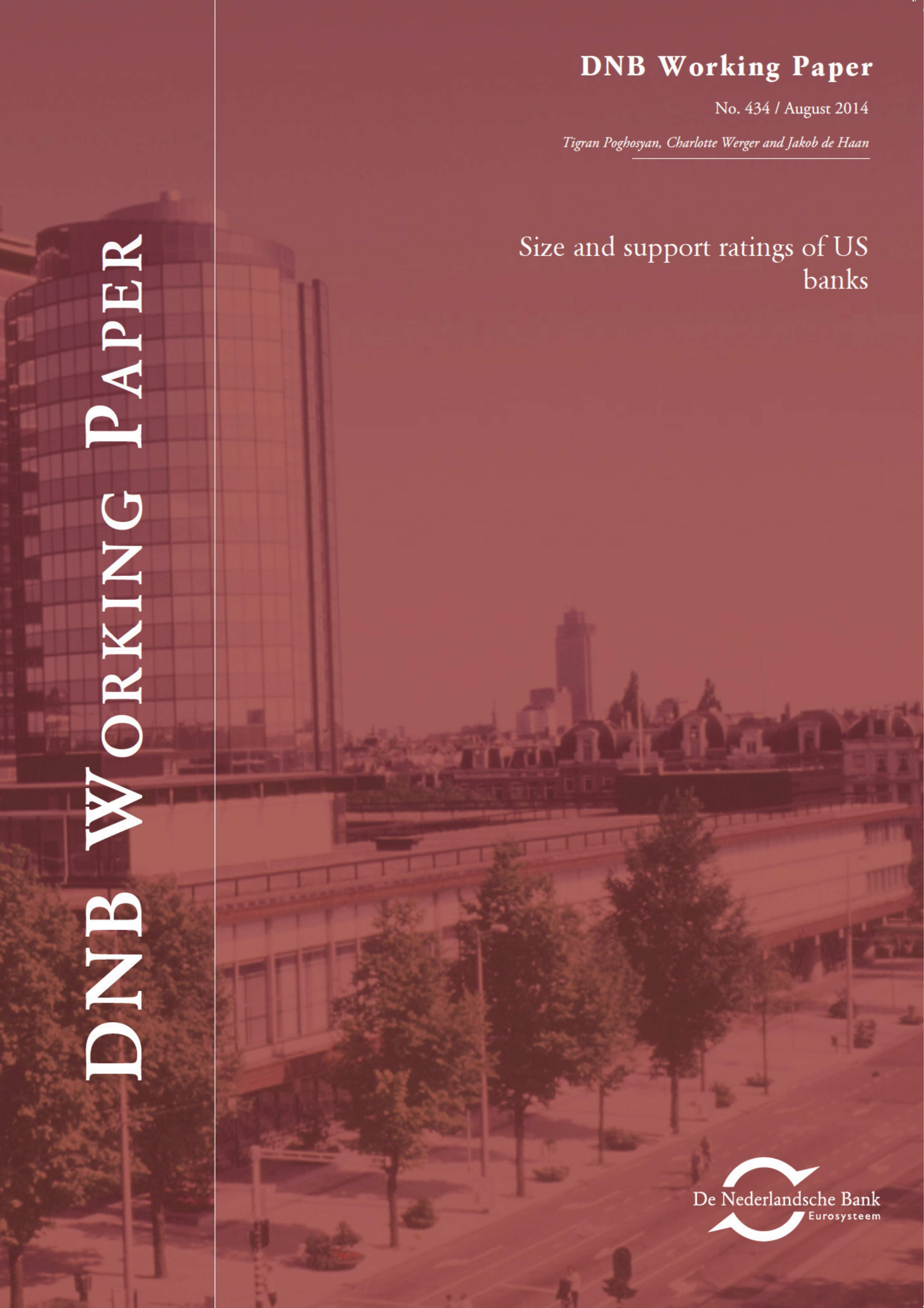

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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De Nederlandsche Bank NV
P.O. Box 98
1000 AB AMSTERDAM
The Netherlands

Size and support ratings of US banks

Tigran Poghosyan[a] , Charlotte Werger[b], and Jakob de Haan[c,d,e,*]

[a] *International Monetary Fund, Washington, United States*
[b] *European University Institute, Florence, Italy*
[c] *De Nederlandsche Bank, Amsterdam, The Netherlands*
[d] *University of Groningen, The Netherlands*
[e] *CESifo, Munich, Germany*

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Abstract

We examine whether Fitch support ratings of US banks depend on bank size. Using quarterly data for the period 2004:Q4 to 2012:Q4 and controlling for several factors that make large and small banks different, we find that bank size is positively related to support ratings. However, the effect is non-linear in line with the 'too-big-to-rescue' argument. After the failure of Lehman Brothers and the passing of Dodd-Frank the relation between size and potential support has become stronger.

Keywords*:* Support ratings, Bank size, Too-big-too-fail, Financial crises.
JEL classification*:* G21, G32, L25.

* Corresponding author. Tel.: +31 205245657; fax: +31 205242506.
E-mail addresses: tpoghosyan@imf.org (T. Poghosyan), Charlotte.Werger@EUI.eu (C. Werger), j.de.haan@dnb.nl (J. de Haan).
The views expressed do not necessarily reflect the views of the IMF of DNB.

