. Kroszner (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 debt 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 the 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 activities and short-term funding strategies on bank risk. They document that expanding into noninterest income-generating activities and relying on nondeposit funding (activities typically associated with large banks) increases risk. Further, Laeven, Ratnovski, and Tong (2016) 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.

1. Bank Valuation and TBTF

The market value of a bank is the present value of the cash flows that accrue to all the providers of funding. A well-established literature approximates the value of future cash flows of a bank using the sum of the book liabilities plus the market value of equity (see, for instance, Demsetz and Strahan 1997; Laeven and Levine 2007; Deng and Elyasiani 2008; Huizinga and Laeven 2012). When this measure is divided by the value of assets, it is a proxy for Tobin's q. We use this measure as our main measure of bank value in this paper. For our purpose, it is a measure of the value created by the bank in excess of its balance sheet assets. Our proxy for Tobin's q is also a scale-free measure of bank value.

An alternative approach would be to follow Calomiris and Nissim (2014) and others who focus instead on the ratio of the market value of equity to the book value of equity. The numerator of the ratio is the present value of the cash flows that accrue to the equity holders. We prefer to focus on our proxy for Tobin's q as a measure of the net benefits of TBTF because it measures value created per dollar of assets. With constant returns to scale and no net benefits from TBTF, the value created per dollar of assets should not depend on the level of assets. Hence, an analysis focused on our proxy for Tobin's q provides a clear benchmark for the case with no net benefits from TBTF. However, market-to-book is widely used in the banking literature as a measure of bank value. We also show results using market-to-book, so that readers can see that our results hold for that often-used alternative valuation metric.

The benefit from TBTF is that a TBTF bank is likely to receive transfers or other forms of support from the government that will prevent it from failing. For instance, if a bank is close to failing, it could receive some form of bailout that would enable it to remain solvent. Alternatively, the government could facilitate a merger of that bank with a healthy bank, so that the owners of the liabilities of the bank would not have to suffer a loss or, if they did suffer a loss, would suffer a smaller one. Any nonzero probability of a bailout would affect the cost of liabilities of a bank as it would reduce that cost by the present value of bailout payments that would accrue to the owners of liabilities. The reduced cost of liabilities would benefit the equity holders.

It follows that if we compare two banks, where one bank benefits from TBTF and the other does not, if the two banks are otherwise the same, the TBTF bank has a higher Tobin's q or MB. This is because the present value of the cash flows is higher as it includes the present value of the amounts paid through bailouts as well as the present value of the costs of financial distress avoided as a result of bailouts. A bailout that prevents a default on a bank's liabilities has the benefit for the bank of avoiding financial distress costs that would occur in the absence of the bailout. Note that when bailouts are extremely low probability events, the impact of TBTF on Tobin's q could be small and perhaps even difficult to notice. However, that impact will be much higher in times when the probability of a bailout is higher. Consequently, the value of TBTF to a bank is not constant. It will change if the probability of bailouts changes or if the distribution of the size of bailouts changes. We would therefore expect the value of TBTF to be higher during a crisis period. Further, this value should fall if steps are taken to reduce the probability of a bailout, which was one of the objectives of the Dodd-Frank Act. We investigate whether the relation between bank value and bank size is different after the adoption of the Dodd-Frank Act and during the crisis, which allows us to consider the impact of plausibly exogenous shocks on the relation between TBTF and bank value.

Being TBTF has costs as well as benefits. These costs are particularly obvious since the crisis as the Dodd-Frank Act subjects banks whose assets exceed the $50 billion threshold to enhanced supervision and Basel II has higher capital requirements for systemically important banks. However, there are reasons to believe that supervisory, regulatory, and political costs were different for TBTF banks before the Dodd-Frank Act. These banks received more attention from politicians and from supervisors. There is no attempt we know of to quantify the costs of regulation for potentially systemically important banks compared to other banks. Because many regulations have fixed costs, regulations at times have favored large banks. For instance, large banks benefitted from rules that allowed them to use their own models for capital requirements. At the same time, however, large banks have been subject to more attention by supervisors, regulators, and politicians. There has been much controversy about the Community Reinvestment Act, but it seems without question that large banks are more affected by this Act (see, for instance, Agarwal et al. 2012). Further, large banks are subject to more frequent exams, and generally have supervisors on location throughout the year.[3] More generally, politicians are more likely to want to interfere with business decisions at the largest banks than at small banks. Finally, TBTF banks are banks that are less subject to shareholder monitoring as any attempt to acquire TBTF banks or to change their management through activism is limited given such changes require approval from regulators. Similarly, the power of the board is diminished by the influence of regulators and regulations.

Given the current state of the literature, the question of whether the potential benefits from TBTF exceed the costs has to be answered empirically. Most of our analyses use the TBTF threshold of $50 billion of assets in 2010. Though the literature has used both higher (e.g., Hughes and Mester 2013) and lower thresholds (e.g., Tsesmelidakis and Merton 2013) for when a bank is TBTF, higher thresholds shrink the sample of TBTF banks and hence reduce our ability to perform empirical analyses. Nevertheless, we conduct some analyses with the higher threshold of $100 billion that has been used in the literature.

We investigate whether bank value is related to bank size. Such an examination comes with two important difficulties. First, we do not have the counterfactual of a large bank that is not TBTF. Second, large banks differ from small banks in their activities. For instance, small banks do not typically have large trading books. Differences in the importance of the activities of large versus small banks create the obvious problem that a large bank might be valued less not because it is large but because of its activities. To address these difficulties, we use a number of different approaches, including as discussed above an examination of the impact of plausibly exogenous changes in the value of TBTF, instrumental variables, and various controls for bank activities.

It would not make sense for us to compare the largest banks to small community banks. To enable us to compare banks that engage in related activities, we select a sample of banks such that the smallest banks in our sample can undertake most activities in which the largest banks in the sample engage. At the same time, however, our sample has to include banks that are smaller than thresholds generally considered for banks to become potentially systemic, such as the $50 billion of assets threshold of Dodd-Frank for enhanced supervision. Faced with this tradeoff, we choose a sample of bank holding companies such that banks included in the sample have at least $10 billion of assets in 2010 dollars. This threshold corresponds to the smallest size of banks that have to

[3] An overview of the examination process for large complex banking organizations is available at https://www.federalreserve.gov/boarddocs/srletters/2008/SR0809a1.pdf.

conduct annual stress tests with Dodd-Frank. With this threshold we eliminate most banks that differ fundamentally in their activities from the largest banks. With such a cutoff point, our sample is quite different from the typical sample in banking studies as for typical samples the median total assets are less than our cutoff point (for instance, the median does not exceed $2 billion for Huizinga and Laeven 2012, and Calomiris and Nissim 2014). Note that a sample that does not include our size threshold but includes all BHCs in 2010 would have a median asset size of $942 million. In contrast, median assets for our sample in 2010 is $22 billion.

2. 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.[4] We collect financial information from FRY-9C reports for the fourth quarter of each year from the Federal Reserve Bank of Chicago's Web site for the period from 1986 to 2017. We start in 1986, which is the first year when the data we use are available.[5] 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.[6] We drop banks with missing data on total assets and restrict our sample to banks with assets greater than $10 billion in 2010 dollars (using the CPI as the deflator) and those with a deposits-to-assets ratio as of the prior year-end of at least 10%. As noted in the previous section, 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 194 banks and 1,914 firm-year observations over the period 1987–2017. The banks in our sample account for 80% of total banking system assets as of 2017.[7]

Table 1 shows descriptive statistics by year for our final sample of banks. The number of banks in our sample varies by year, starting from 74 at the start of the sample period, falling over time, but then increasing again to reach a peak of 77 in 2017. While the average size of the banks increases steadily from

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

5 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.

6 We use the updated FRB New York link file that has been expanded to cover the period June 1986–December 2016. We match RSSID numbers from the regulatory database with PERMCOs by name for the missing period. The linkage table is available at https://www.newyorkfed.org/research/banking_research/datasets.html.

7 Total banking system assets represent the total assets of all bank holding companies that filed the FRY-9C report as of December 2017.

Table 1
Sample description

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	74	$46.63	$25.12	$23.76	$17.65	$117.76	$91.23	24
1988	71	$48.30	$27.06	$24.28	$18.46	$109.55	$83.94	28
1989	75	$49.15	$29.07	$23.45	$19.87	$107.26	$85.73	31
1990	73	$46.06	$23.43	$23.48	$19.26	$101.98	$84.75	29
1991	70	$47.41	$27.39	$23.17	$18.27	$112.48	$78.33	27
1992	64	$52.24	$33.60	$24.60	$20.14	$113.03	$79.40	31
1993	66	$54.71	$30.15	$24.65	$18.99	$119.12	$79.27	32
1994	66	$58.73	$29.65	$22.54	$19.10	$122.05	$84.68	36
1995	60	$62.02	$29.15	$25.32	$21.04	$135.41	$99.08	33
1996	58	$69.47	$29.79	$24.17	$21.16	$149.28	$101.73	36
1997	57	$79.59	$39.64	$25.72	$24.60	$165.29	$109.21	39
1998	51	$89.04	$42.39	$28.67	$26.65	$199.71	$112.51	35
1999	55	$84.73	$37.96	$26.78	$21.84	$203.85	$107.91	33
2000	58	$88.32	$36.41	$22.94	$18.84	$195.31	$97.95	38
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	57	$146.90	$40.85	$21.35	$16.93	$307.60	$109.42	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	70	$178.88	$27.72	$22.83	$21.02	$459.77	$169.02	36
2016	74	$176.14	$27.41	$21.83	$19.87	$444.76	$148.75	36
2017	77	$182.46	$28.29	$23.12	$22.12	$461.29	$172.48	36

This table reports selected descriptive statistics for the publicly traded bank holding companies (banks) in our sample period from 1987 to 2017. 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 was at least 10%. The last column reports the percentage of banks with total assets greater than $50 billion in 2010 constant dollars.

$46.6 billion as of 1987 to $182.5 billion as of 2017, the median size of banks increases very little as it changes from $25.1 billion to $28.3 billion during the same period. The percentage of banks with assets greater than $50 billion in 2010 dollars (reported in the last column) is about 30% early in the sample period, increases to about 40% from 2005 to 2011, before declining to about 36% during the last 6 years of the sample.

We measure bank value using a proxy for Tobin's q, namely the book value of assets minus the book value of equity and preferred stock plus the market value of equity and preferred stock, scaled by the book value of assets, as well as the market-to-book ratio (market value of equity divided by the book value of equity). 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 book equity over the prior year. We use annual buy and hold stock returns as an additional measure of performance. We use four measures of risk: (1) z-score: log of (ROA + equity-to-assets), scaled by the standard deviation of ROA (Demsetz and Strahan 1997),[8] (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), (3) equity volatility: the annualized standard deviation of daily stock returns, and (4) leverage: we use book equity over assets, which falls with leverage, as our proxy for leverage. We also use a measure of income diversity from Laeven and Levine (2007). This measure is one minus the absolute value of the ratio of (net interest income – other operating income) to operating income. Finally, we use the efficiency ratio, which is the ratio of noninterest expenses to noninterest income. Table A1 provides a detailed description of all variables used in the study.

Table 2 shows descriptive statistics for the main variables used in our analyses for the whole sample, for small banks, and for TBTF 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 statistics for our two valuation measures. 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 bank 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 1.065. We see from Table 2 that, though TBTF 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. The same result holds for market-to-book.

