

TBTF Subsidy for Large Banks--Literature Review

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Prepared for:

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Findings of studies on the TBTF subsidy (funding advantage):

GAO, July 2014:

- Across 42 different model specifications, large bank holding companies had funding cost advantages in the range of 17 bps to 630 bps in 2008.
- There is mixed evidence on whether funding costs persisted in 2013 post Dodd-Frank Act, with estimates ranging from a 196 bps large bank advantage to a 63 bps disadvantage, depending on the model.
- If 2013 credit conditions had been similar to the 2008 stressed credit conditions, 30 of the 42 models used in the study estimated a funding advantage for large banks.

Acharya (NYU), Anginer (Virginia Tech) and Warburton (Syracuse University), June 2014:

- The study suggests that large banks' funding cost advantage was 28 basis points annually for the period of 1990-2010; the cost advantage peaked at more than 120 basis points in 2009. Post Dodd-Frank, the authors find that the funding advantage is statistically equivalent to the advantage pre Dodd-Frank.

Balasubramanian (University of Akron) and Cyree (University of Mississippi), April 2014:

- Following the passage of the Dodd-Frank Act, subordinated bond pricing advantages associated with size decreased by 47%, while those advantages associated with TBTF fell by 94%.

International Monetary Fund, April 2014:

- Studying the crisis and its aftermath shows that subsidies rose across the board during the crisis. Post crisis, including post Dodd-Frank for the US, the funding advantages (subsidies) continue but at a lower level in most countries.
- In euro countries, estimated subsidies post Dodd-Frank remain more elevated than in the US, likely reflecting differences in the speed of balance sheet repair and policy responses.

Lester and Kumar (Oliver Wyman, commissioned by The Clearing House), April 2014:

- Bond spreads at the Global Systemically Important Banks (G-SIBs) were nearly 100 bps lower than bond spreads at other banks in 2009, but this effect diminishes over subsequent years to no advantage in 2013.

Bertay (Tilburg University), Demirgüç-Kunt (World Bank), and Huizinga (Tilburg University), March 2014:

- In an international study from 1991-2011, bank size measured as a proportion of bank liabilities to country GDP is associated with a lower interest expense overall, but also a greater sensitivity of expenses to bank capitalization.
- Among poorly capitalized US banks, a one standard deviation increase in size is associated with a 20 bps decrease in interest expense.

Santos (New York FRB), March 2014:

- From 1985-2009 the bond spread difference between large AA-rated banks and similarly rated smaller banks was 91 bps larger than a similar spread among nonbank financial firms. The spread difference between the large A-rated banks and similarly rated smaller banks was 50 bps larger than a similar spread among nonfinancial firms.

Kumar and Lester (Oliver Wyman, commissioned by The Clearing House), March 2014:

- Studying deposits post Dodd-Frank Act, this study shows that from 2010-2012 the largest banks pay only 4 bps less than other banks for uninsured deposits and at least some of this amount is unlikely driven by TBTF perceptions.

Jacewitz and Pogach (FDIC), February 2014:

- The largest banks pay approximately 40 basis points lower in risk premiums for uninsured deposits from 2007 until the increase in the deposit insurance limit in October 2008.

Araten and Turner (JPMorgan Chase), October 2013:

- Deposit rate advantage of 23 bps, and a small advantage in bond spreads (3bps) and CDS spreads (12 bps), pre Dodd-Frank Act. Overall, this translates to a 9 bps advantage for largest bank holding companies, though it is argued that this advantage might not be the result of implicit guarantees.

Ueda and Weder di Mauro (IMF), October 2013:

- Banks in major countries enjoyed an estimated funding cost advantage of 60 basis points in 2007, rising to 80 basis points in 2009.

Tsesmelidakis (University of Oxford) and Merton (MIT), July 2013:

- Wealth transfers to investors amount to \$365 billion (\$129 billion to shareholders and \$236 billion to bondholders) during the crisis (2007-2010).
- Bondholders realized massive wealth transfers in 2008 and 2009, but no subsidies were recorded for 2010.

Carbó-Valverde (Universidad de Granada), Kane (Boston College), and Rodriguez-Fernandez (Universidad de Granada), June 2013:

- Banks on average benefited 10-22 bps from public safety nets from 2003-2008, with larger banks, those that received government support during the crisis, and European banks benefiting the most.

Schweikhard and Tsesmelidakis (Goethe University), May 2013:

- CDS pricing advantages suggest a \$120 billion subsidy to banks during crisis.

Stogin, Hindlian, Lawson, Murillo, Sadan and Subramanian (Goldman Sachs Global Markets Institute Report), May 2013.