1. Introduction

As acquiring information is costly and leads to collective action problems, investors seek to outsource creditworthiness assessments to credit rating agencies (CRAs). Investors' reliance on credit ratings has increased over the past 30 years (Hau et al., 2013). CRAs are probably best known for their credit ratings, which provide an assessment of the credit risk of borrowers (Amtenbrink and de Haan, 2012). However, Fitch – the smaller of the big three CRAs – also provides external support ratings that, according to the Fitch website, "do not assess the intrinsic credit quality of a bank. Rather they communicate the agency's judgment on whether the bank would receive support should this become necessary. These ratings are exclusively the expression of Fitch Ratings' opinion even though the principles underlying them may have been discussed with the relevant supervisory authorities and/or owners."[1]

This paper examines whether support ratings of Fitch for US banks are related to their size.[2] Fitch does not provide details about their rating methodology, but it seems likely that size plays a crucial role. As pointed out by Boyd and Runkle (1993), failure of a large bank is supposedly more feared by supervisors than failure of a small bank, since the former is more likely to result in macroeconomic externalities. Therefore, it is more likely that large banks will receive government support if needed. However, Brewer and Jagtiani (2013, p. 3) argue that "it is not always clear which institutions are 'too big to fail' (TBTF) and would be rescued in the event of a crisis. This was evident recently when AIG and Bear Stearns received support while Lehman Brothers did not. The general perception is that relatively larger institutions

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[1] See: Https://www.fitchratings.com/jsp/general/RatingsDefinitions.faces?context=5&detail=505&context_ln=5&detail_ln=500.

[2] The paper that comes closest to ours is Rime (2005) who shows that issuer ratings (which take external support into account) increases with asset size or measures of size relative to GDP (using data from many countries). In contrast to Rime, we focus on US banks only. As pointed out by Kroszner (2013, p. 12), "Including non-US institutions .... involves an "apples to oranges" comparison since the rules and expectations concerning the potential for government support vary considerably across the globe." Another related study is by Hau et al. (2013) who show that CRAs generally assign more favorable ratings to larger banks. Their study focuses on the quality of ratings by comparing the ranking of banks' credit ratings and the ranking of banks based on expected default two years later. In one of their robustness checks these authors also use Fitch external support ratings. The study by Hau et al. (2013) is based on an international panel of banks and therefore suffers from the 'apples and oranges' problem identified by Kroszner (2013).

are more likely to be considered TBTF, although the specific TBTF threshold has never been officially defined." Banks that are TBTF receive a *de facto* government guarantee, which will be reflected in their riskiness as perceived by creditors (see Strahan (2013) for a review of the TBTF literature). Such a government guarantee reduces market discipline by decreasing investors' incentives to monitor and price the risk taking of TBTF banks (Acharya et al., 2013). In addition, TBTF financial institutions can borrow at costs that do not reflect the risks otherwise inherent in their operations (Jacewitz and Pogach, 2013).[3]

Even though the Comptroller of the Currency named eleven banks "too big to fail" in 1984, generally authorities do not announce their willingness to support institutions they consider too big to fail, but prefer to be ambiguous about which institutions, if any, would receive support if they got into trouble (Acharya et al., 2013). Despite this "constructive ambiguity" several studies (to be discussed in more detail in section 2) provide evidence that TBTF institutions benefit from the government's implicit guarantee.

However, recently, some studies have pointed out that banks may also be 'too big to be rescued'. For instance, for a sample of 91 banks from 24 countries in the period 2002-2007 Völz and Wedow (2009) find a U-shaped relationship between size and CDS spreads, suggesting that some banks have grown so large that they are too-big-to-be-rescued. Demirgüç-Kunt and Huizinga (2013) report that banks' CDS spreads are negatively related to the fiscal balance of the government in the banks' home country. Arguably, countries with sound public finances can spend more on bank bailouts resulting in lower losses on bank liabilities (hence lower CDS spreads). Similarly, Correa et al. (2014) report that sovereign rating changes have a significant, non-linear and robust impact on bank excess stock returns. This effect is stronger for sovereign downgrades than for upgrades. Their results suggest that banks with more government support before the rating event tend to experience a significantly larger fall in excess stock returns. Following these studies, we test for a non-linear relationship between bank size and external support ratings.

[3] Several studies examine whether banks increase their risk taking in the presence of government guarantees. The evidence is mixed. While several studies find support for it (e.g. Gropp et al., 2010), others find that guarantees reduce risk taking (Cordella and Yeyati, 2003), possibly resulting from greater regulatory oversight (Acharya et al., 2013).

According to Kroszner (2013) and Strahan (2013), perceptions of government support have varied considerably over time. We therefore examine whether the impact of size on external support ratings has changed since the failure of Lehman Brothers. On the one hand, the fact that US authorities were not willing to rescue Lehman Brothers may have led to a downward re-assessment of the link between size and external support ratings. Indeed, Acharya et al. (2013) report that following the collapse of Lehman Brothers, larger financial institutions experienced greater increases in their spreads than smaller institutions. On the other hand, the failure of Lehman Brothers has also made it clear that it is very costly to let a large bank fail, due to its interconnectedness (Strahan, 2013). This experience may have reinforced the impact of size on external support ratings.[4]

Similarly, we analyse whether the passing of the Dodd-Frank law has affected the relationship between size and external support ratings. As pointed out by Kroszner (2013), the Dodd-Frank has set in motion reforms that may have ended TBTF expectations. For instance, Dodd-Frank's new resolution approach directs the FDIC to impose losses on uninsured creditors, shareholders, and managers and thus, in principle, ought to help mitigate TBTF by increasing the ex ante belief that creditors would bear losses in default (Strahan, 2013). The law also created the Financial Stability Oversight Council whose objective is, in part, to "promote market discipline, by eliminating expectations on the part of shareholders, creditors, and counterparties of [large financial] companies that the government will shield them from losses in the event of failure." The Council can subject TBTF institutions to additional oversight, including liquidation. Kroszner refers to warnings by credit ratings agencies that they are re-evaluating the likelihood of government support in light of the implementation of Dodd-Frank. The only study that we are aware of examining the impact of Dodd-Frank is Acharya et al. (2013). Their evidence suggests that Dodd-Frank actually lowered spreads for the largest financial institutions. The authors therefore conclude that Dodd-Frank failed to eliminate investors' expectations of future support for major financial institutions: "Dodd-Frank's designation of certain institutions as systemically

[4] After Lehman's failure Congress passed the Troubled Asset Relief Program (TARP), which provided hundreds of billions of dollars to support banks. In addition, the Federal Reserve Board provided support to the banks through a series of newly created special lending facilities. On top of that, the Fed and Treasury also took extraordinary actions to keep Citigroup and Bank of America solvent.

important may have had the unintended consequence of firming market expectations that these institutions are likely to receive government support in the future should they encounter financial problems." (p. 18).