Our next three measures are tail risk, equity volatility, and leverage. These measures are not significantly different between large banks and small banks in our sample. Bank stocks earn 13.4% per year during our sample period. The difference in returns between large and small banks is insignificant. We also see that large banks have less tangible equity. We find no significant differences in ROA and ROE. However, small banks have a higher z-score than large banks, which means that they are further away from the distress threshold. The difference is economically small. As expected, large banks have significantly higher noninterest income and a lower ratio of core deposits to total assets than small banks. They also have more trading assets relative to assets. Small banks make more real estate loans but fewer C&I loans. On average, large banks have significantly higher loan charge-offs. They hold less securities. They have less agency mortgage-backed securities (MBS). There is no significant difference

8 The standard deviation of ROA is estimated using quarterly data using a 3-year rolling window.

Table 2
Descriptive statistics

	Full sample			Small banks (\$10–\$50B)			Large banks (>\$50B)			Test of difference (p-value)	
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median
Tobin's q	1.065	1.045	0.057	1.066	1.047	0.058	1.063	1.057	0.057	(.834)	(.849)
Market-to-book	1.757	1.524	0.687	1.769	1.544	0.696	1.735	1.529	0.695	(.846)	(.762)
Tail risk (%)	4.314	3.465	2.339	4.259	3.405	2.177	4.435	3.626	2.627	(.776)	(.816)
Equity volatility (%)	32.150	27.091	17.213	31.740	26.891	15.994	33.079	27.481	19.334	(.767)	(.905)
Equity-to-assets (%)	8.876	8.699	1.884	8.946	8.755	1.850	8.710	8.860	2.030	(.634)	(.598)
Returns	0.134	0.102	0.267	0.132	0.066	0.270	0.133	0.134	0.278	(.995)	(.883)
Tangible equity-to-assets	0.064	0.063	0.011	0.068	0.068	0.011	0.058	0.058	0.013	(.002)	(.002)
ROA	0.036	0.040	0.017	0.035	0.039	0.017	0.037	0.041	0.018	(.573)	(.410)
ROE	0.110	0.123	0.062	0.107	0.127	0.064	0.111	0.123	0.068	(.828)	(.335)
z-score	2.940	2.894	0.241	2.979	2.913	0.230	2.857	2.874	0.327	(.095)	(.093)
Noninterest income-to-income	0.261	0.268	0.061	0.226	0.229	0.044	0.319	0.315	0.096	(.000)	(.000)
Core deposits-to-assets	0.576	0.573	0.047	0.619	0.624	0.045	0.494	0.498	0.052	(.000)	(.000)
Trading assets-to-assets (%)	0.018	0.017	0.004	0.005	0.005	0.002	0.040	0.039	0.010	(.000)	(.000)
Trading assets-to-assets residuals	−0.004	−0.004	0.004	−0.013	−0.013	0.002	0.011	0.011	0.009	(.000)	(.000)
RE loans-to-assets	0.322	0.338	0.054	0.364	0.384	0.074	0.249	0.245	0.047	(.000)	(.000)
CI loans-to-assets	0.149	0.140	0.026	0.143	0.141	0.022	0.161	0.148	0.040	(.036)	(.208)
Net charge-offs-to-assets	0.005	0.003	0.004	0.004	0.003	0.004	0.006	0.005	0.004	(.067)	(.005)
Securities-to-assets	0.201	0.204	0.021	0.220	0.217	0.026	0.167	0.171	0.024	(.000)	(.000)
MBS-agency-to-assets	0.110	0.113	0.021	0.124	0.131	0.025	0.088	0.084	0.019	(.000)	(.000)
Growth in assets	0.073	0.069	0.051	0.073	0.075	0.051	0.071	0.061	0.070	(.881)	(.668)
Income diversity	0.475	0.482	0.073	0.419	0.449	0.089	0.566	0.574	0.064	(.000)	(.000)
Efficiency ratio	2.168	2.178	0.349	2.473	2.377	0.465	1.632	1.600	0.253	(.000)	(.000)
Other noninterest income-to-assets	0.020	0.019	0.003	0.018	0.017	0.004	0.024	0.024	0.005	(.000)	(.000)

Table 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). Table A1 defines all variables.

in asset growth between small and large banks. Next, we consider the income diversity. Whether we consider the mean or the median, the metric for large banks is significantly larger than the metric for small banks. Lastly, we show results for the efficiency ratio, which is the ratio of noninterest expenses to noninterest income. This ratio is significantly smaller for large banks, which means that, using this metric, they are more efficient.

3. Bank Valuation and Bank Size

It has been widely noticed that valuations of banks after the crisis have been much lower (e.g., Calomiris and Nissim 2014; Sarin and Summers 2016). Figure 1A shows the yearly average of Tobin's q for large banks and for small banks. Post-crisis averages for Tobin's q are low compared to the 10 years before the GFC, but not compared to averages of Tobin's q at the beginning of our sample period. The figure shows that the Tobin's q of banks sharply increases 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

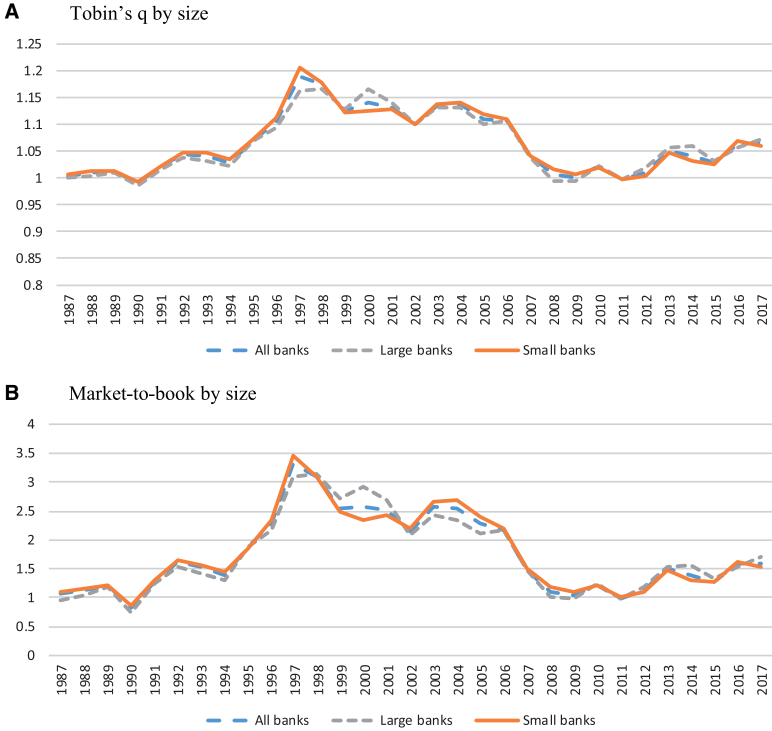

Figure 1
Plot of Tobin's q and Market-to-book for small and large banks
Figure 1A (1B) shows the yearly average Tobin's q (MB) for the full sample of banks and for large banks (total assets greater than \$50 billion) and small banks (assets between \$10 and \$50 billion).

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 3.6% 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 3.5% 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 3.6% of the average Tobin's q of banks. The large banks are always valued less than the small banks, except for two periods. Large banks are valued more from 1999 to 2002 and from 2010 to the end of the sample, except for 2016. We do not show results for medians, but they are similar except that the median Tobin's q of large banks is lower than the median Tobin's q of small banks for all years since the crisis, except 2017. As shown in Figure 1B, the patterns for MB for the whole sample, large banks, and small banks are similar to the patterns for Tobin's q.

To assess how valuation ratios are related to asset size, we use a battery of different approaches. Estimates of our main models are reported in Section 3.1. In Section 3.2, we show results using a nonparametric approach. In Section 3.3, we use instrumental variables for bank size. In Section 3.4, we consider whether the impact on shareholder wealth of acquisition announcements by banks differs depending on the size of the bank and whether the acquisition enables the bank to cross a threshold that makes it more likely to be a TBTF bank. Finally, in Section 3.5, we compare the relation between valuation ratios and size for banks and nonbanks.

3.1 Valuation ratios and bank size regressions

To assess the relation between bank valuation ratios and bank size, we want 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. As noted previously, a large bank typically 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. We also estimate regressions with bank fixed effects, assuming that a bank's activities are relatively stable over time so that their impact on valuation is captured through the bank fixed effects. However, regressions with bank fixed effects only tell us how the value of a bank differs when it is large, as opposed to telling us how TBTF banks are valued relative to other banks.

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 two different ways to relate valuation ratios 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 valuation ratios to be linear with different slopes depending on whether the respective bank crosses the \$50 billion TBTF constant dollars threshold. The second approach is nonparametric and allows the data to dictate the relation between bank valuation ratios and bank size.

In this section, we estimate first the relation between bank size and bank valuation ratios for the precrisis period (1987 to 2006) and for the whole sample period. Table 3, panel A, shows results for Tobin's q and panel B for MB. In each panel, we have two sets of four regressions, one set for the precrisis period and one set for the whole sample period. The first two regressions in each panel have no variables corresponding to 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

Table 3
Bank size and valuation ratios

A. Tobin's q

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1987–2006				**1987–2017**			
\$10–\$50B	0.2225	−1.1997**	−0.2339	−0.8570**	0.1844	−1.1860**	−0.3250	−0.9393*
	(0.93)	(−2.28)	(−1.01)	(−1.99)	(0.78)	(−2.27)	(−1.50)	(−1.95)
>\$50B	−0.0695***	−0.0947***	−0.0643***	−0.0860***	−0.0285***	−0.0201	−0.0321***	−0.0198
	(−2.80)	(−3.00)	(−2.86)	(−3.12)	(−4.01)	(−1.29)	(−4.48)	(−1.37)
Noninterest income			0.3079***	0.1444*			0.1896***	0.1675**
			(4.64)	(1.68)			(3.75)	(2.15)
Equity-to-assets			1.1587***	−0.1036			0.3171	−0.2224
			(3.17)	(−0.38)			(1.17)	(−1.07)
Constant	0.9997***	1.0405***	0.8972***	1.0201***	1.0001***	1.0369***	0.9669***	1.0277***
	(135.77)	(96.49)	(34.10)	(42.38)	(137.33)	(104.74)	(46.77)	(58.56)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,246	1,246	1,246	1,246	1,914	1,914	1,914	1,914
Adjusted R^2	.439	.794	.606	.797	.418	.753	.508	.764
# of banks	145	145	145	145	194	194	194	194

B. Market-to-book

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
\$10–\$50B	1.7681	−16.0858**	−4.1843	−13.6214**	1.4495	−15.8379**	−3.9282*	−14.4748**
	(0.64)	(−2.32)	(−1.57)	(−2.20)	(0.56)	(−2.36)	(−1.72)	(−2.37)
>\$50B	−0.6625**	−1.1164***	−0.7473***	−1.0408***	−0.2761***	−0.2723	−0.3688***	−0.2684
	(−2.38)	(−2.97)	(−2.61)	(−2.94)	(−3.85)	(−1.46)	(−5.09)	(−1.60)
Noninterest income			3.3554***	1.4828*			1.9369***	1.5473**
			(6.69)	(1.80)			(4.66)	(2.03)
Equity-to-assets			0.5565	−9.5883**			−3.4091	−7.9713***
			(0.17)	(−2.21)			(−1.62)	(−2.96)
Constant	1.0151***	1.5318***	0.6363***	1.8776***	1.0178***	1.4877***	1.0742***	1.8043***
	(11.32)	(9.51)	(2.82)	(4.84)	(11.98)	(11.77)	(6.49)	(7.29)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,246	1,246	1,246	1,246	1,914	1,914	1,914	1,914
Adjusted R^2	.477	.746	.588	.755	.472	.721	.547	.736
# of banks	145	145	145	145	194	194	194	194

Table shows results from OLS regressions of bank valuation ratios on proxies for bank size. Panel A uses Tobin's q, and panel B uses market-to-book. The "\$10–\$50B" variable captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion). The ">\$50B" 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 US\$ trillions. Control variables include noninterest income-to-income, and equity-to-assets. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$.

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.[9]

The first four regressions of panel A are for the 1987–2006 sample period and the last four are for the 1987–2017 period. Regression (1) captures the cross-sectional 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 -0.0695. Median q for the sample is 1.045. Consequently, a bank with assets in constant dollars that has \$150 billion of assets, roughly the median assets of large banks, has a q that is lower by 0.00695 than a bank with \$50 billion of assets, which means that the q of the larger bank is lower by approximately 0.66% of median q. 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 -1.199. The interpretation is that an increase in assets of \$10 billion is associated with a reduction in Tobin's q of 0.012. The slope for assets greater than \$50 billion is negative and significant as well. The estimate is larger in absolute value than in Regression (1) as it is -0.0947. 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: noninterest 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 insignificant, while the coefficient on assets above \$50 billion is significant and is similar to the same coefficient in Regression (1). The coefficient on noninterest income is positive and significant, so that banks that have more noninterest income have a higher Tobin's q. 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 affect the size coefficients in the model with bank fixed effects. Though noninterest income has a significant coefficient with bank fixed effects, equity-to-assets does not. Regressions (3) and (4) show that controlling for these important bank characteristics essentially does not affect the relation between bank size and bank Tobin's q.