- The six largest banks enjoyed a slight funding advantage of 6bps on average from 1999 to 2007.
- The funding advantage increased during the crisis but has reversed following the enactment of the Dodd-Frank Act to a funding disadvantage of 10 bps on average.

Barth and Schnabel (Johannes Gutenberg University, Mainz), April 2013:

- The most systemic banks, as measured using conditional value at risk (CoVaR), are associated with 20-30 bps lower CDS spreads than the mean CDS issuing bank. The study period covered 2005-2011.

Brewer (DePaul University) and Jagtiani (Philadelphia FRB), February 2013:

- Acquirers paid more than \$15 billion in added premiums in eight merger deals from 1991-2004 that brought the combined organization to over \$100B in assets.

Balasubramanian (University of Akron) and Cyree (University of Mississippi), June 2012:

- Prior to the crisis, large bank bonds exhibited a 136 bps funding advantage relative to smaller counterparts, though this reversed to a 33 bps premium after DFA (suggesting the largest banks are now *riskier* than other banks).

Noss and Sowerbutts (Bank of England), May 2012:

- Using three methodologies from 2007-2010, the authors find advantages of approximately £40 billion, £30 billion, and £120 billion for UK banks.

Kelly (Chicago), Lustig (UCLA) and van Nieuwerburgh (NYU), June 2011:

- Using a 2003-2009 sample, the value of the government guarantee extended to the entire financial sector (not individual firms) during the crisis peaked at more than \$150 billion annually.

Oxera (prepared for RBS), March 2011:

- Estimates state support of the UK financial system in 2010 to be about £5.9 billion per year.

Völz and Wedow (Deutsche Bundesbank), March 2011:

- From 2002-2009, a one percentage point increase in bank size as a percentage of GDP is associated with a two basis point reduction in CDS spreads.
- At the top of the size distribution increased size is positively associated with CDS spreads, hypothesized to be evidence of “too big to rescue.”

Li, Qu and Zhang (Moody's), January 2011:

- Examining the period 2001-2010, the 20 largest financial institutions' CDS spreads are 23 basis points lower pre-crisis and 56 basis points lower post-crisis, relative to other institutions' CDS spreads.

Gandhi and Lustig (UCLA), November 2010:

- Using data 1970-2009, the largest commercial banks receive an extra 3.10 percent of their market capitalization, which amounts to \$4.7 billion per bank in 2005 dollars.

Haldane (Bank of England), March 2010:

- The average annual advantage for the top five UK banks from 2007-2009 was more than £50 billion.

Baker and MacArthur (CEPR), September 2009:

- Average funding cost advantage increased to 78 basis points for 2008:4-2009:2, implying an advantage of \$34 billion per year to the 18 BHCs with more than \$100B in assets in 2009:1.

Additional Calculations of a TBTF Subsidy Based on Prior Study Findings:

Bloomberg View editorial, February 20, 2013 (based on a study by Ueda and Weder di Mauro cited below):

- The 10 largest US banks receive a subsidy of \$83 billion per year.

Bloomberg, May 10, 2013:

- At the request of Bloomberg Markets, Anginer (of Acharya, Anginer and Warburton) calculated that bondholders of the six biggest US banks are willing to accept lower returns, amounting to \$82 billion from 2009 to 2011 (\$37.3 billion in 2009 after TARP, \$29.9 billion in 2010, and \$14.6 billion in 2011).
- When other tax breaks are added in, Bloomberg calculates that the amount of the subsidy jumps to \$102 billion since 2009.

Bibliography, Findings and Methodological Summaries of TBTF Subsidy Studies and Additional Calculations:

Acharya, Viral V., Deniz Anginer, and A. Joseph Warburton. "The End of Market Discipline? Investor Expectations of Implicit State Guarantees." June 2014.

Findings:

- An annual funding cost advantage of 30 basis points from 1990-2012, representing approximately \$30 billion per year.
- The cost advantage peaked at more than 100 basis points in 2009, representing a funding advantage of \$150 billion.
- After the passage of the Dodd-Frank Act, the funding advantage was statistically equivalent to the pre Dodd-Frank advantage. Following the release of an FDIC white paper on the single point of entry strategy, the large bank funding advantage statistically declined, though was economically comparable.

Methodology:

Using data for the period 1990-2012, the authors conclude that investors' expectations of government support are embedded in the credit spreads on bonds issued by major U.S. financial institutions. To calculate the amount of the subsidy that results from the assumption of government support, the authors compute the credit spread on each financial institution's bonds as the difference between the yield on its bonds and the corresponding maturity-matched Treasury bond. The authors find a significant negative relationship between spreads and systemic importance. In particular, they find that size—as a measure of systemic importance—has a negative effect on spreads. The results are robust to including size effects in other industries. Using event study analysis, the authors also test for changes in funding advantages surrounding events such as the Lehman failure, passage of Dodd-Frank, and the release of a white paper on single point of entry.