The remainder of the paper is structured as follows. The next section discusses related studies and explains how our study adds to the literature. Section 3 outlines our methodology and section 4 describes our data. Section 5 offers our main results. The final section concludes.

2. Related literature

Our paper is related to three strands of literature. This section outlines the main issues in these literatures and explains how our paper contributes.

First, several studies have examined the impact of bank size on bank risk.[5] Arguably, larger banks are better diversified. However, Demsetz and Strahan (1997) report that large bank holding companies are not less risky than small bank holding companies, as large banks use their diversification advantage to work with lower capital ratios and to pursue riskier strategies. In line with this argument, DeYoung and Roland (2001) report that fee-based activities are associated with increased earnings volatility. Also Stiroh (2004, 2006b) and de Haan and Poghosyan (2012) find that a greater reliance on non-interest income is associated with more volatile returns. As pointed out by Stiroh (2006a), a shift into new activities affects the portfolio variance by changing the weights on the components and by introducing a diversifying covariance. Apparently, the higher reliance on relatively volatile non-interest activities outweighs the diversification benefits. In our regressions we include leverage, several proxies for risk, and diversification (proxied by the share of non-interest income in total income of banks) as controls.

Second, several papers have examined the importance of economies of scale. Arguably, banks can benefit from scale economies because the credit risk of their loans and financial services and the liquidity risk of their deposits become better diversified, thereby reducing the cost of managing these risks and allowing banks to conserve equity capital as well as reserves and liquid assets. Furthermore, overhead

[5] This part draws on de Haan and Poghosyan (2012). Recently, Hovakimian et al. (2012) examined banks' systemic risk. They find that bank size, leverage, and asset risk are key drivers of a bank's systemic risk.

costs may be reduced due to scale economies (Hughes and Mester, 2011). However, economies of scale may disappear once a certain size threshold is reached, with diseconomies emerging due to the complexity of managing large institutions and implementing effective risk management systems (cf. Laeven and Levine, 2007; Demirgüç-Kunt and Huizinga, 2011).

Until recently, most research did not yield strong support for economies of scale in US banking. However, more recent studies, such as Hughes and Mester (2011) and Wheelock and Wilson (2012), report strong evidence for scale economies. For instance, Hughes and Mester (2011) find positive scale economies for even the largest institutions. In their robustness checks these authors examine whether perceptions of government support could account for these results and do not find support for that hypothesis. We take the efficiency of banks into account in our regressions.

Finally, a more recent strand of literature examines the benefits that banks receive due to their TBTF status (see Kroszner 2013 for an excellent review).[6] A challenge faced in this line of literature is to come up with an approach that any measured difference between large and small banks is primarily due to perceptions of government support and not due to other factors that might be associated with size but are unrelated to perceptions of government support, such as diversification and scale economies (Kroszner, 2013).

A good example of this line of research is the study by Brewer and Jagtiani (2013). Using data from the bank merger boom in the US of 1991–2004, these authors find that banking organizations were willing to pay an added premium for mergers that would put them over the asset sizes that are commonly viewed as the thresholds for being TBTF. After controlling for risk factors and macroeconomic factors, they find that the combined cumulative abnormal returns to the target and the acquiring banks increase significantly for those mergers that allow the merged firms to become TBTF. In addition, their analysis of bond spreads before and after the mergers also indicates

[6] As pointed out by Kroszner, funding cost differentials appear to exist generally between large and small firms in many industries, not simply in banking. In addition, funding costs differentials in banking are not unusual compared to other sectors. This implies that “one cannot simply conclude that a funding cost difference in banking is due to perceptions of government support” (p. 5).

that the combined banking organizations face a lower funding cost after becoming TBTF through the merger.

Others follow different strategies. For instance, Jacewitz and Pogach (2013) focus on funding through deposits and document significant and persistent pricing advantages at the largest banks for comparable deposit products and deposit risk premiums. Between 2005 and 2008, the risk premium paid by the largest banks was 15-40 bps lower than at other banks, even after controlling for common risk variables.

Some studies in this line of literature employ credit ratings. For instance, Morgan and Stiroh (2005) find that the naming of the TBTF banking organizations by the Office of the Comptroller of the Currency (OCC) in 1984 elevated the bond ratings of those banks about one notch compared with non-TBTF organizations. Acharya et al. (2013) find that between 1990 and 2010 a positive relationship exists between risk and spreads for medium-sized and small institutions, but the risk-to-spread relationship is not present for the largest institutions. These results are robust to various bond-, firm-, and macro-level controls. In one of their robustness analyses, Acharya et al. (2013) use Fitch's long-term issuer rating (which incorporates implicit government support) and Fitch's individual rating as independent variables in the spread regression. Their evidence suggests that banks likely to receive government support pay lower spreads on their bonds.[7] However, Araten (2013) investigates market-based bond spreads as well as CDS spreads and finds that for the largest banks (>$500 billion) these market-based indicators more closely track the standalone rather than the with-support ratings. The purpose of our paper is not to determine the TBTF subsidy using credit ratings, but is more modest, namely to examine whether a (time-varying and non-linear) relationship exists between Fitch support ratings and banks size.

[7] However, Kroszner (2013) argues that CDS spreads of banks that will receive government support according to the CRAs and those that will not are virtually the same. This does not "support the assumption that a ratings "uplift" automatically translates into lower borrowing costs, and hence calls into question the use of the "uplift" as a measure of funding cost differentials." (p. 17).

3. Methodology

The model specification is as follows:

$$Rating_{i,t} = \alpha_{i,t} + \beta_1 Size_{i,t} + \beta_2 Size_{i,t}^2 + \gamma_1 X_{i,t} + \varepsilon_{i,t} \tag{1}$$

where *Size* is a proxy for size of bank *i* at time *t*; and *X* is a vector of bank-specific control variables. In order to allow for non-linear ('too big to rescue') effects, the square of size is taken up. The model includes a vector of state fixed effects to control for state-specific macroeconomic developments and a vector of time fixed effects to control for systemic factors affecting all banks simultaneously (for example, the level of interest rates). The dependent variable *Rating* is the log of Fitch's external support rating.