[9] 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.

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 like 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 is negatively related to size like in Regression (2). Now, however, the value of large banks no longer falls with size. Regressions (7) and (8) control for noninterest 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).

The regressions without bank fixed effects tell us about the relation between bank size and q in the cross-section. In contrast, the regressions with bank fixed effects tell us about how a bank's q changes as its size changes. 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. It is important to note, however, that all the results with bank fixed effects show that the value of banks with assets between \$10 billion and \$50 billion falls with size, so that TBTF banks are worth less than other banks.

Though we do not tabulate the results, we also estimate our regressions separately for 1987–2010. With the 1987–2010 period, the value of large banks significantly falls 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 for the whole sample is due to the addition of the years following the adoption of Dodd-Frank. We examine how the relation between valuation ratios and size evolves from before to after Dodd-Frank in Section 5. Again, without tabulating the results, we reestimate the regressions of panel A using the logarithm of assets instead of the piecewise linear model. For the precrisis period, the coefficient on the logarithm of bank size is significantly negative for all regressions except in the regression with only the logarithm of bank size and year fixed effects. For the whole sample period, we observe similar results. Finally, 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; 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. Note that the absence of a positive significant coefficient cannot be attributed to a lack of power in that the coefficient estimates are always negative.

We now turn to the results in panel B of Table 3. These results use MB as the dependent variable instead of Tobin's q. The significance in the coefficients on bank size in panel B replicates the results in panel A. Not surprisingly, the magnitude of the coefficients differs sharply between panel B and panel A, as the coefficients in Panel B are roughly 10 times the coefficients in panel A. This means that an increase in assets from \$50 to \$150 billion is associated with a decrease in MB of 0.07 (a 4.6% decrease relative to the median of 1.52), in contrast to a decrease in q of 0.006.

In summary, the regressions of Table 3 consistently show that the value of large banks falls with size before the crisis. The results that directly address the question we are focused on are the results with only year fixed effects, as these results are informative about whether TBTF banks are valued less than other banks in the cross-section. These results hold throughout the sample period and show that the value of TBTF banks is negatively related to their size.

3.2 Nonparametric 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 valuation ratios without such assumptions. First, Figure 2 shows scatterplots. We obtain these scatterplots by taking residuals of regressions of valuation ratios on year fixed effects. By doing so, we remove the

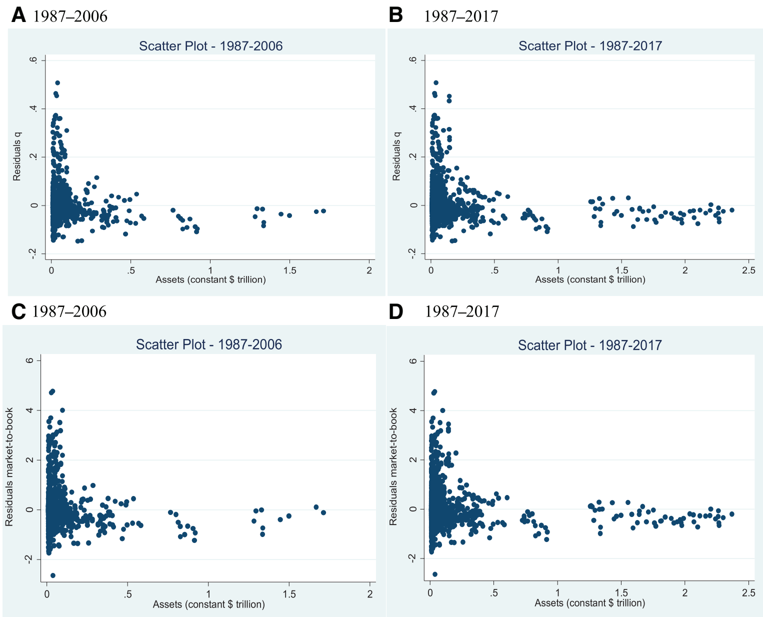

Figure 2
Scatterplots
The graphs show scatterplots of residuals from regressions of Tobin's q (MB) on year fixed effects on asset size (in constant US\$ trillion). Figures 2A and 2B (2C and 2D) show scatterplots for the periods 1987–2006 and 1987–2017 for Tobin's q (MB) residuals, respectively.

comovement of valuation ratios across banks and can focus on differences in the cross-section. Figures 2A and 2B show the residuals of regressions of Tobin's q on year fixed effects plotted against asset size for the period 1987–2006 and the period 1987–2017, respectively. Turning first to the precrisis period, we find 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 find banks with positive residuals. However, it is quite clear that most banks over that range have negative residuals. No evidence here supports the view that large banks have higher valuations. When we turn to the whole sample period, we find six observations of banks with assets in excess of $500 billion with positive residuals. Yet, as for the precrisis sample, most observations for large banks have negative residuals. In contrast, for both figures, the smallest banks have a distribution of residuals that stretches towards high positive residuals, so that the distribution is skewed towards positive values. Figures 2C and 2D show the residuals of the regression of MB on year fixed effects plotted against asset size for the two sample periods. The results are similar to those found for panel A.

The scatterplots 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 nonparametric regression to show the relation between valuation ratios 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. Figures 3A and 3B show the local polynomial smoothing for Tobin's q. Starting with the results for the precrisis period (Figure 3A), 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. With very few observations for banks with assets exceeding $1 trillion in constant dollars, the confidence interval is quite large. However, the estimates for banks in excess of $250 billion are always significantly lower than the estimates 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 becomes negative as assets increase beyond $50 billion. When we turn to the whole period in Figure 3B, the smoothed line has a shape similar to that of the smoothed line for the precrisis period, but with a range of asset values between $1 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 line slopes downward, and it is again clear that large banks have lower valuations.

Figures 3C and 3D show the results for MB. The estimates for large banks are also always below the estimates for small banks. The confidence interval

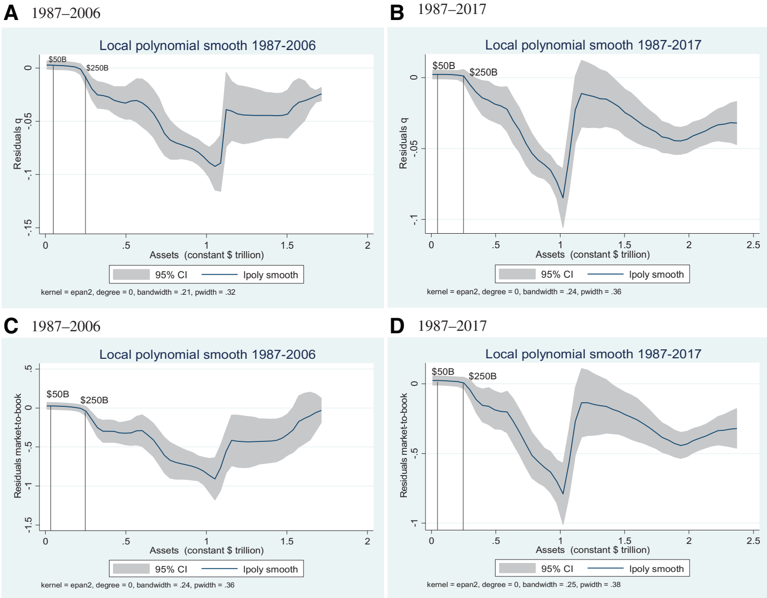

Figure 3
Tobin's q and size
The figure shows the relation between Tobin's q (MB) and size implied by nonparametric regressions. We first obtain residuals by estimating OLS regressions of Tobin's q (MB) on year fixed effects. The solid lines in the figures are obtained from local polynomial regressions 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. Figures 3A and 3B show graphs for the period 1987–2006 and 1987–2017 for Tobin's q, respectively. Figures 3C and 3D show results using MB.

for large banks is also almost always below the confidence interval for small banks.

3.3 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 valuation ratios and size, but a relation between valuation ratios 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 employed in the literature. Our results that the coefficients on the size variables are little affected by the addition of control variables is comforting in this regard. Second, reverse causation could be at play, so that valuation ratios affect 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 valuation ratios also increases the value of assets because some, but 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.

Panel A of Table 4 estimates 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 at t on assets at t-1 and the log of the number of employees at t-1 and does the same for small bank assets. The first-stage regressions 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 positive but insignificant. When we turn to Regression (2) which has bank fixed effects, both coefficients are significantly negative. The next two regressions include equity-to-assets and noninterest 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) reestimate the coefficients for the whole sample period. All the estimates are consistent with the ordinary least squares (OLS) results.

Panel B of Table 4 shows results for MB. The main difference between panel B and panel A is that in panel B the coefficient on size for large banks is significantly negative in all regressions, except Regression (6). Consequently, using instrumental variables appears to make our results somewhat stronger.

3.4 Do shareholders gain when banks cross TBTF thresholds?

Results showing that shareholders gain when large banks become larger or when banks cross a TBTF threshold would be inconsistent with the results shown so far in this section. Because nonfinancial acquirers typically do not have positive stock-price reactions when they announce a bid, evidence that bank acquirers have more positive stock-price reactions than nonfinancial acquirers would raise questions about the interpretation of the results presented earlier and suggest that TBTF status comes with valuation benefits. Consequently, looking at abnormal returns for acquisitions by banks provides additional evidence on the relation between bank size and value[10]

We examine cumulative abnormal returns (CARs) of acquirers. We collect announcement dates from Securities Data Company (SDC) and only look at acquisitions of majority stakes of public targets by banks in our sample. We estimate CARs using a market model estimated from 250 days to 21 days prior to the announcement of the acquisition. During the period, 606 acquisitions involving public acquirers are completed. The literature that evaluates announcement effects of acquisitions typically uses CAR windows

10 An extremely large literature addresses mergers and acquisitions in the financial industry. DeYoung, Evanoff, and Molyneux (2009) review the recent literature and conclude that “the event-study literature presents a mixed picture regarding stockholder wealth creation” (p. 87). They do not report results on stockholder wealth creation through acquisitions crossing TBTF thresholds.

Table 4
Regressions with size instrumented

A. Tobin's q

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1987–2006				**1987–2017**			
\$10–\$50B	0.221	−1.200**	−0.235	−0.857**	0.184	−1.186**	−0.326	−0.939**
	(0.93)	(−2.46)	(−1.03)	(−2.14)	(0.79)	(−2.42)	(−1.52)	(−2.08)
>\$50B	−0.070***	−0.095***	−0.064***	−0.086***	−0.029***	−0.020	−0.032***	−0.020
	(−2.83)	(−3.23)	(−2.89)	(−3.37)	(−4.06)	(−1.38)	(−4.53)	(−1.46)
Equity-to-assets			1.158***	−0.104			0.317	−0.222
			(3.20)	(−0.41)			(1.18)	(−1.14)
Noninterest income			0.308***	0.144*			0.190***	0.168**
			(4.70)	(1.81)			(3.80)	(2.30)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,245	1,245	1,245	1,245	1,913	1,913	1,913	1,913
Adjusted R^2	.449	.793	.606	.798	.425	.752	.508	.765
First-stage F-stat p-value	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
# of banks	145	145	145	145	194	194	194	194

B. Market-to-book

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
\$10–\$50B	1.726	−15.177**	−3.853	−12.854**	1.434	−15.021**	−3.700*	−13.705**
	(0.65)	(−2.51)	(−1.57)	(−2.36)	(0.57)	(−2.47)	(−1.73)	(−2.46)
>\$50B	−0.649**	−1.084***	−0.731***	−1.014***	−0.273***	−0.268	−0.364***	−0.264*
	(−2.42)	(−3.25)	(−2.65)	(−3.25)	(−3.92)	(−1.56)	(−5.21)	(−1.70)
Equity-to-assets			0.231	−8.169**			−3.597*	−7.433***
			(0.07)	(−2.55)			(−1.78)	(−3.33)
Noninterest income			3.129***	1.354*			1.844***	1.469**
			(7.35)	(1.84)			(4.82)	(2.21)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,245	1,245	1,245	1,245	1,913	1,913	1,913	1,913
Adjusted R^2	.499	.536	.605	.552	.487	.561	.562	.584
First-stage F-stat p-value	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
# of banks	145	145	145	145	194	194	194	194

Table shows estimates from 2SLS regressions of bank valuation ratios (Tobin's q in panel A and market-to-book ratio in panel B) on proxies for bank size. We use two instruments: (1) *Number of 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–\$50B" variable captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion). The ">\$50B" 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 noninterest income-to-income, and equity-to-assets. We report p-values from the first-stage partial F-tests of the null hypothesis that the instruments are jointly zero. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

from 3 days centered on the event date to 11 days centered on the event date. We show results for a 3-day window, a 5-day window, and an 11-day window. The 5-day window is motivated by the fact that for acquisitions that cross the $50 billion TBTF threshold the estimate of the mean CAR is quite different from the 3-day window, but not from the 11-day window. We also estimated CARs for longer windows starting on the day before the announcement, but returns become noisier as the window is extended. We show results for the window from the day before the announcement to the tenth day after.