Araten, Michel and Christopher Turner. "Understanding the Funding Cost Differences between Global Systemically Important Banks (G-SIBs) and Non-G-SIBs in the United States." *Journal of Risk Management in Financial Institutions* 6(4), 2013, 387-410.

Findings:

- Large bank holding companies have a deposits pricing advantage of 23 bps, other funding advantages are present pre-crisis, but largely reversed during and after the crisis.
- However, large firms in other industries also experience similar (or larger) pricing advantages (suggesting large firm advantages are not from special government support of the financial industry).

Methodology:

Using data from 2002-2011, the authors calculate G-SIB funding costs across a variety of sources. They run OLS regressions for deposits, bonds, CDS, and cost of fed funds controlling for firm specific and macro-economic factors. They divide the analysis into pre-crisis (until-2006:Q4), crisis (2007:Q1-2009:Q1), and post-crisis (post 2009:Q2) periods. They claim to find pricing advantages for large BHCs only pre-crisis, with large BHCs experiencing disadvantages during and after the

crisis. The also examine large firms in other industries and claim that pricing advantages are larger elsewhere and conclude this to be evidence against TBTF.

Baker, Dean, and Travis MacArthur. "The Value of the "Too Big to Fail" Big Bank Subsidy." Issue Brief, The Center for Economic Policy Research, September 2009.

Findings:

- An average funding cost advantage of 29 basis points for institutions with more than \$100 billion in assets for the period 2000-2007. This advantage increased to 78 basis points for the period from the fourth quarter of 2008 through the second quarter of 2009.
- The increase—of 49 basis points—is suggested to imply a subsidy of \$34 billion per year to the 18 bank holding companies with more than \$100 billion in assets in the first quarter of 2009.

Methodology:

The authors calculate the difference between the average quarterly cost of funds for institutions with less than \$100 billion in assets to the average quarterly cost of funds for institutions with more than \$100 billion in assets for the periods 2000-2007 and 2008:4-2009:1. The authors then calculate the difference in the differences between the two periods to determine if there was a TBTF subsidy. The authors acknowledge that there could be multiple explanations for growth in the difference between the costs of funds for the two groups of banks in the 2008:4 – 2009:2 period, but after adjusting for other possible explanations, the authors find that the spread between large and smaller banks could have increased by 9 basis points following the crisis. For the TBTF banks, this represents an annual subsidy of \$6.3 billion. The authors caution that this subsidy may only be temporary and that spreads may return to more normal levels once financial markets settle. The authors use data on US banks provided by the FDIC.

Balasubramanian, Bhanu and Ken Cyree. "The End of Too-Big-to-Fail? Evidence from senior bank bond yield spreads around the Dodd-Frank Act." June 2012.

Findings:

- A 136 bps advantage for the largest banks pre Dodd-Frank transforms to a 33 bps disadvantage to them post Dodd-Frank.

Methodology:

Using senior debt transaction data from the secondary market, the authors estimate bond spreads including indicators for passage of the Dodd-Frank act and for being large institutions. The methodology follows similarly from Balasubramanian and Cyree (2014), with the primary difference being the use of senior, rather than subordinated, debt.

Balasubramanian, Bhanu and Ken Cyree. "Has market discipline on banks improved after the Dodd-Frank Act?." *Journal of Banking & Finance* 41(155), 2014, 155-166.

Findings:

- Following the passage of Dodd-Frank, the funding advantage associated with size reduced by 47%, while the funding advantage associated with TBTF decreased by 94%.

Methodology:

Using investment grade subordinated notes and debentures data from the secondary market, the authors estimate bond spreads including indicators for passage of the Dodd-Frank Act and for being large institutions. The authors examine six-month periods before and after the passage of Dodd-Frank of daily transaction data and use a GMM approach to compare bond spreads between bank holding companies of different sizes. Using a simple size definition, they find that the size related funding advantage fell by 47% after Dodd-Frank. However, funding advantages measured using the SIFI definitions fell by 94% after Dodd-Frank.

Barth, Andreas and Isabel Schnabel. "Too big to fail?" *Economic Policy* 28(74), 2013, 335-369.

Findings:

- CDS spreads are negatively correlated with systemic importance, as measured using conditional value at risk (CoVaR, rather than simple size measures). Among CDS issuing institutions, moving from the mean systemic importance to the maximum is associated with a 20-50 bps decrease in CDS spreads.
- Size measures are generally insignificant after controlling for systemic importance (CoVaR). However, for indebted sovereigns size is positively associated with CDS spreads.