Our approach is to first estimate the model with only the size variables and fixed effects and then step-wise augment the model with additional factors that may be related to size and affect support ratings, such as firm-specific risk measures, returns, leverage, efficiency, etc. (Kroszner, 2013). We can thus examine to what extent the impact of size on external support ratings may be wrongly attributed to omitted variables. We use the following bank-specific variables:

Bank size. A recent survey of the Bank for International Settlements shows that all but one central bank consider size as the most important factor for determining the systemic relevance of a bank (BIS, 2009). We use two measures of size: (i) share of individual bank assets in total banking system assets and (ii) share of individual bank assets in nominal GDP (multiplied by 1 million to get coefficients comparable to other estimates).

Bank size squared. To test a non-linear relationship between support ratings and size, a quadratic size term is included as well in the regressions in the first two steps of our analysis (cf. Demirgüç-Kunt and Huizinga, 2013).

Returns. Following Acharya et al. (2013), we include Return on Assets (ROA). If big banks are more profitable than small banks, the significance of size may wrongly be attributed to size if ROA is not controlled for.

Riskiness. An important driver of credit ratings is riskiness. According to Demsetz and Strahan (1997), large banks hold a greater fraction of assets in loans relative to safer government securities. To control for this we include the *share of high-risk securities*, which is defined as the sum of equity securities, trading accounts, and asset-backed securities relative to total securities. Following Brewer and Jagtiani (2013), we also include the percentage of *non-performing loans* over total loans (NPLs) as indicator of riskiness of the banks' assets. In addition, we include the *Z-score*, calculated as the sum of ROA and equity ratio (ratio of book equity to total assets), averaged over four quarters, divided by the standard deviation of ROA over four quarters. The Z-score indicates the number of standard deviations that a bank's return on assets has to drop below its expected value before equity is depleted and the bank is insolvent (see Boyd and Runkle, 1993). Thus, a higher Z-score indicates that a bank is less fragile.

Subsidiary. This variable is a dummy that is one for subsidiaries and that captures possible support from a mother bank. Subsidiaries often rely on lifelines from their mother bank, which decrease their risk.

Cost-to-income ratio. We use the ratio of bank total non-interest costs to total non-interest revenues to proxy the efficiency of bank operations (following Shezad et al., 2010), where a higher ratio implies less efficiency. As pointed out in section 2, larger banks may be more efficient than small banks.

Leverage. Leverage of banks has been found to be increasing in size (cf. Demsetz and Strahan, 1997 and de Haan and Poghosyan, 2012). High-leveraged banks are arguably more risky than banks with lower leverage (cf. Brewer and Jagtiani, 2013). Leverage is measured as the ratio of bank total assets to total equity.

Diversification. We include the share of non-interest income to total income of banks to control for diversification (cf. Stiroh, 2004 and de Haan and Poghosyan, 2012).

Funding structure. Finally, we include a variable to account for funding structure, which is measured as total assets minus equity and interest bearing deposits, divided by total liabilities.

4. Data description and analysis

Bank balance sheet and income statement data are taken from the Federal Reserve's: (i) Reports on Condition and Income (the "Call Report"), and (ii) Y-9C Reports. These reports provide financial data for (i) all commercial, savings, and cooperative banks in the U.S. and (ii) domestic bank holding companies (BHCs) with total consolidated assets of US$500 million or more. The data is reported on a consolidated basis in the form of balance sheets, income statements, and detailed supporting schedules, including schedules of off balance-sheet items. This information is used to assess and monitor the financial condition of banks and BHCs, which may include parent, bank, and non-bank entities. We drop data on US insular areas (American Samoa, Guam, Puerto Rico, and Virgin Islands), keeping the total number of states used in the analysis to 51. We do not use any thresholds to select banks to the sample.

Table 1 provides summary statistics for the bank statistics used. The appendix presents a table containing correlations of the explanatory variables (Table A1) and provides information on the number of banks per state in our sample (Table A2). Our sample runs from 2004:Q4 to 2012:Q4 and contains 8,289 bank-year observations (out of which 2,718 observations are for BHCs).

Table 1. Descriptive statistics

	Mean	Standard deviation	Minimum	Maximum	Observations
Fitch external support rating	4.15	1.51	1.00	5.00	8,285
Bank assets as share in total banking system	0.26	0.86	0.00	10.07	8,016
Bank assets as share in GDP	0.49	1.63	0.00	16.29	8,016
ROA	0.00	0.01	-0.33	0.39	8,228
Share of high-risk securities	0.09	0.18	0.00	1.00	6,206
Non-performing loans	0.03	0.04	0.00	1.00	7,845
Z-score	0.41	6.43	0.00	527	7,051
Dummy for BHC subsidiaries	0.59	0.49	0.00	1.00	8,302
Cost-to-income ratio	0.53	0.99	0.00	39.22	5,524
Leverage	10.23	4.09	1.00	144.31	7,935
Diversification	0.31	0.21	0.00	1.00	7,969
Funding structure	0.87	2.46	-204.09	1.00	7,901

Note: This table provides summary statistics. See the main text for details on the definition of the variables used.

Data on credit ratings were retrieved from BankScope. As only Fitch publishes an external support rating, we use Fitch's support ratings as dependent variable. This rating runs from 1 to 5, with 1 being the highest attainable notch meaning that a bank has a high likelihood of receiving external support. As shown in Table 2, most banks are assigned rating 5 (lowest likelihood of external support). In our sample, the average rating is around 4.4 and the median is 5. The dispersion around the mean has slightly increased following the collapse of Lehman Brothers (see Figure 1), while the number of banks with a rating of 5 has declined and the number of banks with a rating of 1 increased (see Figure 2). There was also some uptick in the number of banks with rating = 2 (close to TBTF) in 2012.