Panel A of Table 5 reports mean and median CARs for banks classified as small or large based on their asset size immediately prior to the acquisition. The mean and median CARs are negative and significantly different from zero for both groups of banks. However, the mean and median CARs for large banks are not statistically different from those for small banks. The results are similar for the four event windows we consider.

A negative reaction to an acquisition announcement for the bidder's stock is not unusual. For instance, a recent study using a sample of acquisitions by nonfinancial public firms from 1980 to 2014 finds an average abnormal return for acquisitions of public firms of −1.39% (Schneider and Spalt 2016). This average abnormal return is similar to the average abnormal returns we document in Table 5. At the very least, however, our evidence shows that acquisitions are not more valuable for banks above the $50 billion threshold than for banks below that threshold, which is inconsistent with the view that TBTF banks benefit from becoming larger.

The evidence we turn to next has no parallel among nonfinancial firms as crossing a threshold of $50 billion of assets or $100 billion of assets has no meaning for these firms. Panel B reports the mean acquirer CAR for deals in which the acquirer crosses the $50 billion and $100 billion TBTF thresholds.[11] In 16 (16) deals, acquirers pass the $50 ($100) billion threshold. We compare the mean CAR of the acquirers crossing a threshold to the mean CAR of acquirers with assets below or above the threshold. Specifically, we compare acquirers crossing the $50 billion threshold to acquirers with assets from $10 to $100 billion who do not cross the $50 billion or the $100 billion threshold, and compare the acquirers crossing the $100 billion threshold to acquirers with assets above $50 billion who do not cross the $100 billion threshold. As before, the thresholds are in 2010 dollars and so are bank assets.

Starting with acquirers crossing the $50 billion threshold, we find that, for the 3-day window, the CAR for the threshold-crossing deals is −2.4% and the CAR for the comparison deals is −1.5%. We can reject the TBTF hypothesis that threshold-crossing deals are better than other deals, but no evidence suggests that threshold-crossing deals are worse deals. Turning to the 5-day window,

[11] We classify a deal as crossing the $50 billion ($100 billion) threshold if both the acquirer and the target have total assets below $50 ($100) billion prior to the announcement of the deal, but the combined asset size exceeds the threshold after the deal.

Table 5
Cumulative abnormal returns

A. CARs by acquirer size

		CAR (-1,+1)			CAR (-2,+2)			CAR (-5,+5)			CAR (-1,+10)		
	N	Mean	Median	% positive	Mean	Median	% positive	Mean	Median	%positive	Mean	Median	% positive
Small	364	−0.015***	−0.012	29.12	−0.016***	−0.014	29.40	−0.018***	−0.018	33.79	−0.021***	−0.020	32.97
Large (>$50B)	242	−0.013***	−0.010	35.54	−0.015***	−0.012	31.82	−0.016***	−0.017	35.12	−0.014***	−0.016	39.26
Difference		−0.002	−0.002		−0.001	−0.001		−0.002	−0.001		−0.006	−0.003	
p-value		(.518)	(.438)		(.880)	(.918)		(.642)	(.998)		(.238)	(.329)	
B. Deals crossing threshold													
Deals crossing $50B	16	−0.024*	−0.011	37.50	−0.033**	−0.024	12.50	−0.035**	−0.032	12.50	−0.044**	−0.030	12.50
Deals (under $50B or $50–$100B)	367	−0.015***	−0.013	29.16	−0.016***	−0.014	30.52	−0.018***	−0.016	36.51	−0.020***	−0.018	34.33
Difference		0.009	−0.001		0.017*	0.011*		0.017	0.016		0.024	0.012	
p-value		(.285)	(.645)		(.070)	(.086)		(.199)	(.171)		(.126)	(.133)	
Deals crossing $100B	16	−0.035**	−0.051	18.75	−0.035**	−0.039	18.75	−0.048***	−0.040**	18.75	−0.041**	−0.035	18.75
Deals ($50B–$100B or deals >$100B)	303	−0.011***	−0.009	35.31	−0.013***	−0.010	33.66	−0.014***	−0.014	36.30	−0.013***	−0.015	39.93
Difference		0.025**	0.042**		0.022**	0.029**		0.034**	0.026**		0.028	0.020*	
p-value		(.017)	(.021)		(.041)	(.030)		(.035)	(.031)		(.056)	(.066)	

This table shows average cumulative abnormal returns (CARs) for acquirers in completed acquisitions of majority stakes of public targets. Data on acquisitions are obtained from the SDC. We compute CARs using a market model estimated from 250 days to 21 days prior to the announcement of the acquisition. Panel A shows CARs based on acquirer's asset size prior to the acquisition. Small (large) acquirers are those with total assets below (above) $50 billion as of the quarter end prior to the announcement of the acquisition. Panel B shows acquirer CARs for deals that cross the $50 ($100) billion threshold. We classify a deal as crossing the $50 billion ($100 billion) threshold if both the acquirer and the target each has total assets below $50 ($100) billion prior to the announcement of the deal, but the combined asset size exceeds the threshold after the deal. We report p-values for t-test (Wilcoxon signed rank) tests of differences in mean (median). $^{*}p<.1$; $^{**}p<.05$; $^{***}p<.01$.

we see that the mean CAR for threshold-crossing deals worsens by over a half a percentage point. Now, we find that the deal-crossing deals are worse than other deals. The difference between the mean CAR for threshold-crossing deals and other deals is a large 1.7 percentage points. For the 11-day window, the mean CAR for deal-crossings is not statistically different from other deals. Finally, for the (-1,10) window, the CAR difference is economically large at 2.4 percentage points, but it is not significant. We perform the same analysis for deals crossing the \$100 billion threshold. In that case, for each event window, the threshold-crossing deals have a significantly lower mean CAR than the other deals.

A concern with these results is that target size might be different for threshold-crossing deals. To examine that possibility, we estimated regressions of CAR on a constant, an indicator for TBTF threshold crossing, target size, and year fixed effects. Though we do not tabulate the results, the results for deals crossing \$50 billion, but not those for deals crossing \$100 billion, are weaker than in Table 5, in that there are fewer instances where we reach the conclusion that threshold-crossing deals are worse deals. It is noteworthy that in these regressions the indicator variable on threshold crossing attracts large significant coefficients in absolute value for the (-1,10) window. The coefficient is -3.1% for the deals crossing the \$50 billion threshold and -3.81% for deals crossing the \$100 billion threshold.

Overall, the results of Table 5 show that we can reject the hypothesis that threshold-crossing deals are better for shareholders than other deals, whether the threshold is \$50 billion or \$100 billion, as would be predicted by the hypothesis that TBTF status increases bank value. Instead, we cannot reject the hypothesis that threshold-crossing deals are worse than other deals for the threshold of \$100 billion and for the 5-day window for the threshold of \$50 billion. Further, there is no basis in the table to conclude that banks benefit from acquisitions more than do other firms because of TBTF.

3.5 Size and valuation ratios: Banks versus nonfinancial firms

Banks are quite different in their production technology from typical nonfinancial firms. It seems reasonable to believe most nonfinancial firms experience decreasing returns to scale. As mentioned earlier, the evidence on whether banks experience decreasing returns to scale or increasing returns to scale is mixed, but the more recent literature seems to be more favorable to the hypothesis of increasing returns to scale. In the presence of adjustment costs, it would not be surprising to see a negative relation between valuation ratios and size for firms experiencing decreasing returns to scale. Hence, if one were to compare the relation between valuation ratios and size for nonfinancial firms, one would expect it to be different than it is for banks. Table 6 uses our sample of banks and matches each bank to a nonfinancial firm with book assets closest to the book assets of the bank. We drop banks for which we cannot find a nonfinancial firm with book assets within 20% of the book assets of the bank.

Table 6
Banks, nonfinancial firms, valuation ratios, and size

	Tobin's q		Market-to-book	
	(1)	(2)	(3)	(4)
	1987–2006	**1987–2017**	**1987–2006**	**1987–2017**
Bank x \$10–\$50B	−4.0148	−3.5477	−10.6393	−5.7283
	(−1.45)	(−1.53)	(−1.21)	(−0.79)
Bank x >\$50B	1.0086**	0.8029**	−0.3610	0.0591
	(2.05)	(1.99)	(−0.15)	(0.03)
\$10–\$50B	4.2900	4.0892*	13.7497*	9.5982
	(1.58)	(1.81)	(1.67)	(1.46)
>\$50B	−1.2803***	−1.0415***	−1.0059	−1.2169
	(−2.59)	(−2.59)	(−0.43)	(−0.73)
Bank	−0.3478***	−0.4070***	−0.3279	−0.7237***
	(−4.31)	(−5.94)	(−1.36)	(−3.75)
Constant	1.2716***	1.2991***	1.3599***	1.6049***
	(10.94)	(12.85)	(4.07)	(5.67)
Observations	2,418	3,658	2,418	3,658
Adjusted R^2	.235	.235	.263	.250
# of banks	416	575	416	575
F-test >\$50B + Banks x >\$50B=0	14.76	14.14	10.27	8.545
p-value	(.000)	(.212)	(.002)	(.004)
F-test \$10–\$50B + Bank x \$10–\$50B=0	0.362	1.561	1.136	1.812
p-value	(.548)	(.000)	(.287)	(.179)

Table shows results from OLS regressions of bank valuation ratios on proxies for bank size for banks and a matched sample of nonfinancial firms. We match each bank to a nonfinancial firm with book assets closest to the book assets of the bank. We drop banks with no nonfinancial firm with book assets within 20% of the book assets of the bank. The "\$10–\$50B" variable captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion). The ">\$50B" 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 \$US trillions. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. *$p<.1$; **$p<.05$; ***$p<.01$.

We then reestimate the regressions of Table 3 that have only size variables on the matched sample, but add a bank indicator variable that we interact with the size variables. We use only year fixed effects.

Regression (1) of Table 6 regresses Tobin's q on the size variables, the bank indicator variable, and the interaction of the bank indicator variable and the size variables for the period 1987–2006. We find that banks have a lower Tobin's q than nonfinancial firms. The difference is large as it represents more than 30% of the sample mean of Tobin's q for banks. The interaction between size and the bank indicator variable is insignificant for small banks, but it is positive and significant for large banks. For nonfinancial firms with assets greater than \$50 billion, the coefficient on size above \$50 billion is −1.2803 and it is significant at the 1% level. The interaction coefficient is 1.0086 and it is significant at the 5% level. The sum of the coefficients is significantly negative. It follows from this evidence that bank Tobin's q falls less with size than the Tobin's q of nonfinancial firms. The same results hold for the whole sample, except that the sum of the coefficients for large banks is not significantly negative.

We then use MB in Regressions (3) and (4). The results for MB are surprisingly different from the results for Tobin's q. The coefficient on size in excess of the \$50 billion threshold is not significant and neither is the interaction with the bank indicator variable. However, when we look at the sum of the coefficients for large banks, the sum is significantly negative. In other words, though MB does not fall with size above the $50 billion threshold for nonfinancial firms, it does fall for banks.

4. Why Are TBTF 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; the numerator of MB is the present value of the cash flows to equity. We would expect large banks to be worth less than small banks if they are riskier than small banks. In this case, large banks are more likely than small banks to incur costs of financial distress and their expected cash flows would be discounted at a higher rate. Everything else equal, large banks also should be worth less than small banks if their accounting performance is worse than the accounting performance of small banks as they would have lower future expected cash flows. Finally, the market may discount some activities that large banks engage in more than small banks. In this section, we explore these possible explanations for the lower valuation of TBTF banks.