Methodology:

The authors use CDS data for 73 banks in 21 countries from 2005-2011 to establish the relationships between investor perceptions of expected losses and systemic risk and bank size. The authors use a conditional value at risk measure (Adrien and Brunnermeier (2011)) designed to capture the tail losses to the financial system given that an institution experiences a distressed event. Using a first differencing approach, the authors regress CDS spreads on the systemic risk measure, size, size interacted with sovereign debt and other controls. They interpret their results as suggesting that systemic risk, rather than size, is of policy relevance. Furthermore, they interpret their results on size and sovereign debt as suggestive evidence that the market penalizes less systemic, but still large, institutions for being too big to save. The discussion notes that the first differencing approach may obscure the interpretation of results as it eliminates cross-sectional differences in systemic importance.

Bertay, Ata Can, Asli Demirgüç-Kunt, and Harry Huizinga. "Do we need big banks? Evidence on performance, strategy and market discipline." Journal of Financial Intermediation 22(4), 2013, 532-538.

Findings:

- Using an international sample of banks, the authors separately examine the relationships of absolute bank size (assets) and systemic size (liabilities as a proportion of the country GDP) with other bank variables.
- Larger systemic size is associated with lower average interest expense, though greater sensitivity of interest expense to firm capitalization. This is interpreted as evidence that the too-big-to-fail effect dominates a too-big-to-save effect in determining funding costs.
- The authors further show positive (negative) relationships between absolute (systemic) size and returns on assets and returns on equity.

Methodology:

In an OLS framework, the authors exploit cross-country and inter-temporal variation in international banks 1991-2011 to examine the differential relationships that absolute size and systemic size have with bank characteristics including funding costs, returns on assets/equity, bank risk and bank strategies. The authors examine evidence of market discipline by interacting alternative size measure with various risk measures, and interpret stronger relationships as greater market discipline. Additional OLS analysis considers only the U.S. case, where it is more difficult to separate the different notions of size. Results suggest that a one standard deviation increase in bank liabilities is associated with up to a 20 bps funding advantage, with this number decreasing as capital levels increase.

Bloomberg, editors. "Why Should Taxpayers Give Big Banks \$83 Billion a Year?" February 20, 2013.

Findings:

- The authors suggest that the 10 largest banks in the United States by assets receive a taxpayer subsidy of \$83 billion a year. The top five banks account for \$64 billion of this total -- an amount roughly equal to their typical annual profits.

Methodology:

Using the findings of Ueda and Weder di Mauro (below), Bloomberg multiplies the total liabilities of the 10 largest US banks to calculate a subsidy of \$83 billion.

Bloomberg Markets. Ivry, Bob, "No Lehman Moments as Biggest Banks Deemed Too Big to Fail." May 10, 2013.

Findings:

- Bondholders of the six biggest U.S. banks are willing to accept lower returns, which amounted to \$82 billion from 2009 to 2011 (\$37.3 billion in 2009 after TARP, \$29.9 billion in 2010, and \$14.6 billion in 2011).
- Adding in other tax breaks, the amount of the subsidy jumps to \$102 billion since 2009.

Methodology:

- At the request of Bloomberg Markets, Deniz Anginer (Acharya, Anginer, and Warburton) calculated the subsidy received by six US banks as a result of bondholders accepting lower returns (because bondholders may believe these institutions will be bailed out).
- Bloomberg takes the Anginer estimate and adds tax breaks and additional income from the Federal Reserve's mortgage-bond purchases and the interest it pays for bank deposits and calculates that the amount jumps to \$102 billion since 2009.

Brewer, Elijah III and Julapa Jagtiani. "How Much Did Banks Pay to Become Too-Big-To-Fail and to Become Systemically Important?" Working paper No. 11-37. Federal Reserve Bank of Philadelphia. 2 September 2011.

Findings:

- Acquirers paid at least \$15.3 billion in added premiums in the eight merger deals that brought the combined organizations to more than \$100 billion in assets (assumed to be the TBTF threshold).

Methodology:

Using data from the merger boom of 1991-2004, the authors analyze the differences in market reactions to bank acquisitions depending on whether the acquisition caused the acquiring organization to cross the threshold from being too small to warrant government support in the event of failure to becoming TBTF (assumed to be \$100 billion in assets). The authors use OLS regressions to estimate the effect of crossing the threshold on the cost of the acquisition, the abnormal stock market returns, and the cost of funds measured as bond spreads. They show that when banks cross the threshold they pay an acquisition premium, that abnormal returns increase, and that banks face a lower cost of funds. The authors use the estimated coefficients from the OLS results to predict the value of the government subsidy. The data sample is restricted to U.S. banks.

Carbó-Valverde, Santiago, Edward J. Kane and Francisco Rodriguez-Fernandez. "Safety-net benefits conferred on difficult-to-fail-and-unwind banks in the US and EU before and during the great recession." *Journal of Banking & Finance*, 37(6), 2013, 1845-1859.