Table 2. Overview of support ratings of 374 US banks, 2004-2012

Number of ratings, of which:	8289
Rating = 1	1363
Rating = 2	170
Rating = 3	274
Rating = 4	499
Rating = 5	5983

Figure 1. Fitch support ratings of US banks, 2004-2012

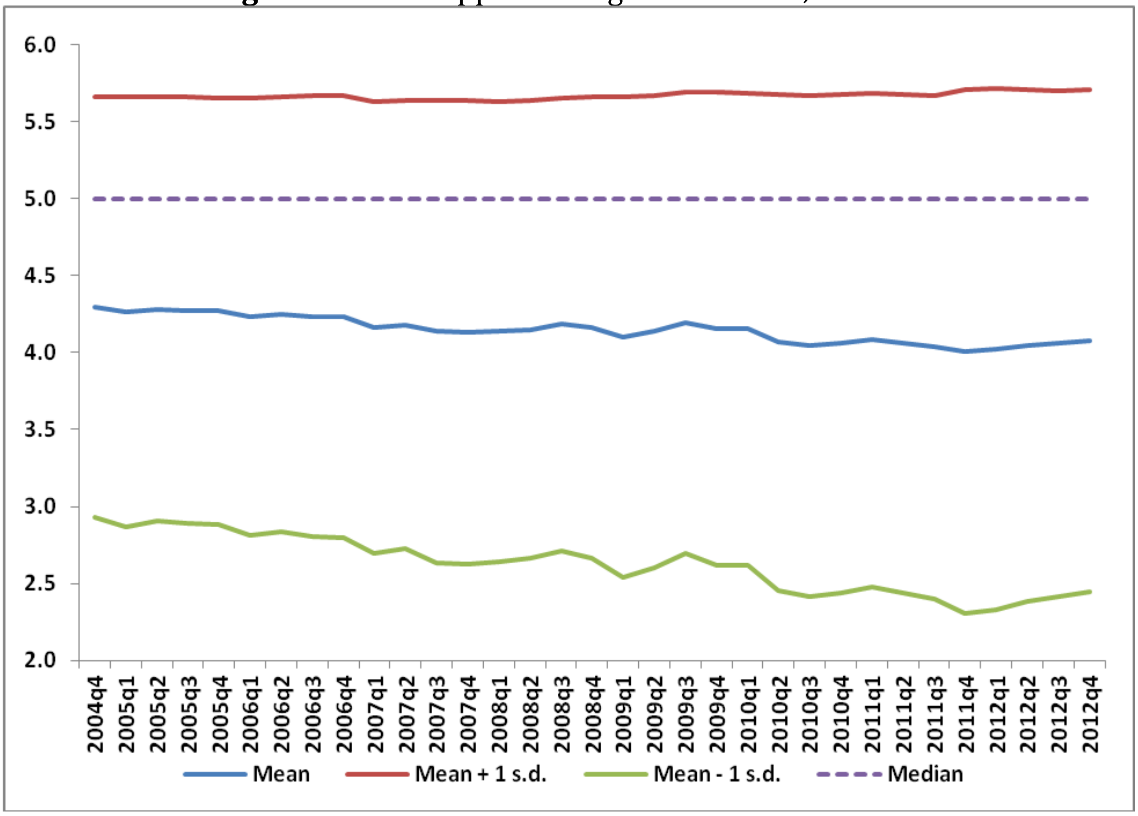
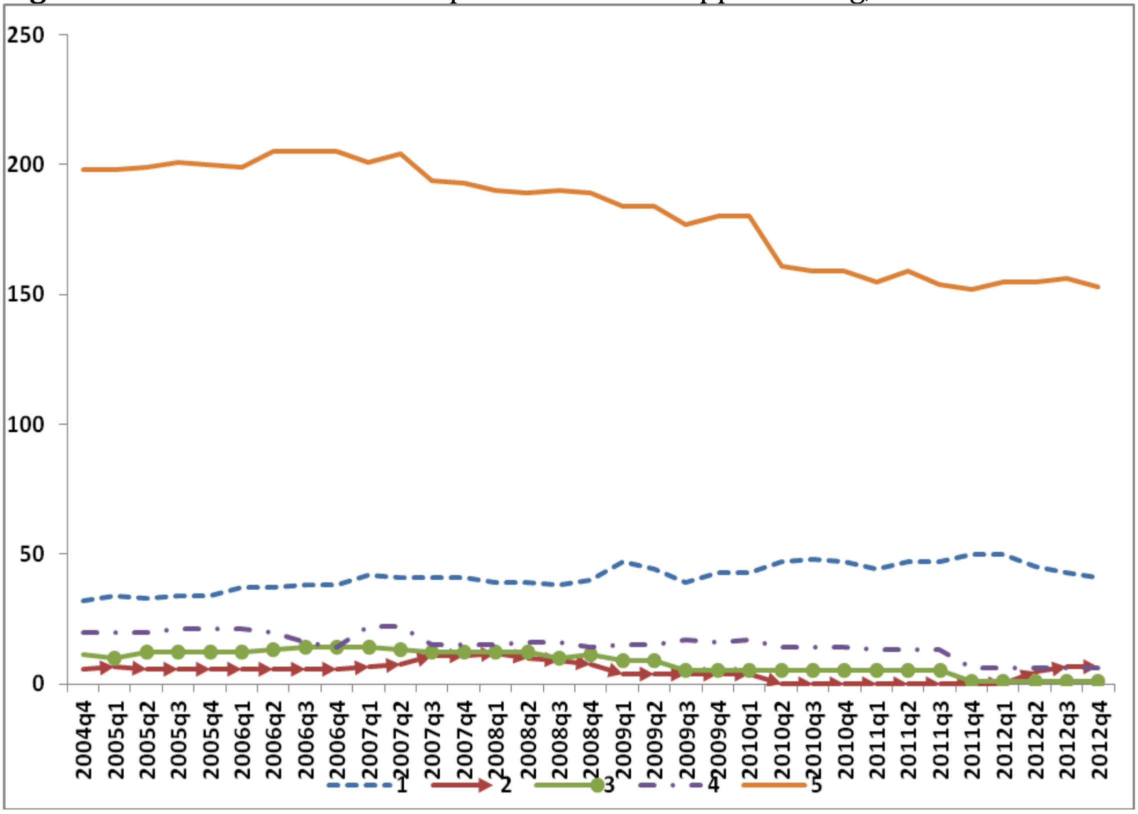


Figure 2. Number of banks with particular Fitch support rating, 2004-2012



For most banks support ratings did not change during the sample under consideration (2004Q4 – 2012Q4). Of the 374 banks in our sample, 34 experienced at least one downgrade over the sample, while 35 had at least one upgrade. In the following section we will present the empirical results from the model as described in section 3.