4.1 Are TBTF banks riskier than small banks?

The issue of whether TBTF banks are riskier than small banks is interesting by itself as many observers argue that TBTF banks take more risks because of their TBTF status. In addition, 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 the bank's value because the present value of increased distress costs could be associated with higher cash flows in nondistress 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 large banks have a higher probability of distress costs than small 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. The first measure is the log of the bank z-score (e.g., Demsetz and Strahan 1997). The second measure is a proxy for leverage. Keeping the risk of the assets constant, an increase in leverage makes equity riskier. However, as pointed out by DeAngelo and Stulz (2015), banks have incentives to adjust asset risk to maximize the value of what they receive from the liabilities they produce, such as deposits. The third measure is tail risk, and the last measure is equity volatility.

Table 7 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 7 shows estimates of regressions where we use the piecewise linear model for the precrisis sample. 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 not for large banks. For large banks, the size coefficient is positive but insignificant. In other words, for large banks, an increase in bank size is not associated with a worsening of the z-score. When we also use bank fixed effects in Regression (2), we find the same results. 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 for large banks as their size increases, so 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, but not large banks. When we turn to equity volatility in Regressions (7) and (8), the results are similar.

Panel B of Table 7 shows estimates of the regressions of panel A using the whole sample period. In Regressions (1) and (2), we see that the z-score falls with bank size for small banks (though the t-statistic is only -1.61 when we have bank fixed effects), but then increases for large banks, so that large banks become safer as they grow larger. 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 for the precrisis sample and for the whole sample. No other risk metric is significant for large banks before 2006. For the whole sample, the z-score increases with size for large banks. As long as the risk of assets and cash flows of large banks fall with size, these results show no inconsistencies. 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. They are also inconsistent with the hypothesis that TBTF leads larger banks to take more risks.

4.2 Do TBTF banks perform worse than small banks?

If the income of large banks falls with assets, we expect their valuation to fall with assets as well. Table 8 explores 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. We see in Regression (1) that ROA increases with size for small banks and is unrelated

Table 7
Bank size and risk

A. 1987–2006

Dependent variable	(1) z-score	(2)	(3) Equity-to-assets	(4)	(5) Tail risk	(6)	(7) Equity volatility	(8)
\$10–\$50B	−4.5763***	−4.8111*	−4.2238	−8.1667	10.7361***	20.2427***	83.2968***	133.2197**
	(−3.44)	(−1.93)	(−0.64)	(−0.43)	(2.75)	(2.75)	(2.79)	(2.47)
>\$50B	0.0022	0.0391	−1.3809***	−0.1961	−0.0547	−0.2975	−0.0297	−3.1315
	(0.03)	(0.12)	(−3.57)	(−0.48)	(−0.26)	(−0.91)	(−0.02)	(−1.33)
Constant	2.7412***	2.8732***	5.8662***	6.4415***	5.1214***	4.3755***	33.3623***	28.1010***
	(31.00)	(30.69)	(26.37)	(13.34)	(22.87)	(16.57)	(22.22)	(13.97)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,243	1,243	1,246	1,246	1,246	1,246	1,246	1,246
Adjusted R^2	.086	.429	.359	.737	.374	.689	.355	.668
# banks	145	145	145	145	145	145	145	145

B. 1987–2017

Dependent variable	(1) z-score	(2)	(3) Equity-to-assets	(4)	(5) Tail risk	(6)	(7) Equity volatility	(8)
\$10–\$50B	−4.7252***	−4.2470	−2.5065	−10.4049	6.7440	26.9433***	51.2613*	191.5804***
	(−3.89)	(−1.61)	(−0.36)	(−0.56)	(1.64)	(3.98)	(1.66)	(3.76)
>\$50B	0.1208*	0.1849**	−0.8073***	0.1377	0.0452	−0.0696	0.1418	−0.8642
	(1.94)	(2.41)	(−3.09)	(0.37)	(0.21)	(−0.19)	(0.11)	(−0.33)
Constant	2.7435***	2.8884***	5.8074***	6.7257***	5.2344***	4.2882***	34.2797***	27.2148***
	(30.25)	(30.06)	(25.38)	(16.68)	(22.52)	(16.78)	(21.92)	(13.58)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,910	1,910	1,914	1,914	1,914	1,914	1,914	1,914
Adjusted R^2	.237	.475	.518	.804	.634	.784	.640	.785
# of banks	194	194	194	194	194	194	194	194

Table shows results from OLS regressions of various proxies for bank risk on bank size. Panel A shows results for the period 1987–2006, and panel B shows results for the full sample period of 1987–2017. 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; and (4) equity volatility: the annualized standard deviation of daily stock returns. We use two piecewise linear size specifications: (1) "\$10–\$50B," which captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion), and (2) ">\$50B", 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. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$.

to size for large banks. When we use bank fixed effects as well as year fixed effects in Regression (2), we find that ROA falls with bank assets above the $50 billion threshold. Turning to ROE, we find in Regression (3) that performance is unrelated to bank size. In Regression (4), where we use bank fixed effects as well, ROE falls with size for small and large banks. 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)) for small and large banks. Panel A makes clear that the performance measures fall with bank size for large banks when we use bank fixed effects, but not otherwise. The interpretation of this result is that a bank's performance is significantly worse when the bank is larger, but in the cross-section large banks do not perform significantly worse than small banks. Because our strongest result for the relation between valuation ratios and bank size is for the cross-section, it follows that the relation between performance and bank size does not help explain the cross-section results. Panel B of Table 8 shows estimates for the whole sample period. None of the coefficients are significant for large banks except for the coefficient on returns when we use bank fixed effects.

When we keep 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 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. Though we do not tabulate the results, we find no evidence that ROA growth, ROE growth, or asset growth are related to size for large banks.

4.3 Do TBTF banks have higher risk-adjusted stock returns than do small banks?

If the risk-adjusted stock returns of large banks were higher than those of small banks, this would mean that the market discounts future expected cash flows at a higher rate for large banks than for 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 their results would be different. Though we do not report the results, we examine first whether the Gandhi and Lustig (2015) results hold for our sample period. Like them, we focus on value-weighted portfolios and exclude 2007–2008. We form portfolios at the end-of-June using book value deciles. Both the largest banks and the smallest banks have significant intercepts. The annualized excess return of the long-short portfolio for our sample period is larger than the annualized excess return reported by Gandhi and Lustig (2015) for their sample period.

The average number of banks in a decile is more than 40 when we use all commercial banks as Gandhi and Lustig (2015). In contrast, the average number

Table 8
Bank size and performance

A. 1987–2006

Dependent variable	ROA		ROE		Returns	
	(1)	(2)	(3)	(4)	(5)	(6)
\$10–\$50B	0.0917**	0.0114	−0.5282	−2.3393***	−0.8165**	−6.5123***
	(2.21)	(0.25)	(−1.13)	(−3.64)	(−2.05)	(−4.25)
>\$50B	0.0008	−0.0050***	0.0033	−0.0771**	0.0200	−0.2343***
	(0.19)	(−2.70)	(0.15)	(−2.22)	(1.13)	(−2.78)
Constant	0.0491***	0.0542***	0.0417**	0.0820*	−0.1218***	0.0222
	(36.43)	(32.95)	(2.29)	(1.72)	(−4.37)	(0.58)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,246	1,246	1,246	1,246	1,246	1,246
Adjusted R^2	.551	.804	.039	.388	.528	.547
# of banks	145	145	145	145	145	145

B. 1987–2017

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
\$10–\$50B	0.0825**	−0.0342	−0.2088	−2.2598***	−0.0924	−5.5861***
	(2.33)	(−0.89)	(−0.60)	(−4.07)	(−0.29)	(−5.14)
>\$50B	−0.0009	−0.0009	0.0046	−0.0138	0.0061	−0.0743**
	(−0.92)	(−0.65)	(0.50)	(−0.60)	(0.33)	(−2.37)
Constant	0.0494***	0.0554***	0.0325*	0.0722	−0.1424***	−0.0245
	(38.26)	(36.28)	(1.77)	(1.41)	(−5.43)	(−0.83)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,914	1,914	1,914	1,914	1,914	1,914
Adjusted R^2	.750	.877	.087	.421	.531	.555
# of banks	194	194	194	194	194	194

Table shows results from OLS regressions of various performance measures on bank size. Panel A shows results for the period 1987–2006, and panel B shows results for the full sample period: 1987–2017. 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; and (3) Returns: annual buy and hold stock returns. We use two piecewise linear size specifications: (1) "\$10–\$50B", which captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion), and (2) ">\$50B," 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. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. *$p<.1$; **$p<.05$; ***$p<.01$.

of banks with assets in constant dollars of more than \$50 billion is only 21 in our sample period. Consequently, the large banks in our sample are about half of the top decile of the banks in Gandhi and Lustig (2015). Given the number of banks in our sample, it does not make sense to estimate regressions for size deciles. To assess the performance of large banks in our sample, which includes only banks with assets in excess of \$10 billion, we split the sample into TBTF banks and small banks and compare the returns of value-weighted portfolios of the two sub-samples.

Table 9 first shows results using the Fama-French three-factor model and the five-factor model of Gandhi and Lustig (2015) for the sample period ending in 2006. The factors for the five-factor model are the three Fama-French factors (market factor (Market), a size factor (SMB), and 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). Regression (1) shows estimates of the Fama-French model for the small banks and Regression (2) shows the estimates for TBTF banks. Neither

Table 9
Risk-adjusted returns.

A. July 1987–December 2006

	(1)	(2)	(3)	(4)	(5)	(6)
	Small banks	**Large banks**	**Difference**	**Small banks**	**Large banks**	**Difference**
α	−0.001	−0.003	−0.002	−0.001	−0.004	−0.002
	(−0.44)	(−1.26)	(−1.30)	(−0.60)	(−1.36)	(−1.22)
Market	1.182***	1.391***	0.209***	1.170***	1.384***	0.214***
	(17.59)	(17.93)	(4.21)	(18.38)	(18.02)	(3.96)
SMB	−0.184**	−0.249**	−0.065	−0.185**	−0.247**	−0.062
	(−2.44)	(−2.43)	(−0.77)	(−2.22)	(−2.38)	(−0.72)
HML	0.748***	0.895***	0.146	0.739***	0.889***	0.150
	(7.05)	(8.36)	(1.41)	(7.00)	(8.14)	(1.44)
LTG				−0.005	0.020	0.025
				(−0.03)	(0.11)	(0.15)
CRD				0.146	0.082	−0.064
				(0.69)	(0.30)	(−0.28)
Observations	234	234	234	234	234	234
R-squared	.695	.663	.074	.696	.664	.074

B. Full sample period, July 1987–December 2017

	(1)	(2)	(3)	(4)	(5)	(6)
α	−0.002	−0.004**	−0.002	−0.002	−0.004*	−0.002
	(−1.36)	(−2.03)	(−1.03)	(−0.96)	(−1.89)	(−1.36)
Market	1.149***	1.440***	0.291***	1.173***	1.457***	0.284***
	(19.46)	(18.47)	(3.32)	(21.04)	(16.53)	(3.01)
SMB	−0.054	−0.204**	−0.150*	−0.049	−0.194**	−0.145
	(−0.63)	(−2.53)	(−1.76)	(−0.54)	(−2.21)	(−1.56)
HML	0.793***	1.032***	0.239**	0.802***	1.041***	0.238*
	(8.78)	(9.45)	(1.98)	(9.20)	(8.99)	(1.90)
LTG				0.082	0.099	0.017
				(0.67)	(0.47)	(0.07)
CRD				−0.283	−0.185	0.098
				(−1.47)	(−0.64)	(0.30)
Observations	342	342	342	342	342	342
R-squared	.71	.72	.14	.71	.72	.14

This table presents estimates from OLS regressions of monthly equally weighted excess returns of portfolios of large (>\$50B) and small (\$10–\$50B) banks 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 at the end of June of year t. Panel A shows results for the 1987–2006 period, and panel B shows results for the full sample period, excluding the crisis period 2007–2008. Standard errors are adjusted for heteroscedasticity and autocorrelation using Newey-West (1987) with three lags. $^*p<.1$; $^{**}p<.05$; $^{***}p<.01$.

intercept is significant. In Regression (3), we use the return of a portfolio long in large banks and short in small banks. The intercept is not significant either. Regressions (4) to (6) estimate the Gandhi and Lustig (2015) five-factor model. Again, no intercept is significant. The size of the long-short portfolio risk-adjusted return is much smaller than it is when we use the Gandhi and Lustig (2015) sample. Generally, the small banks in our sample are smaller than banks commonly viewed as TBTF banks. Hence, if the size effect documented by Gandhi and Lustig is due to TBTF, we should see an economically and statistically significant difference between our TBTF banks and the banks with assets between \$10 and \$50 billion.