Findings:

- The authors suggest that all banks on average benefited 10-22 bps from government safety-nets. They say that larger banks, those that received government support in the crisis, and EU banks benefited the most.

Methodology:

The authors use a contingent claims approach (i.e. a Merton's default put) to value the annual "fair insurance premium percentage" (IPP) for banks. The IPP is argued to be a measure of the per-period value of the safety-net benefits conferred to banks. The authors show that across all banks, the IPP ranges from 10-22 bps even prior to the crisis (2003, 2005). Furthermore, the authors argue that IPP is larger for: (1) banks that were the largest at the start of the sample period; (2) banks that received government support during the crisis; and (3) EU banks relative to their US counterparts. The authors further examine the extent to which increased firm risk translates into greater safety-net guarantees across different groupings of banks. Compared to other banks, the largest banks and those that received government support during the crisis both exhibit a stronger IPP response to changes in asset volatility. This result holds in both the EU and the US.

GAO. "Large Bank Holding Companies: Expectations of Government Support." GAO-14-631, July 2014.

Findings:

- Across 42 different model specifications, large bank holding companies had funding cost advantages in the range of 17 bps to 630 bps in 2008.
- There is mixed evidence on whether funding costs persisted in 2013, with estimates ranging from a 196 bps advantage to a 63 bps disadvantage, depending on the model.
- The report also finds large bank funding advantages conditional on high credit risk. This is done both by restricting analysis to high credit risk banks and by estimating the large bank funding advantages with 2013 parameter estimates but 2008 credit risk variables.

Methodology:

This report uses bond spreads in an OLS framework to examine funding advantages at large bank holding companies. The report considers 42 different model specifications, using alternative size and volatility definitions as controls in addition to common controls for credit risk and bond characteristic. The analysis is conducted year-by-year to assess changes in funding advantages at large bank holding companies. Models consistently provide evidence of funding cost advantages for large bank holding companies before DFA, but mixed evidence afterward. The report also computes hypothetical funding cost advantages in 2013 with 2008 credit risk conditions by using parameter estimates from the 2013 analysis, but 2008 credit risk values. Under these calculations, the report suggests a large bank funding advantage.

Gandhi, Priyank and Hanno Lustig. "Size Anomalies in U.S. Bank Stock Returns: A Fiscal Explanation." *Journal of Finance*, forthcoming.

Findings:

- The authors find a higher stock return of 3.10 percent for the largest commercial banks and a 3.25 percent tax on the smallest banks. This translates into an annual advantage to the largest commercial banks of \$4.71 billion per bank in 2005 dollars.

Methodology:

Gandhi and Lustig show that a long position in a stock portfolio of the largest U.S. banks and a short position in a stock portfolio of the smallest banks underperforms an equally risky portfolio of all non-bank stocks and government and corporate bonds by nearly 8 percent per year over 39 years. The authors interpret this difference as the ex-ante distortion of an implicit government guarantee for the largest financial firms. The authors then build a general equilibrium model of asset prices and calibrate it to match the subsidy. The authors decompose the subsidy into a 3.10 percent subsidy to the largest banks and a 3.25 percent disaster tax on the smallest banks. In the absence of the subsidy, all banks would pay a 3.25 percent disaster tax. The authors multiply the subsidy by the average market cap of the largest banks to calculate the annual subsidy. The data cover U.S. financial institutions.

Haldane, Andrew. "The \$100 billion question." Comments by Mr. Andrew G Haldane, Executive Director, Financial Stability, Bank of England, at the Institute of Regulation & Risk, Hong Kong, 30 March 2010.

Findings:

- The average annual advantage for the top five UK banks from 2007-2009 was more than £50 billion.

Methodology:

The author estimates a large bank advantage by employing the difference in bank credit ratings that include the credit rating agency's judgment of expected government support and the ratings that exclude that support. He finds the average rating difference is higher for large banks than for small ones. The monetary measure of the advantage is estimated by "mapping from the ratings to the yields paid on bank's bonds; and then by scaling the yield difference by the value of each bank's ratings-sensitive liabilities." The sample includes banks and building societies in the UK as well as global banks over the period 2007 - 2009.

Haldane, Andrew. "On being the right size." Speech given by Andrew G. Haldane, Institute of Economic Affairs' 22nd Annual Series, The 2012 Beesley Lectures, 25 October 2012.

Findings:

- An advantage of \$70 billion per year for the period 2002-2007. By 2009, the advantage reached over \$700 billion per year.

Methodology:

The author estimates the large bank advantage with the ratings-based measure used in Haldane (2010). The sample includes the 29 world's largest banks (as defined by the Financial Stability Board).