5. Results

Table 3 shows the basic results using the log of Fitch's external support ratings as dependent variable. Column (1) shows the results if only our measures of size (assets to GDP ratio) and the fixed effects are included. In columns (2) and (3) control variables are added, and in columns (4)-(6) the procedure is repeated for an alternative measure of size (assets to total assets). The results suggest that an increase in our relative size variable (*Size*) leads to decrease in the Fitch support rating, which corresponds to bigger banks having a higher likelihood of receiving support when in trouble. The squared-size term (*Size^2*) furthermore indicates that this effect is non-linear and that there is a marginal decrease in the effect. When size increases to a very large extent, the so-called "too-big-to-fail" effect on the support rating at some point decreases for the very large banks. The tipping point of size is estimated at 7.3 percent of GDP (average of columns 1-3) and 4.0 percent of total bank assets (average of columns 4-6).

The results for the diversification variable (*Diversification*) suggest that banks that have more diverse activities are more likely to receive support. This is in line with the findings of Brunnermeier et al. (2012) who suggest that more diversified banks potentially impose more systemic risk on the financial system. According to our findings such banks are then also more likely to receive government support. The non-performing loans variable (*Non performing loans*) indicates that banks with a low quality of assets (a high share of non-performing loans) are less likely to receive support. Apparently, Fitch considers that external support is less likely perhaps because the institutional supporter may not want to support banks that are fundamentally weak, and thereby creating "zombie banks". Banks with relatively risky securities (*High sec. risk*) are also more likely to receive government support. The results for *funding structure* indicate that banks that rely more heavily on wholesale debt relative to deposit funding are less likely to be bailed out. This is not surprising, as also banks with a high level of deposits could be considered "politically sensitive". Perhaps more surprising is that some other control variables (leverage, efficiency, Z-score and return on assets) do not seem to influence the Fitch support rating.

Comparing columns (1)-(3) and (4)-(6) shows that our findings are independent of the definition of our relative size variable, i.e. our results are similar for the bank's size relative to GDP as well as the bank's size relative to total banks assets in the US.

Table 3. Determinants of Fitch Support Ratings

Dependent variable	Log Fitch support ratings					
Size variable	Assets/GDP			Assets/Total assets US		
	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.2304***	-0.4035***	-0.4187***	-0.4337***	-0.7206***	-0.7415***
	[0.0163]	[0.0273]	[0.0288]	[0.0286]	[0.0576]	[0.0615]
Size^2	0.0144***	0.0288***	0.0300***	0.0510***	0.0930***	0.0960***
	[0.0014]	[0.0027]	[0.0029]	[0.0045]	[0.0119]	[0.0127]
Subsidiary		0.1355***	0.1151***		0.1337***	0.1132***
		[0.0370]	[0.0420]		[0.0371]	[0.0421]
Leverage		0.0039	0.0035		0.0040	0.0035
		[0.0030]	[0.0026]		[0.0030]	[0.0026]
Diversification		-0.2233***	-0.1116*		-0.2292***	-0.1196**
		[0.0486]	[0.0599]		[0.0488]	[0.0600]
Cost to income		-0.0346	-0.0324		-0.0344	-0.0315
		[0.0235]	[0.0365]		[0.0235]	[0.0363]
Non-performing loans		1.4367***	1.2984***		1.4598***	1.3225***
		[0.2035]	[0.2017]		[0.2041]	[0.2021]
Share of high-securities risk		-0.4230***	-0.4261***		-0.4269***	-0.4289***
		[0.0571]	[0.0618]		[0.0573]	[0.0620]
Z-score			-0.0356			-0.0369
			[0.0248]			[0.0250]
ROA			0.1159			0.1679
			[1.4474]			[1.4554]
Funding structure			0.4926***			0.4910***
			[0.1311]			[0.1318]
Observations	8020	4634	4058	8020	4634	4058
R-Squared	0.2907	0.4567	0.4703	0.2915	0.4552	0.4685
R-Squared adj	0.2837	0.4468	0.4593	0.2846	0.4453	0.4574
Time FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES

Note: This table shows estimates of equation (1). The dependent variable is the natural logarithm of Fitch external support rating. In columns (1)-(3) the size variable is the bank's assets to GDP, while in columns (4)-(6) size is measured as the bank's share in the banking sector's total assets. In columns (1) and (4) only size and its square are included. In columns (2) and (4) a dummy for subsidiaries and proxies for leverage, diversification, efficiency, NPLs, and the share of high-risk securities are included (see main text for a description), while in columns (3) and (6) also the Z-score, ROA and funding structure are included. Estimations are performed using the OLS estimator. Robust standard errors are reported in parentheses. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1*.

The following tables contain extensions of our model as presented in Table 3 in order to investigate whether there is a structural break in the relation between size and expected support. We first examine whether the failure of Lehman Brothers in the third quarter of 2008 has affected the relationship between size and external support rating. One might expect that the failure of Lehman Brothers could have led to a decrease in support ratings, as Lehman being a large bank, did not receive support. On the other hand, one can also hypothesize that, given that the failure of Lehman Brothers had a disastrous effect on the financial system, regulators and the government wanted to prevent further disasters and decided to bailout any large failing banks afterwards. Table 4 presents the results for a sample split based on the Lehman Brothers failure. Comparing pre- and post-Lehman Brothers samples suggests that the second hypothesis is true. The higher coefficient of our size measures for the post-Lehman Brothers sample indicates that the relation between size and Fitch support ratings became stronger, i.e. the too-big-to-fail effect became more prevalent, after the failure of Lehman Brothers.