Turning to the whole sample period, we estimate Fama-French three-factor regressions and five-factor regressions. Like Gandhi and Lustig (2015), we omit the crisis. Again, the difference in risk-adjusted returns between small and large banks is insignificant regardless of the number of factors. That there is no significant difference is a challenge for the Gandhi and Lustig (2015) interpretation of their results, but it is not surprising in light of the fact that there is almost no difference between the intercept of the ninth decile portfolio and the intercept of the tenth decile portfolio (−5.70% versus −5.21%) in their sample and that our sample is roughly the two top deciles of their sample. For our sample period, the risk-adjusted return of the 9th decile portfolio in our Gandhi and Lustig (2015) replication is indistinguishable from the return of the 10th decile portfolio.

It follows from the results from Table 9 that our results concerning the relation between valuation ratios and size cannot be explained by abnormal risk-adjusted performance of large firms. If anything, the risk-adjusted performance of large firms increases the valuation ratios.

4.4 Does the market discount the contribution to shareholder wealth of some activities by TBTF banks?

TBTF banks have a different portfolio of activities compared to small banks and the composition of their balance sheet differs as well. These banks are generally viewed as more diversified and more complex. We saw in Table 2 that during our sample period TBTF banks are significantly more diversified than small banks using the income-diversity measure of Laeven and Levine (2007). The literature has devised measures of complexity. For instance, Cetorelli, McAndrews, and Traina (2014) develop a measure based on the extent of acquisitions, especially nonbank acquisitions. In general, complexity and diversification are correlated.

In results that we do not tabulate, we performed two related exercises. First, we checked that our results in Table 3 are robust to adding a bank's income diversity as a control. To avoid transitory effects, we average income diversity over 3 years. If large banks are valued less because they are more diverse, we would find that controlling for income diversity would make our size variables insignificant. This is not the case. Our results on size are unaffected by controlling for income diversity. Second, we explore the possibility that diversity and complexity worsen the size effect. In other words, banks that are more diverse and complex are more adversely affected by size. This could be because managing a larger bank when the bank is more complex is more difficult and involves interactions with more regulators. It also could be that large banks that are more diversified could not expand in their core activities and had to expand through diversification, so that they became less efficient. We reestimate Regressions (1) and (5) of Table 3 by splitting the sample between banks above and below the median of income diversity. When we use Tobin's q or MB, the value of large banks falls significantly with size if they have above median income diversity. There is no evidence that the value of below median income diversity banks falls with size. The difference in the coefficient on size for large banks between above and below median income diversity is significant for the precrisis sample, but not for the post-crisis sample. An important caveat for these results is that in any given year only six large banks, on average, have a below-median 3-year average of income diversity.

TBTF banks could be valued less because they concentrate more on activities that the market discounts than small banks or because the market discounts some activities that they engage in more than it discounts the same activities for small banks. We explore these two possibilities to understand better why TBTF banks are valued less using the framework developed by Huizinga and Laeven (2012) and Calomiris and Nissim (2014). Huizinga and Laeven (2012) regress q on bank balance sheet items and Calomiris and Nissim (2014) regress MB on balance sheet items as well as other proxies for the value of bank activities. We consider measures of the importance of asset types in bank balances sheets. Specifically, we relate valuation ratios to trading assets as a fraction of total assets, real estate (RE) loans to total assets, commercial and industrial (CI) loans to assets, and securities as a fraction of total assets. We also include an indicator variable for banks without trading assets. Because trading assets to assets is highly correlated with assets, we use residuals from a regression of trading assets on assets. We include four performance measures. First, we have net charge-offs to assets, which is shown to be informative by Calomiris and Nissim (2014). Second, we include other noninterest income to assets, where the numerator of the ratio is noninterest income net of trading revenue. Third, we use the efficiency ratio, which is noninterest expense to bank noninterest income. Fourth, we use the growth rate of assets. Turning to bank liabilities, we include core deposits to assets and tangible equity to assets. Finally, though data on MBS are available only since 1994, we also estimate regressions with holdings of agency MBS and nonagency MBS.

To address the issue of whether TBTF banks engage more in activities that are valued less by the market or if the market values less activities when TBTF banks engage in them than when small banks engage in them, we estimate two different types of regressions. First, we add bank characteristics to the regressions of Table 3. With regressions that have bank characteristics and year fixed effects, the coefficients on the characteristics can be used to assess whether TBTF banks are valued less because of the activities in which they engage. Second, we estimate regressions separately for TBTF banks and small banks. Comparing the coefficients between large and small banks tells us whether an expansion of a specific activity is associated with different valuation changes for small and large banks.

Regressions (1) and (2) of panel A of Table 10 show estimates of the regressions for the sample period ending in 2006 using the piecewise linear function for size. The coefficient for trading assets is -0.12 and significant at the 10% 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. In the regression, we use the residual in a regression of trading assets on bank size as the dependent variable. The mean residual is -1.3% for

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Table 10
Bank size, valuation ratios, and bank activities

A. Tobin's q

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1987–2006				**1987–2017**			
	Full sample		Large	Small	Full sample		Large	Small
Trading-to-assets residuals	−0.1244*	−0.0494	−0.1914***	−0.5356**	−0.2044**	−0.1063	−0.1801**	−0.5208
	(−1.77)	(−0.37)	(−2.86)	(−2.02)	(−2.38)	(−1.11)	(−2.36)	(−1.25)
Securities-to-assets	0.0594	0.0852	0.0163	0.0596	−0.0030	0.1132**	−0.0107	−0.0028
	(1.10)	(1.30)	(0.17)	(1.03)	(−0.07)	(2.18)	(−0.15)	(−0.04)
RE loans-to-assets	0.0080	0.0185	−0.0930	0.0403	−0.0822*	0.0234	−0.1361**	−0.0672
	(0.20)	(0.34)	(−1.65)	(0.89)	(−1.82)	(0.50)	(−2.22)	(−0.87)
CI loans-to-assets	−0.0307	−0.1248	−0.1365**	−0.0136	−0.0864	−0.0988	−0.1538**	−0.0544
	(−0.63)	(−1.25)	(−2.47)	(−0.20)	(−1.49)	(−0.97)	(−2.65)	(−0.50)
Net charge-offs-to-assets	−1.8755***	−2.3561***	−2.5143*	−1.0465	−1.1282*	−1.8882***	−1.1808	−1.1649
	(−2.97)	(−3.24)	(−1.96)	(−1.31)	(−1.92)	(−4.14)	(−1.24)	(−1.53)
Other noninterest income-to-assets	2.8541***	0.8423**	1.8453***	3.1487***	1.8015***	1.5076***	1.9653***	1.7225***
	(8.64)	(2.06)	(3.31)	(6.70)	(4.35)	(4.09)	(7.34)	(2.75)
Tangible equity-to-assets	0.8909**	0.0225	0.5890	1.1319***	0.2345	0.1410	0.4593	0.1903
	(2.30)	(0.06)	(1.33)	(3.08)	(0.82)	(0.48)	(1.20)	(0.65)
Core deposits-to-assets	0.0189	0.1305***	0.1307***	−0.0047	0.0495**	0.0980**	0.1034***	0.0453
	(0.78)	(2.84)	(3.48)	(−0.12)	(1.97)	(2.56)	(3.05)	(1.30)
Efficiency ratio	−0.0024	−0.0138**	−0.0498**	0.0011	0.0020	−0.0047*	−0.0039	0.0015
	(−0.29)	(−2.06)	(−2.26)	(0.15)	(0.72)	(−1.96)	(−0.57)	(0.46)
Growth in assets	0.0145*	0.0034	0.0105	0.0268*	0.0046	0.0002	0.0035	0.0036
	(1.70)	(0.62)	(0.84)	(1.96)	(0.66)	(0.06)	(0.30)	(0.44)
No trading in assets	0.0174**	−0.0104	−0.0204	0.0170*	0.0166*	0.0101	0.0044	0.0148
	(2.03)	(−0.75)	(−0.79)	(1.84)	(1.88)	(0.92)	(0.20)	(1.59)
\$10–\$50B	0.3736	−0.4065		0.3505	0.0829	−0.4215		0.1676
	(1.53)	(−1.07)		(1.03)	(0.45)	(−1.22)		(0.69)
>\$50B	−0.0105	−0.0558**	−0.0157		−0.0088	−0.0085	−0.0043	
	(−0.59)	(−2.20)	(−0.67)		(−1.00)	(−0.71)	(−0.49)	
Constant	1.0321***	1.0651***	1.0610***	0.9948***	0.9773***	0.9703***	1.0728***	0.9615***
	(27.92)	(17.00)	(25.85)	(25.59)	(23.13)	(21.09)	(23.06)	(14.38)
Fixed effects	Year	Bank, year	Year	Year	Year	Bank, year	Year	Year
Observations	1,156	1,156	391	765	1,809	1,809	636	1,173
Adjusted R^2	.673	.812	.677	.696	.616	.791	.690	.582
# of banks	141	141	52	119	190	190	64	159

(Continued)

Table 10
(continued)

B. Market-to-book

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1987–2006				**1987–2017**			
	Full sample		Large	Small	Full sample		Large	Small
Trading-to-assets- residuals	−2.6180***	−1.5186	−3.1196***	−4.8271*	−2.1760***	−2.0098**	−2.6843***	−3.8604
	(−3.42)	(−1.34)	(−5.21)	(−1.78)	(−3.44)	(−2.21)	(−4.86)	(−1.43)
Securities-to-equity	0.0125	0.0235	−0.0207	0.0160	0.0374*	0.0679**	−0.0068	0.0423*
	(0.59)	(0.70)	(−0.51)	(0.62)	(1.91)	(2.55)	(−0.16)	(1.76)
RE loans-to-equity	−0.0364	−0.0024	−0.1147***	−0.0027	−0.0220	0.0240	−0.1221***	0.0063
	(−1.35)	(−0.09)	(−3.46)	(−0.09)	(−0.90)	(0.77)	(−3.03)	(0.22)
CI loans-to-equity	−0.0797**	−0.1246**	−0.1518***	−0.0640	−0.0657**	−0.1359**	−0.1448***	−0.0280
	(−2.27)	(−2.34)	(−4.57)	(−1.22)	(−2.16)	(−2.34)	(−3.99)	(−0.59)
Net charge-offs-to-equity	−2.1317***	−1.5428***	−2.0351***	−2.2436***	−1.1572**	−0.9661**	−1.2629**	−1.2431*
	(−5.00)	(−2.89)	(−2.99)	(−3.47)	(−2.18)	(−2.02)	(−2.19)	(−1.82)
Other noninterest income-to-equity	2.1896***	1.0833***	1.7213***	2.2852***	2.0214***	1.5619***	2.1103***	1.8977***
	(5.92)	(2.62)	(2.89)	(5.22)	(8.24)	(4.89)	(9.44)	(4.92)
Tangible equity-to-equity	0.7969***	0.7107**	0.5123	1.0702***	0.7680***	0.7256***	0.6803**	0.8699***
	(3.37)	(2.33)	(1.66)	(3.49)	(3.91)	(2.86)	(2.45)	(3.99)
Core deposits-to-equity	0.0174	0.0481	0.0778***	0.0013	0.0263	0.0365	0.0758***	0.0129
	(0.89)	(1.42)	(3.09)	(0.04)	(1.36)	(1.13)	(2.84)	(0.42)
Efficiency ratio	−0.0266	−0.1641***	−0.3932	−0.0057	0.0186	−0.0654**	−0.0288	0.0108
	(−0.26)	(−2.64)	(−1.65)	(−0.06)	(0.82)	(−2.46)	(−0.54)	(0.42)
Growth in assets	0.1138	0.0592	0.0207	0.2210	0.0987	0.0255	0.0365	0.0951
	(1.17)	(0.80)	(0.15)	(1.50)	(1.45)	(0.51)	(0.30)	(1.18)
No trading assets	0.1583	−0.0768	−0.2212	0.1620	0.0841	0.0678	−0.0229	0.0711
	(1.54)	(−0.48)	(−0.60)	(1.44)	(1.02)	(0.62)	(−0.08)	(0.80)
$10–$50B	3.6737	−7.3190		4.3895	2.1738	−7.9991*		2.2252
	(1.58)	(−1.30)		(1.25)	(1.15)	(−1.73)		(0.82)
>$50B	−0.1444	−0.6132**	−0.1476		−0.0428	−0.1394	−0.0084	
	(−0.68)	(−2.07)	(−0.58)		(−0.63)	(−1.29)	(−0.12)	
Constant	1.1224***	1.9285***	2.3083***	−0.1276	0.2267	1.0114***	0.7530**	−0.0544
	(3.09)	(5.31)	(5.02)	(−0.25)	(1.26)	(3.81)	(2.50)	(−0.27)
Fixed effects	Year	Bank, year			Year	Bank, year		
Observations	1,156	1,156	391	765	1,809	1,809	636	1,173
Adjusted R^2	.646	.786	.689	.641	.648	.779	.720	.623
# of banks	141	141	52	119	190	190	64	159