International Monetary Fund. "How Big Is the Implicit Subsidy for Banks Considered Too Important to Fail?" Global Financial Stability Report, Ch. 3, April 2014.

Findings:

- Subsidies rose across the board during the crisis but have since declined in most countries, as banks repair their balance sheets and financial reforms are put forward.
- Estimated subsidies remain more elevated in the euro area than in the United States, likely reflecting the different speed of balance sheet repair, as well as differences in the policy response to the problems in the banking sector.
- All in all, however, the expected probability that SIBs will be bailed out remains high in all regions.

Methodology:

Primarily a survey paper of existing literature and documenting policy changes globally, the paper also compares TBTF subsidy estimates from three measurement alternatives: (1) a bond spread differential; (2) a contingent claims analysis (CCA) approach; and (3) a ratings-based approach. The first estimate is created by examining the difference between the spread over the London interbank offered rate (LIBOR) in the same currency for SIB bonds and the spread for non-SIB bonds. The second method compares observed CDS spreads with fair-value CDS spreads calculated from equity price information. The third method exploits the fact that credit rating agencies typically provide a breakdown of the overall credit rating for each bank.

Jacewitz, Stefan, and Jonathan Pogach. "Deposit rate advantages at the largest banks." FDIC Working Paper, February 2014.

Findings:

- The largest banks pay approximately 40 basis points in lower risk premiums for uninsured deposits than do smaller banks.

Methodology:

This study makes use of the fact that the difference in interest rates banks pay on insured and uninsured deposits in part reflects the risk of the bank as perceived by the market. The authors use money market deposit accounts with a minimum deposit of \$100,000 as their measure of uninsured deposits and money market deposit accounts with \$25,000 as their proxy for insured deposits. The authors calculate the difference in the interest rates offered on uninsured and insured money market deposit accounts at all banks for the period 2005-2010. The authors interpret the differences in interest rates across these two accounts as the market perceived risk of the bank. After controlling for observable differences in risk across banks, the authors find an unexplained residual difference in risky deposit rates between large and small banks of approximately 40 bps. Finally, they show that the differences in advantages vanish after the increase in the deposit insurance limit. They conclude that the results are consistent with a TBTF subsidy.

Kelly, Bryan, Hanno Lustig, and Stijn van Nieuwerburgh. "Too-Systemic-To-Fail: What Option Markets Imply About Sector-Wide Government Guarantees." Working Paper No. 11-12 Fama-Miller Paper Series University of Chicago Booth School of Business. June 2011.

Findings:

- The estimated dollar value of the expected government support to the financial sector (not to individual banks) is calculated to have peaked at over \$150 billion.

Methodology:

The authors use the difference between the price of a basket of put options on individual financial firms and the price of a put option on the financial sector index as the basis for measuring the size of a collective bailout guarantee to the financial sector. The authors use an asset pricing model with rare events to study the impact of supposed sector-wide bailout guarantees on option prices. The authors use the parameters of the model to infer the effect of the bailout guarantee on a firm's expected return and cost of capital as well as the overall dollar size of the government subsidy. The sample period covers January 2003 to June 2009.

Kumar, Aditi, and John Lester. "Do Deposit Rates Show Evidence of Too Big to Fail Effects?" Available at SSRN 2412852 (2014).

Findings:

- The authors find that after the passage of the Dodd-Frank Act, the pricing advantage at the largest banks on uninsured deposits is 4 bps.
- The authors argue that most if not all of the 4 bps advantage can be explained by non-TBTF factors.

Methodology:

The authors use a strategy similar to Jacewitz and Pogach (2014) and use the difference in the deposit rate for uninsured deposits (above \$250K) and the deposit rate for insured deposits (\$100K) to obtain a deposit risk premium. Like Jacewitz and Pogach (2014), they use a difference-in-difference approach to determine the extent to which the deposit risk premium differs between large banks and smaller banks. They also run OLS regressions to explore the extent to which this difference can be explained by various non-TBTF factors.

Kumar, Aditi, and John Lester. " Do Bond Spreads Show Evidence of Too Big to Fail Effects? Evidence from 2009-2013 Among Us Bank Holding Companies" Available at SSRN 2422769 (2014).

Findings:

- Bond spreads at the Global Systemically Important Banks (G-SIBs) were nearly 100 bps lower than bond spreads at other banks after controlling for credit risk and bond characteristics in 2009.
- The difference in bond spreads between G-SIBs and other banks declined over time and was statistically insignificant in 2013.