Table 4. Bank size and ratings: Pre- and post-failure of Lehman Brothers

	(1)	(2)	(3)	(4)
Dependent variable	Log Fitch support rating			
Time sample	*Pre-Lehman*		*Post-Lehman*	
Size variable	Assets/GDP	Assets/Total assets US	Assets/GDP	Assets/Total assets US
Size	-0.2826***	-0.5175***	-0.5338***	-0.8883***
	[0.0475]	[0.0876]	[0.0318]	[0.0823]
Size^2	0.0179***	0.0600***	0.0410***	0.1206***
	[0.0051]	[0.0168]	[0.0031]	[0.0173]
Observations	1933	1933	2125	2125
R-Squared	0.5244	0.5246	0.5487	0.5423
R-Squared adj	0.5076	0.5078	0.5345	0.5279
Time FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Constant	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Note: This table shows the effect of size on support ratings using the models in columns (3) and (6) of Table 3, when the sample is split in the periods before and after the fall of Lehman Brothers. Robust standard errors are reported in parentheses. Estimations are performed using the OLS estimator. The dependent variable is the natural logarithm of Fitch external support rating. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1*.

In Table 5 we investigate whether the passing of the Dodd-Frank act has changed the relation between size and support ratings. One could expect that the more stringent regulation on SIFIs in the Dodd-Frank act might lead to a reduction in the effect of size on the likelihood of receiving a bailout. However, the results in Table 5 suggest that after the passing of Dodd-Frank the relation between size and potential support has only become stronger as the coefficients of the size variables in the regression for the post-Dodd Frank act period are higher than those in the model for the pre-Dodd Frank act period. In line with the results of Acharya et al. (2013), these findings suggest that the relation between size and support has become stronger over time, regardless of any shocks that could have weakened the TBTF phenomenon, such as the failure of Lehman Brothers or the passage of the Dodd-Frank act.

Table 5. Bank size and ratings: Pre- and post-Dodd Frank act

	(1)	(2)	(3)	(4)
Dependent variable	Log Fitch support rating			
Time sample	*Pre-Dodd Frank*		*Post-Dodd Frank*	
Size variable	Assets/GDP	Assets/Total assets US	Assets/GDP	Assets/Total assets US
Size	-0.3799***	-0.6462***	-0.5668***	-1.0305***
	[0.0362]	[0.0763]	[0.0479]	[0.0991]
Size^2	0.0276***	0.0815***	0.0434***	0.1469***
	[0.0037]	[0.0161]	[0.0049]	[0.0203]
Observations	2890	2890	1168	1168
R-Squared	0.4651	0.4627	0.5448	0.5424
R-Squared adj	0.4512	0.4487	0.5214	0.5189
Time FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Constant	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Note: This table shows the effect of size on support ratings using the models in columns (3) and (6) of Table 3, when the sample is split in the periods before and after the adoption of the Dodd-Frank act. Robust standard errors are reported in parentheses. Estimations are performed using the OLS estimator. The dependent variable is the natural logarithm of Fitch external support rating. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1*. The sample split is before and after 2010Q3.

5. Sensitivity analysis

As a check for robustness, we have re-estimated the regressions as reported in Tables 3-5 using data for BHC and non-BHC banks separately. Tables 6 and 7 present the results for these regressions. They present similar results for the relation between size and support, and thus confirm our earlier qualitative findings.

Table 6. Fitch external support ratings and size: non-BHC banks only

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Log Fitch support rating									
Size variable	*Assets/GDP*					*Assets/Total assets US*				
Time sample	Total sample	Pre-Lehman	Post-Lehman	Pre-Dodd Frank	Post-Dodd Frank	Total sample	Pre-Lehman	Post-Lehman	Pre-Dodd Frank	Post-Dodd Frank
Size	-0.4187***	-0.2826***	-0.5338***	-0.3799***	-0.5668***	-0.7415***	-0.5175***	-0.8883***	-0.6462***	-1.0305***
	[0.0288]	[0.0475]	[0.0318]	[0.0362]	[0.0479]	[0.0615]	[0.0876]	[0.0823]	[0.0763]	[0.0991]
Size^2	0.0300***	0.0179***	0.0410***	0.0276***	0.0434***	0.0960***	0.0600***	0.1206***	0.0815***	0.1469***
	[0.0029]	[0.0051]	[0.0031]	[0.0037]	[0.0049]	[0.0127]	[0.0168]	[0.0173]	[0.0161]	[0.0203]
Observations	4058	1933	2125	2890	1168	4058	1933	2125	2890	1168
R-Squared	0.4703	0.5244	0.5487	0.4651	0.5448	0.4685	0.5246	0.5423	0.4627	0.5424
R-Squared adj	0.4593	0.5076	0.5345	0.4512	0.5214	0.4574	0.5078	0.5279	0.4487	0.5189
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows estimates of equation (1) for a sub-sample of non-BHC banks. The dependent variable is the natural logarithm of Fitch external support rating. In columns (1)-(5) the size variable is the bank's assets to GDP, while in columns (6)-(10) size is measured as the bank's share in the banking sector's total assets. Estimations are performed for the total sample and subsamples split by Lehman and Dodd-Frank events. Estimations are performed using the OLS estimator. Robust standard errors are reported in parentheses. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1*.