Table shows results from OLS regressions of valuation ratios (Tobin's q in panel A and market-to-book in panel B) on proxies for bank size. We show results for two periods: 1987–2006 and 1987–2017. Models (3) and (7) use the sample of large (>$50B) banks, and Models (4) and (8) use the sample of small banks. Trading-to-assets residuals refer to residuals from regressions of trading assets-to-assets on log (assets). The "$10–$50B" variable captures the first $50 billion in assets and takes the value: min (bank asset size, $50 billion). The ">$50B" variable captures asset size in excess of $50 billion, taking the value: max (bank asset size - $50 billion, 0). Table A1 provides etailed descriptions of all control variables. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

small banks and 1.2% for large banks, so that the difference in means between large and small banks is associated with a higher q for small banks of 0.003. The regression also includes an indicator variable that takes value one if a bank does not report trading assets. This indicator variable has a value of 0.0174, which is 29% of the standard deviation of q before the crisis. Huizinga and Laeven (2012) use similar regressions to assess how the market valued assets on bank balance sheets during the GFC and find evidence that the market discounts trading assets in 2008. It is important to note that the sample used here ends in 2006, so that our results are unlikely to be affected by the accounting issues and the regulatory forbearance phenomenon that they highlight during the crisis.

Huizinga and Laeven (2012) find real estate loans to be sharply discounted by the market in 2008. For our precrisis sample, we do not find evidence of a discount in our sample. Their sample is quite different from ours in the importance of real estate for the banks considered. In their much larger sample including mostly banks smaller than our threshold of $10 billion of assets, average real estate loans to assets is 53%. In our sample focused on banks with assets in excess of $10 billion in 2010 dollars, it is 30%.

Net charge-offs have a large negative coefficient. Net charge-offs to assets equals 0.4% for small banks and 0.5% for TBTF banks, so net charge-offs reduce the value of TBTF banks. Because other noninterest income has a positive coefficient and other noninterest income to assets is 1.8% for small banks and 2.4% for TBTF banks, noninterest income other than trading income is associated with a higher q of TBTF banks compared to smaller banks of 0.017. TBTF banks have average tangible equity to assets that is one percentage point lower than smaller banks during the precrisis sample period, so that their greater leverage lowers their valuation compared to the value of small firms. Banks with more asset growth have a higher Tobin's q, but there is essentially no difference in asset growth between small and large banks in the sample. Neither size variable is significant. We reestimated Regression (1) using trading-assets-to-assets instead of the residual of trading-assets-to-assets. The results are similar.

The first lesson from Regression (1) is that precrisis TBTF banks were valued less in part because the market discounted trading activities and penalized them for their higher leverage. At the same time, however, these banks were valued more because of having more nontrading noninterest income. To the extent that TBTF made it possible for banks to operate with higher leverage and to engage in more trading activities, Regression (1) raises questions as to whether this was to the benefit of enterprise value. The second lesson is that once we control for all these bank characteristics, size is no longer significant. This result has to be interpreted with caution because many bank characteristics are positively correlated with size, so that multicollinearity is a concern. Of all the variables, the one that is most highly correlated with size is trading-to-assets, but we orthogonalize trading assets-to-assets with respect to assets.

In contrast to the regression with only year fixed effects, the regression with year and bank fixed effects has a significantly negative coefficient on size for large banks. In Regression (2), the variables relating to trading assets are not significant. A plausible explanation for this result is that variation in trading assets within banks is limited as a number of banks report zero trading assets through the sample period. In this regression, core deposits to assets has a positive significant coefficient. The efficiency ratio has a negative coefficient, which is what we would expect as a lower ratio means greater efficiency.

Regressions (3) and (4) show regression estimates when we split the sample between small and TBTF banks and use year fixed effects. Because of the use of year fixed effects, the interpretation of a coefficient for large banks is that it explains how a change in the associated variable is correlated with changes in q for large banks. Calomiris and Nissim (2014) split their sample by size and conclude that differences between regressions using their sample of large banks and the regressions using their sample of small banks were not material. In their case, large banks have assets in excess of \$2 billion in contrast to our analysis where large banks have assets exceeding \$50 billion and small banks have assets between \$10 billion and \$50 billion. We see that the value of large banks is negatively related to trading, C&I loans, net charge-offs, and the efficiency ratio (remembering that the efficiency falls as the ratio increases). The value of large banks increases with other noninterest income and core deposits. All large banks have trading assets, but a substantial number of small banks do not have trading assets. We assess the significance of the coefficients on characteristics of TBTF banks versus small banks. The only coefficients that are significantly different are those for real estate loans where the coefficient is significantly more negative for large banks, those for core deposits to assets, where the market values core deposits more for large banks, and those for the efficiency ratio where the market values efficiency more for large banks. It is noteworthy that the market valued TBTF banks more if they had more deposits, which means that it valued more banks that had less wholesale funding.

Regressions (5) to (8) show the results for the full sample period. When we turn to the whole sample in Regressions (5) and (6), we find that most coefficients are similar to those of Regressions (1) and (2). None of the size coefficients are significant. The coefficients on trading asset variables are similar to those of Regressions (1) and (2). Real estate loans have a negative coefficient in Regression (5). Perhaps not surprising because regulations after the crisis favor financing through core deposits, there is a strong positive coefficient on core deposits whether we have bank fixed effects or not. Regressions (7) and (8) show separate regressions for large and small banks for the whole sample. For the whole sample period, no coefficient on bank characteristics is significantly different between small banks and TBTF banks.

Though we do not tabulate the results, we reestimated Regressions (1) and (2) adding the ratio of agency MBS to assets and the ratio of nonagency MBS to assets. When we do that, we have to start the sample in 1994 because these variables became available that year. None of the MBS variables has a significant coefficient. Adding the MBS variables does not change our inferences about the relation between valuation ratios and size.

Panel B of Table 10 estimates the same regressions with MB as the dependent variable. For this panel, we normalize bank characteristics by equity following Calomiris and Nissim (2014). The inferences from that panel are similar to the inferences from panel A. Some differences are noteworthy. In particular, trading assets have a negative significant coefficient over the whole sample for regressions with and without bank fixed effects. Tangible equity has a positive significant coefficient for all regressions. However, our focus is on whether these bank characteristics can help explain the relation between MB and asset size. As for q, we find that the size variable for large banks is insignificant except for Regression (2). Regressions (3) and (4) and (7) and (8) report separate estimates for small and large banks. The only coefficients that are significantly different for the precrisis period are those for real estate loans, core deposits, and efficiency. The coefficients for real estate loans and C&I loans are significantly different for the whole sample.

The results in Table 10 should be interpreted with some caution, because several variables have a relatively high correlation with assets. Nevertheless, the results in Table 10 support the conclusion that TBTF banks engage more in activities that the market discounts than small banks, with the exception that the market values noninterest income unrelated to trading and large banks have more of that type of income than small banks.

5. Changes in the Value of TBTF

As discussed in Section 2, we would expect the value of TBTF to be higher during the GFC, so that the negative relation between valuation ratios and size should be weaker. Many have argued that Dodd-Frank reduced or eliminated the upside of TBTF for banks, namely the potential for bailouts, while worsening the downside, namely greater regulatory scrutiny. If that's the case, the relation between valuation ratios and size should become more negative after Dodd-Frank. We investigate these hypotheses in this section.

We first investigate whether the relation between bank value and bank size differs in the post-Dodd-Frank period, which we define to be 2011 to 2017, 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.

Table 11 reestimates Regressions (1) through (4) of Table 3 with an indicator variable for the post-Dodd-Frank period and interactions of all variables with that indicator variable. Regressions (1) through (4) use Tobin's q as the dependent variable and Regressions (5) through (8) use MB.

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 other words, there is no evidence that the relation between Tobin's q and bank size changes after Dodd-Frank. In Regressions (3) and (4), we add noninterest income and equity-to-assets. In Regression (3), both added variables have negative coefficients when interacted with the Dodd-Frank indicator variable. The negative coefficient on the interaction with equity-to-assets is quite large. The relation between q and equity is positive for the whole sample, but the interaction is larger in absolute value than the coefficient for the whole sample, so that after Dodd-Frank q and equity are negatively related. When we turn to the regression with bank fixed effects, none of the interactions are significant. Regressions (5) to (8) reestimate Regressions (1) through (4) using the market-to-book ratio as the dependent variable. None of the interactions with size are significant. In contrast to the regressions using q, the interaction of equity with the Dodd-Frank indicator variable is not significant.

In results that are not tabulated, we examined whether the relation between bank risk and bank size changes for large banks after Dodd-Frank. We found that the only change is that the equity-to-assets ratio increases with bank size for large banks after Dodd-Frank. Perhaps not surprisingly given the increase in the equity-to-assets ratio, ROE falls with size for large banks after Dodd-Frank.

These results mean that the relation between bank Tobin's q and size is not different between the pre- and post-Dodd-Frank periods, which is difficult to reconcile with the view that Dodd-Frank and other post-crisis regulatory reforms eliminated TBTF and that TBTF was valuable for the largest banks before Dodd-Frank. 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. In other unreported results, we reestimated the regressions of Table 10 for the whole sample with a Dodd-Frank indicator variable and interactions with that variable. Besides the interactions for noninterest income and tangible equity, none of the interactions are significant.