Methodology:

The authors examine senior, fixed rate bond spreads from 2009-2013 for bank holding companies. Using an OLS specification on a year-by-year basis, the authors show that after controlling for common credit risks and bond characteristics, the G-SIBs spreads were approximately 100 bps lower than those at other banking institutions in 2009. However, this estimated advantage declined in each subsequent year and was statistically insignificant in 2013. Furthermore, the authors argue that the advantages can be explained by effects unrelated to government support. They show that both within banking and across other industries, size is a significant determinant of bond spreads even outside of the largest institutions.

Li, Zan, Shisheng Qu, and Jing Zhang. "Quantifying the value of implicit government guarantees for large financial institutions." Modeling Methodology, Moody's Analytics, January 2011.

Findings:

- The authors calculate that large bank CDS spreads were lower than those at other institutions by 23 basis points pre-crisis and 56 basis points post-crisis.

Methodology:

The study explores differences in funding costs between large and all other banks in two stages for the period November 2001 through May 2010. The authors first calculate the difference between an observed CDS spread to an estimated 'fair market' CDS spread using information from the equities market for all institutions in the sample. The authors then compare the observed and estimated fair market CDS spreads between the largest banks and smaller institutions. The data used include information on the 20 largest and 63 other U.S. financial institutions that have CDS spreads and other market information available. (The authors also perform analysis on European data but the estimates in this summary include only US institutions.)

Noss, Joseph and Rhiannon Sowerbutts. "The implicit subsidy of banks." Financial Stability Paper No. 15. Bank of England. May 2012.

Findings:

- The funding advantage, historical-price contingent claims, and options-price contingent claims approaches produce estimates of approximately £40 billion, £30 billion, and £120 billion.

Methodology:

The authors use three methodologies to examine a potential TBTF subsidy -- a funding advantage approach, a historical-price contingent claims approach, and an options-price contingent claims approach.

- The funding advantage approach mirrors that of Haldane (2010) and (2012).
- The contingent claims models proxies the subsidy with the expected annual payment from the government to banks needed to prevent their default. This requires estimation of the distribution of banks' future asset values.
 - The options-price contingent claims approach mirrors that of Oxera (2011), except the authors "value the subsidy as a look-back option discounted at a rate of 1.2 percent, calibrated to the distribution of bank equity prices during 2010."

The historical-price contingent claims approach estimates the distribution of banks' future asset values based on historical prices of bank equity. The authors use data from UK banks in 2010 in their study.

Oxera (prepared for The Royal Bank of Scotland). "Assessing state support to the UK banking sector." March 2011.

Findings:

- The authors suggest the value of state support for a financial system with total asset values of approximately £7 trillion and volatility of about 4 percent is about £5.9 billion per year.

Methodology:

The report estimates the value of state support using data from 2010 in three steps: determining the magnitude of systemic shocks that would require the government to provide support, calculating the probability that such a shock would occur, and estimating the expected government payment that would be needed in the event of such shock. The authors use various shares of bank Tier 1 capital as the proxy for the "systemic threshold" -- the amount of asset value loss the system could withstand without requiring government intervention. They estimate the risk of such a shock using the variance in the equity prices of banks in the UK and the ratio of equity to assets. Lastly, the authors employ a Black-Scholes model to estimate the value of a European put option on the system's assets as a proxy for the level of state support necessary in the event of a shock. The study focuses on the UK banking sector.

Santos, João. "Evidence from the Bond Market on Banks' 'Too-Big-to-Fail' Subsidy." *Economic Policy Review* 20.2. 2014.

Findings:

- The five largest banks have a bond pricing advantage of 41 bps on average over other banks from 1985-2009.
- The pricing advantage for the top five is also observed in nonbank financials and nonfinancial firms. However, the top five bank pricing advantage remains after accounting for these general large firm price effects.

Methodology:

The author compares bond prices between the five largest banks and other banks from 1985-2009. Using OLS, the paper shows that, controlling for credit rating and bond characteristics, the five largest banks pay 41 bps less than other banks. Running OLS for a fixed bond rating, the author shows that this advantage is 120 bps for AA-rated bonds and 31 bps for A-rated bond.

However, the author contends that to argue that this advantage is related to TBTF it is important to show that these advantages are larger than similar advantages observed in nonbank financial firms or nonfinancial firms. The author then runs a new OLS specification, allowing the top five pricing advantage to vary between banks and other industries. Comparing banks to nonbank financials, the top five advantage is 91 bps larger for AA-rate banks and 16 bps larger for A-rated banks (the latter is insignificant). Comparing banks to non-financials, the top five advantage is 56 bps larger for AA-rate banks and 61 bps larger for A-rated banks (the former is insignificant).

Schweikhard, Frederic and Zoe Tsesmelidakis. "The Impact of Government Interventions on CDS and Equity Markets." May 2013.