Table 7. Fitch external support ratings and size: BHC banks only

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Log Fitch support rating									
Size variable	*Assets/GDP*					*Assets/Total assets US*				
Time sample	Total sample	Pre-Lehman	Post-Lehman	Pre-Dodd Frank	Post-Dodd Frank	Total sample	Pre-Lehman	Post-Lehman	Pre-Dodd Frank	Post-Dodd Frank
Size	-0.2122***	-0.4190***	-0.2686***	-0.1602***	-0.2681***	-0.3972***	-0.8208***	-0.4519***	-0.2668***	-0.5447***
	[0.0473]	[0.1065]	[0.0593]	[0.0476]	[0.0781]	[0.0771]	[0.1941]	[0.0966]	[0.0908]	[0.1315]
Size^2	0.0214***	0.0941***	0.0325***	0.0213***	0.0299***	0.0764***	0.3418***	0.1038***	0.0668***	0.1164***
	[0.0064]	[0.0279]	[0.0074]	[0.0056]	[0.0100]	[0.0170]	[0.0907]	[0.0188]	[0.0230]	[0.0231]
Observations	1398	492	906	892	506	1398	492	906	892	506
R-Squared	0.3526	0.5902	0.4477	0.3564	0.5341	0.3537	0.5924	0.4487	0.3551	0.5421
R-Squared adj	0.32	0.5437	0.4134	0.3124	0.4886	0.3212	0.5462	0.4144	0.311	0.4973
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows estimates of equation (1) for a sub-sample of BHC banks. The dependent variable is the natural logarithm of Fitch external support rating. In columns (1)-(5) the size variable is the bank's assets to GDP, while in columns (6)-(10) size is measured as the bank's share in the banking sector's total assets. Estimations are performed for the total sample and subsamples split by Lehman and Dodd-Frank events. Estimations are performed using the OLS estimator. Robust standard errors are reported in parentheses. Significance levels are indicated by *** p<0.01, ** p<0.05, * p<0.1*.

The reason why we decided to split the sample into BHC and non-BHC entities is that these types of corporations are intrinsically different. For example, BHC Barclays receives a different support rating then Barclays Bank (a support rating of 5 versus 1 for the latter). BHCs consist of different parts and corporate activities, and not all parts can count on external support, which can result in lower support ratings for the BHC as a whole. We therefore explore the relation between size and support for both BHCs and non-BHCs separately. We find, however, that the TBTF effect is present for both the non-BHC (Table 6) and BHC subsample (Table 7). For the non-BHC sample we see again an amplification of the TBTF effect for the post-Lehman and post-Dodd Frank periods, suggesting the effect has become stronger over time. For the BHC sample this doesn't seem to be the case. We actually see a reduction for the post-Lehman period for BHCs. However, as the sample is significantly reduced here, it is hard to compare the size of the coefficients with our base model or the non-BHC sample.

6. Concluding comments

We examine whether Fitch support ratings of US banks depend on bank size. Using quarterly data for the period 2004:Q4 to 2012:Q4 and controlling for several factors that make large and small banks different, we find that bank size is positively related to support ratings. This finding provides evidence for the existence of a 'too big to fail' effect. However, the effect of size on support ratings is non-linear. This finding provides support for the 'too-big-to-save' argument and is in line with the results of Demirgüç-Kunt and Huizinga (2013) and Correa et al. (2014). A possible alternative interpretation is that for the largest banks, the government and regulators might look for alternative resolutions rather than simply providing capital injections and bailouts as means of support. It would be an interesting exercise to investigate other types of resolutions, although the benefit of using Fitch Support ratings would then obviously be lost.

After the failure of Lehman Brothers and the passing of Dodd-Frank the relation between size and potential support has become stronger. These results suggest that the regulatory efforts to reduce the too big to fail problem have not been successful. This conclusion is in line with the findings of Acharya et al. (2013).

As we focus our analysis on Fitch Support ratings only, our analysis would gain in robustness if we could confirm our findings using other proxies for government support. An example would be to use the difference in interest rates charged for guaranteed deposits by various banks. Although the Fitch support ratings are unique in their ability to proxy external support (they are after all constructed for that purpose), it would be interesting to expand this analysis to a broader set of government support variables. This is left for future research.

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Appendix

Table A1. Correlation matrix of independent variables

	Bank assets share in total banking system	Bank assets share in GDP	Dummy for BHC subsidiaries	Leverage	Diversification	Inefficiency	Credit risk	High risk securities	Z-score	ROA	Funding structure
Bank assets share in total banking system	1.00										
Bank assets share in GDP	0.99	1.00									
Dummy for BHC subsidiaries	0.06	0.06	1.00								
Leverage	0.00	-0.01	0.06	1.00							
Diversification	0.19	0.19	-0.01	-0.08	1.00						
Inefficiency	0.00	0.00	-0.03	-0.02	0.14	1.00					
Credit risk	0.10	0.10	-0.02	-0.11	-0.10	0.19	1.00				
High risk securities	0.44	0.44	0.03	-0.02	0.30	0.05	0.06	1.00			
Z-score	0.00	0.00	0.04	-0.04	-0.07	-0.10	-0.24	-0.08	1.00		
ROA	0.02	0.02	0.00	0.00	0.07	-0.67	-0.26	0.00	0.13	1.00	
Funding structure	-0.05	-0.06	0.04	0.03	-0.43	-0.15	-0.02	-0.16	0.07	0.02	1.00

Table A2. Number of banks and BHCs in each state

Alabama	AL	9
Arizona	AZ	1
California	CA	31
Colorado	CO	0
Connecticut	CT	5
Delaware	DE	11
Florida	FL	15
Georgia	GA	18
Hawaii	HI	6
Illinois	IL	15
Indiana	IN	4
Kentucky	KY	1
Louisiana	LA	4
Massachusetts	MA	13
Maryland	MD	9
Maine	ME	4
Michigan	MI	5
Minnesota	MN	11
Missouri	MO	6
Mississippi	MS	4
Montana	MT	2
North Carolina	NC	7
North Dakota	ND	3
Nebraska	NE	3
New Hampshire	NH	1
New Jersey	NJ	7
New Mexico	NM	1
Nevada	NV	3
New York	NY	40
Ohio	OH	15
Oklahoma	OK	3
Oregon	OR	2
Pennsylvania	PA	16
Puerto Rico	PR	6
Rhode Island	RI	2
South Carolina	SC	4
South Dakota	SD	2
Tennessee	TN	6
Texas	TX	6
Utah	UT	12
Virginia	VA	7
Vermont	VT	2
Washington	WA	5
Wisconsin	WI	7
Total	Total	334

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