The results about the post-Dodd-Frank period are surprising in light of the concerns expressed by large banks about post-crisis regulations. However, in Figure 1 we showed that the post-Dodd-Frank period is a period where large banks have slightly higher valuations than small banks. Further, the average

Table 11
The impact of Dodd-Frank

	Tobin's q				Market-to-book			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-Dodd Frank x \$10–\$50B	0.3439	−0.6091	0.5164	−0.4541	2.9929	−6.6640	6.0063	−4.7838
	(0.63)	(−1.25)	(1.14)	(−0.99)	(0.60)	(−1.19)	(1.48)	(−0.98)
Post-Dodd Frank x >\$50B	0.0071	0.0147	−0.0008	0.0121	0.0815	0.1592	0.0753	0.1930
	(0.47)	(1.24)	(−0.05)	(1.12)	(0.55)	(1.20)	(0.46)	(1.63)
Post-Dodd Frank x Noninterest income			−0.1980**	−0.0535			−2.2220***	−0.8338*
			(−2.40)	(−1.28)			(−3.67)	(−1.68)
Post-Dodd Frank x Equity-to-assets			−0.9919**	−0.1959			−5.0867	0.1700
			(−2.45)	(−0.62)			(−1.50)	(0.05)
\$10–\$50B	0.1158	−1.1342**	−0.4581**	−0.8863**	0.8625	−14.4544**	−5.3528**	−13.1745**
	(0.53)	(−2.26)	(−2.05)	(−2.00)	(0.35)	(−2.31)	(−2.38)	(−2.37)
>\$50B	−0.0341***	−0.0268*	−0.0305**	−0.0236	−0.3332***	−0.3398*	−0.3945***	−0.3397*
	(−3.48)	(−1.69)	(−2.58)	(−1.59)	(−3.07)	(−1.80)	(−3.09)	(−1.96)
Noninterest income			0.2794***	0.1877**			2.8804***	1.8215**
			(4.46)	(2.30)			(6.97)	(2.57)
Equity-to-assets			0.6874*	−0.1946			−2.0147	−8.0818***
			(1.95)	(−0.73)			(−0.75)	(−2.78)
Constant	1.0022***	1.0347***	0.9351***	1.0213***	1.0421***	1.4327***	0.8946***	1.7175***
	(146.92)	(104.83)	(36.52)	(52.96)	(12.80)	(11.80)	(4.68)	(7.12)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,914	1,914	1,914	1,914	1,914	1,914	1,914	1,914
Adjusted R^2	.418	.754	.540	.765	.488	.737	.587	.753
# of banks	194	194	194	194	194	194	194	194

This table shows results from OLS regressions of Tobin's q and market-to-book on proxies for bank size for the sample period 1987–2017. Post-Dodd Frank is an indicator variable equal to 1 for years after 2010 and 0 otherwise. We interact all independent variables with the Post-Dodd Frank indicator. The "\$10–\$50B" variable captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion). The ">\$50B" 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. Table A1provides detailed descriptions of all control variables. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

yearly stock returns of small banks of 13.1% are significantly lower than those of large banks of 16.9% over the period of 2011–2017. TBTF banks have a significantly higher ROA over the post-Dodd-Frank period than small banks, but the ROE is not significantly different. The efficiency ratio advantage of the largest banks is very substantial for the post-Dodd-Frank period. Remember that the efficiency ratio is the ratio of noninterest expenses to noninterest income, so that a lower ratio means that a bank is more efficient. In the post-Dodd-Frank period, the average efficiency ratio for the banks with assets from $10 to $50 billion is 3.119. In contrast, the ratio for TBTF banks is significantly lower at 1.669. In the precrisis period, the efficiency ratio of small banks was 2.177 in contrast to the efficiency ratio of TBTF banks of 1.603. It follows from this that the efficiency ratio of TBTF banks is essentially the same during the precrisis period and the post Dodd-Frank period, but, in contrast, efficiency worsens sharply for the smaller banks.

We now turn to an investigation of the relation between valuation ratios and bank size during the crisis. We would expect TBTF to be especially valuable during a crisis, when bailouts for TBTF banks become most likely. Table 12 repeats the regressions of Table 11, but now we define a crisis indicator variable which takes value one for 2007–2009 and interact that indicator variable with the other regressors. The key result of the table is that the interaction of the crisis indicator variable and size is positive for large banks in all regressions. We report the results for an F-test of the equality of the sum of the coefficient for the size variable for the large banks and of the interaction of the size variable for the large banks with the crisis indicator variable. Except for Regressions (3) and (7), we cannot reject the hypothesis that during the crisis the valuation ratios of large banks are not related to size.

6. Conclusion

In this study, we examine whether TBTF banks are valued more highly than small banks as one would expect if TBTF status is valuable for shareholders. We conduct our inquiry by looking at banks that could potentially become TBTF, which we take to be banks with assets in excess of $10 billion in 2010 dollars, and banks that exceed the Dodd-Frank threshold for enhanced supervision of $50 billion of assets in 2010 dollars. We find no evidence that TBTF banks are valued more highly than the other banks in our sample, but most of our evidence supports the conclusion that TBTF banks are worth less than small banks and that their value is negatively related to their size. None of our results are consistent with the view that TBTF banks benefited from a valuation premium compared to other banks at any time during our sample period.

A possible explanation for our results is that TBTF is valuable, but for other reasons bank value is negatively related to size and it would be more so without TBTF. We have some evidence against this view. First, if, as the recent literature argues, banks benefit from economies of scale, we would expect that with

Table 12
The impact of the crisis

	A. Tobin's q				*B. Market-to-book*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis x \$10–\$50B	−0.5720	−0.6202*	−0.7229**	−0.7172**	−4.3281	−6.2089	−6.5908*	−8.0134**
	(−1.36)	(−1.67)	(−2.29)	(−1.98)	(−0.94)	(−1.57)	(−1.84)	(−2.04)
Crisis x >\$50B	0.0273***	0.0184***	0.0252***	0.0171***	0.2195***	0.1633***	0.2395***	0.1663**
	(3.49)	(3.26)	(2.99)	(2.80)	(2.80)	(2.67)	(2.69)	(2.43)
Crisis x Noninterest income			0.0226	0.0908**			0.6224	0.9944**
			(0.39)	(2.42)			(1.21)	(2.49)
Crisis x Equity-to-assets			−1.2680***	−0.6009**			−6.5593**	−0.8430
			(−3.76)	(−2.37)			(−2.25)	(−0.33)
\$10–\$50B	0.2368	−1.1426**	−0.2391	−0.8848*	1.8452	−14.5825**	−3.0616	−13.1252**
	(0.97)	(−2.25)	(−1.09)	(−1.91)	(0.72)	(−2.31)	(−1.38)	(−2.27)
>\$50B	−0.0330***	−0.0226	−0.0379***	−0.0226	−0.3094***	−0.2890	−0.4108***	−0.2793*
	(−4.20)	(−1.45)	(−4.83)	(−1.57)	(−4.13)	(−1.57)	(−5.32)	(−1.71)
Noninterest income			0.1903***	0.1677**			1.8182***	1.4219*
			(3.60)	(2.16)			(4.51)	(1.97)
Equity-to-assets			0.4524	−0.1409			−2.8641	−7.2305***
			(1.59)	(−0.66)			(−1.35)	(−2.95)
Constant	0.9987***	1.0354***	0.9565***	1.0216***	1.0135***	1.4424***	1.0429***	1.7290***
	(133.22)	(107.52)	(43.93)	(57.46)	(12.12)	(12.28)	(6.20)	(7.47)
Fixed effects	Year	Bank, year	Year	Bank, year	Year	Bank, year	Year	Bank, year
Observations	1,914	1,914	1,914	1,914	1,914	1,914	1,914	1,914
Adjusted R^2	.418	.754	.517	.767	.488	.736	.565	.751
# of banks	194	194	194	194	194	194	194	194
F-test [>\$50B+>\$50BxCrisis]=0	0.622	0.079	5.772	0.158	1.129	0.536	6.226	0.455
p-value	(.431)	(.779)	(.017)	(.691)	(.289)	(.465)	(.013)	(.501)
F-test [\$10–\$50B+>\$10–\$50BxCrisis]=0	0.634	6.222	10.70	5.789	0.255	5.896	7.775	6.987
p-value	(.427)	(.014)	(.001)	(.017)	(.614)	(.016)	(.006)	(.009)

Table shows results from OLS regressions of (Tobin's q in panel A. Market-to-book in panel B) on proxies for bank size for the sample period 1987–2017. Crisis is an indicator variable equal to 1 for years 2007–2009 and otherwise. We interact all independent variables with Crisis indicator. The "\$10–\$50B" variable captures the first \$50 billion in assets and takes the value: min (bank asset size, \$50 billion). The ">\$50B" 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. Table A1provides detailed descriptions of all control variables. Heteroscedasticity-robust t-statistics with standard errors clustered at the bank level are shown in parentheses. *$p < .1$; **$p < .05$; ***$p < .01$.

economies of scale and imperfect competition the largest banks would be worth more than small banks in the absence of TBTF, so that we should not see a negative relation between valuation and size for large banks at all. Second, if TBTF was valuable when banks crossed a TBTF threshold, banks should have gained from crossing that threshold. We investigate the returns to acquirers who cross the $50 billion of assets threshold and to those who cross the $100 billion threshold. We find no support for the view that acquisitions that cross a TBTF threshold are better for shareholders than other acquisitions by banks; instead, we show that acquiring firm shareholders experience a negative abnormal return when the bank makes an acquisition that crosses a TBTF return and provide some evidence that threshold-crossing deals have a worse impact on shareholder wealth than other acquisitions. Specifically, acquisitions that cross the $100 billion threshold have worse acquirer returns than acquisitions by either smaller or larger banks that do not cross that threshold. For acquisitions that cross the $50 billion threshold, we find some evidence that these acquisitions have worse returns than those by smaller or larger banks that do not cross the threshold. Third, the value of TBTF should vary over time. In particular, the positive effects of TBTF should increase when the probability of a bailout increases. We find that the negative relation between the TBTF bank value and size is not negative during the GFC for all regression models but two.

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 (1) 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, (2) 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, or (3) the discount rate for cash flows increases 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. Bank performance is not lower for TBTF banks in the cross-section. TBTF banks do not have higher risk-adjusted stock returns than banks with assets from $10 billion to $50 billion.

As discussed throughout this paper, TBTF status has costs and benefits. The costs have to do with more regulatory and supervisory attention and requirements, as well as greater insulation of management from shareholder monitoring. Though we show that it seems unlikely that TBTF increases bank value in normal times in such a way that these banks are valued higher than smaller banks, future research will have to investigate the impact on bank value of the different costs of TBTF. However, we find some evidence that is helpful in addressing this issue. Though bank diversification and complexity do not explain the negative relation between bank value and size, we find that the relation between bank value and size for large banks is stronger for more diverse and complex banks, especially before the crisis. We also find that the market discounts trading activities, which are activities that TBTF banks engage in more than other banks, throughout our sample period. Some evidence suggests that the market values more banks with more deposit funding and values less banks with more C&I loans, which further helps explain why TBTF banks are valued less. Even though the market values nontrading noninterest income of banks and the largest banks have more of such income than small banks, nontrading noninterest income of TBTF banks does not differ from the income of small banks sufficiently to offset the adverse relation between bank valuation and trading assets. Together, our evidence suggests that TBTF allows banks to pursue more activities that create less enterprise or shareholder value than the activities that are more important for smaller banks, and it challenges the view that TBTF is valuable for shareholders.

Appendix

Table A1
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).
Core deposits-to-assets	The sum of non-interest-bearing deposits and interest-bearing core deposits, scaled by the book value of assets
CRD	The excess returns (raw return minus the 1-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 Treasury-bill rate (R_f) obtained from Kenneth French's Web site.
Efficiency ratio	The ratio of total noninterest expense-to-total noninterest income
Equity-to-assets ratio	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.
Growth in assets	Annual growth rate in book value of assets
HML	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 Web site.
Income diversity	$1-\left\lvert\frac{\textit{Net interest income-Other operating income}}{\textit{Total operating income}}\right\rvert$. Other operating income includes net fee income, commission income, and trading income
log (assets)	The natural logarithm of total assets (in U.S. \$000s) Source: FRY9C: BHCK2170.
LTG	The excess returns (raw return minus the 1-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 Treasury-bill rate (R_f) obtained from Kenneth French's Web site.

(Continued)

Table A1
(Continued)

Variable name	Definition
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 United States, and R_f is the 1-month Treasury-bill rate *Source*: Kenneth French's Web site.
Market-to-book ratio	Market value of equity, divided by the book value of equity *Source*: Compustat: PRCC_C x CSHO; FRY9C: BHCK3210.
Net charge-offs-to-assets	Loan charge-offs and write-downs minus loan recoveries, scaled by the book value of assets
Noninterest income	Noninterest income divided by the sum of noninterest income and interest income *Source*: FRY9C: BHCK4079, BHCK4107.
No trading assets	Indicator variable equal to 1 if the bank reports no trading assets and 0 otherwise
Other noninterest income-to-assets	Total noninterest income minus trading revenue, scaled by book value of assets
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 1994.
SMB	SMB is the Fama-French (1993) 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 Web site.
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.
Tangible equity-to-assets	Total equity capital minus perpetual preferred stock and related surplus, minus intangible assets, scaled by the book value of assets
Tobin's q	The market value of assets, scaled by the book value of assets. Market value of assets is the sum of the book value of assets, minus the book value of equity plus market value equity and preferred stock
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-to-assets residuals	Residuals from regressions of trading assets-to-assets on log (assets)
Trading liabilities	Total trading liabilities *Source*: FRY9-C: BHCK3548 (available only since March 1995).
z-score	The log of z-score, where the 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 report *Source*: FRY9C: BHCK4340; BHCK4073; BHCK2170; BHCK3210.

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