Findings:

- Evidence of a structural break in the valuation of US bank debt in the course of the 2007-2010 financial crisis.
- During crisis, this translates to \$130 billion in benefit to the industry.

Methodology:

The authors use stock market prices and a Merton-type credit model to obtain model-based predictions for CDS prices. They compare these predictions to realized CDS spreads to obtain estimates for pricing advantages for banks, as well as other industries. Using OLS, they show that the differences in model-implied CDS spreads from actual CDS spreads are positively associated with size. They extend the model to also allow for a time varying default boundary.

Stogin, Steve, Amanda Hindlian, Sandra Lawson, Jorge Murillo, Koby Sadan, and Balakrishna Subramanian. 2013. "Measuring the TBTF effect on bond pricing," Goldman Sachs Global Markets Institute Report, May.

Findings:

- Within a subset of bond-issuing banks, the six largest banks enjoyed a slight funding advantage of 6bps on average from 1999 to 2007.
- The funding advantage increased during the crisis but has since reversed to a funding *disadvantage* of 10 bps on average.

Methodology:

The authors compare bank bond spreads over maturity-matched Treasuries for a subset of U.S. banks. The set of banks are drawn from institutions that are included in the IBOXX Investment Grade Index, which contains daily pricing information for investment grade bonds from January 1999 to March 2013. Banks are defined as all firms that have at least one FDIC-insured affiliate. The average number of banks included in the index over all years is 24. The authors calculate the median spread of the bank bond on a daily basis. Next, the authors rank the bank by assets and compare the average spread of the six largest banks to the average spread of the remaining banks in their data.

Tsesmelidakis, Zoe and Robert C. Merton, “The Value of Implicit Guarantees.” Working Paper, July 2013.

Findings:

- Wealth transfers to shareholders and debt holders amount to \$129 billion and \$236 billion, respectively.
- Debt holders realized massive wealth transfers in 2008 and 2009, but no subsidies were recorded for 2010.
- Most subsidies accrue to the banking subsector; the period from October 2008 to June 2009 accounts for most of the subsidies.
- The determinants of the subsidies are highly related to proxy variables for company size, default correlation, and systemic risk.

Methodology:

Calculates how firms considered TBTF benefit from access to cheaper funding during crises by combining a structural-model-based methodology for estimating a TBTF premium with a comprehensive data set of bond characteristics and prices in the primary and secondary markets for a sample of 74 U.S. financial institutions. Data are for the years 2007-2010. Separate benefits are calculated for shareholders and debt holders. Shareholder benefits are calculated as of time of issuance while debt holder benefits are calculated over the life of the bond. Authors estimate that actual subsidies could be twice as high as other forms of debt financing.

Völz, Marja and Michael Wedow. “Market Discipline and too-big-to-fail in the CDS market: Does banks’ size reduce market discipline.” *Journal of Empirical Finance* 18, 2011, 195-210.

Findings:

- Among large banks in 2002-2007, a one percentage point increase in size as a fraction of GDP is associated with a two basis point reduction in CDS spreads.
- Increasing size beyond 10% of GDP has a positive association with CDS spreads, argued to be evidence of too-big-to-rescue.

Methodology:

The authors use an international sample of CDS issuing banks and holding companies to examine the role that size plays on credit spreads. Focusing on 2002-2007, they use a quadratic specification to investigate hypotheses surrounding both TBTF and TBTR (too big to rescue). In the regression analysis they include both a time-varying size variable and a time invariant size variable (the mean size for a bank over the sample period), interpreting the former as a short-run size effect and the latter as a long-run time effect. Using a Mundlak-type (1978) random effects model, they find that the linear term on the long-run measure of size is generally negative, while the quadratic term is generally positive. The authors interpret the former as supporting TBTF, while the latter is argued to support TBTR. They show that the TBTR result is driven primarily by the inclusion of Swiss and Icelandic banks in the sample. Further, they demonstrate that these long-run relationships persist in the crisis.

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

Findings:

- Banks in major countries enjoyed an estimated funding cost advantage of 60 basis points in 2007 and 80 basis points in 2009.

Methodology:

In calculating the credit default ratings of financial institutions, Fitch Ratings estimates a measure of external support that reflects both the probability of parent company and government support. The authors use this information as a proxy for the likelihood of government intervention on behalf of a financial institution. The authors then estimate the effect of the government support on the long-term rating of the financial institution. The data include information on 895 banks rated by Fitch in 2007 and 2009.

As a point of reference when considering the magnitude of the TBTF subsidy calculations, the following table reports the net income of the top 10 BHCs for 2008-2012.

Net income of top 10 BHCs, 2008-2012	
Year	Net Income (\$Bs)
2008	-\$19.5
2009	\$37.5
2010	\$56.4
2011	\$69.0
2012	\$68.9