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Too-big-to-fail and funding costs: A repository of research studies

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Technical Paper

Too-big-to-fail and funding costs: A repository of research studies

01/2021

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Non-technical summary

Addressing the systemic and moral hazard risks associated with systemically important banks is a core element of financial sector reforms that were implemented after the global financial crisis. Funding costs of banks are an important metric for assessing the effects of these reforms. Expectations that a bank, when in distress, is considered to be “too-big-to-fail” and might therefore receive public support can lead to an implicit government subsidy and affect risk-taking incentives. Tracking changes in banks’ funding costs and analyzing patterns across institutions, countries, and time is thus important to assess reform effects.

This paper describes a new initiative which collects evidence on the determinants of banks’ funding costs. It complements FRAME, an online repository of evaluation studies by the Bank for International Settlements (BIS). FRAME includes studies from academia, policy institutions, and the private sector. It enables users to compare the findings of different studies in an interactive way. Its value depends on the number of studies included. The repository is a sharing platform where researchers can report their own findings.

More specifically, this paper describes the set-up of studies assessing changes in and drivers of implicit funding subsidies of banks. It explains how studies on implicit funding subsidies have been included in FRAME and how the repository is structured. At time of its launch in November 2020, the too-big-to-fail section of FRAME contains results from over 280 impact estimates from 25 studies. The paper is not a comprehensive review of the literature, nor does it aim to draw any inference from these studies. This selection of studies is not final, and authors of relevant studies are encouraged to submit their work to FRAME.

Nichttechnische Zusammenfassung

Die Minderung von systemischen und „Moral-Hazard“-Risiken, welche von systemrelevanten Banken ausgehen, ist ein Kernelement der Finanzsektorreformen, die nach der globalen Finanzkrise umgesetzt wurden. Die Refinanzierungskosten der Banken sind dabei eine wichtige Messgröße zur Beurteilung der Wirkungsweise der Reformen. Die Erwartung, dass eine sich in Schieflage befindende Bank als "Too-big-to-fail" angesehen wird und daher öffentliche Unterstützung erhalten könnte, kann zu einer impliziten staatlichen Subvention führen und sich auf die Anreize zur Risikoübernahme auswirken. Um die Wirkung der Reformen beurteilen zu können, ist es daher wichtig, Veränderungen bei den Refinanzierungskosten von Banken zu verfolgen und etwaige Muster über Institute, Länder und Zeiträume hinweg zu analysieren.

Dieses Papier beschreibt eine neue Initiative, die Erkenntnisse über die Determinanten der Refinanzierungskosten von Banken sammelt. Dies ist eine Erweiterung von FRAME, dem Online-Repositorium von Evaluierungsstudien der Bank für Internationalen Zahlungsausgleich (BIZ). FRAME umfasst Studien aus dem akademischen Bereich, von öffentlichen Institutionen sowie aus dem Privatsektor. Es ermöglicht den Nutzern, die Ergebnisse verschiedener Studien auf interaktive Weise zu vergleichen. Der Nutzen von FRAME steigt mit der Anzahl der enthaltenen Studien. Das Repositorium ist eine Austauschplattform, auf der Forscher ihre eigenen Ergebnisse hinzufügen können.

Zudem beschreibt dieses Papier verschiedene Studienansätze zur Schätzung der impliziten Finanzierungssubventionen von Banken. Es wird erläutert, wie entsprechende Studien in FRAME aufgenommen wurden und wie das Repositorium strukturiert ist. Zum Zeitpunkt seiner Veröffentlichung im November 2020 enthält der „Too-big-to-fail“-Abschnitt von FRAME über 280 Schätzgrößen aus 25 Studien. Das Papier stellt weder einen umfassenden Literaturüberblick dar, noch zielt es darauf ab, Schlussfolgerungen aus diesen Studien zu ziehen. Die Auswahl der Studien ist nicht endgültig und Autoren einschlägiger Studien werden ermutigt, ihre Arbeiten bei FRAME einzureichen.

Too-big-to-fail and funding costs: A repository of research studies[1]

Claudia M. Buch

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Martin Völpel

Abstract

Systematic reviews of evaluation studies benefit policy discussions and academic research and are used in many disciplines. In March 2019, the Bank for International Settlements (BIS) thus launched FRAME, a public, online and interactive repository of studies on the effects of financial regulations with an initial focus on the Basel III reforms. This paper describes an extension to this repository with research on the impact of too-big-to-fail (TBTF) reforms on banks' funding costs. One objective of post-crisis financial sector reforms has been to internalize systemic risk externalities through changes in the funding costs of banks that are classified as being systemically important. The FRAME repository now contains studies on the funding costs of systemically important banks (SIBs), and it currently comprises over 280 quantitative impact estimates from 25 studies.

Keywords: Financial sector reforms, too-big-to-fail, banks' funding costs

JEL codes: E44, G01, G18, G21, G28

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1. Motivation

In the aftermath of the 2007/2008 global financial crisis, financial sector regulations have been overhauled in order to increase the resilience of individual financial institutions and to prevent the build-up of systemic risk in the financial system. More than ten years after the crisis, as the implementation of the agreed reforms is progressing, it has become possible to assess the effects of the implemented reforms. A large number of academic and policy-related studies have assessed the effects of financial sector reforms. Some of these findings have been prepared using a framework for the post-implementation evaluation of the effects of financial regulatory reforms which the Financial Stability Board (FSB) introduced in 2017 (FSB 2017).[2]

This paper describes the set-up of studies assessing changes in and drivers of implicit funding subsidies of banks. These studies have now been added to a public, online, and interactive repository of studies on the effects of financial regulations, which was set up by the Bank for International Settlements (BIS) in 2019.[3] The repository "FRAME – Financial Regulation Assessment: Meta Exercise" contains standardized impact estimates on economic outcome variables and the characteristics of the underlying studies. FRAME includes studies from academia, policy institutions, and the private sector. The repository is a sharing platform where researchers can report their own findings.

FRAME is an important element of the infrastructure on regulation. Prior to its launch, information on evaluation studies was not collected in a consistent manner, and it has thus been difficult to obtain an overview of the existing body of evidence. Collecting relevant evaluation studies is important for a range of different stakeholders. For researchers, a good overview of empirical studies is helpful for identifying relevant gaps in the literature, benchmarking their own empirical results, and conducting meta-analyses.[4] For policymakers, it is important to base policy decisions on a broad empirical basis rather than on individual studies or anecdotal evidence only. Finally, accessible evidence is important for the broader public as it contributes to transparency. A repository which centrally collects evaluation studies can improve transparency by reducing the costs of accessing evaluation studies for all stakeholders (Buch 2017).[5]

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2 The evaluations conducted include the impact of reforms on incentives for central clearing, on infrastructure finance, and on the financing of small and medium-sized enterprises. An ongoing evaluation assesses the effects of the too-big-to-fail reforms of the FSB. See http://www.fsb.org for details.

3 For details, see the website of FRAME https://www.bis.org/frame/index.htm

4 A meta-analysis is a statistical tool which allows the results of different scientific studies which address the same research question to be combined. They thus allow an inference to be drawn from a larger range of studies, provide information on results that generalize beyond individual research papers, and can consequently be a useful source of information for policy work. In economics, meta-analyses have been performed on various subjects such as, for example, the impact of minimum wages.

5 Examples from other disciplines such as medicine or development economics include the Health Systems Evidence from the McMaster Health Forum (https://www.healthsystemsevidence.org), the Cochrane Library

The initial version of FRAME launched in 2019 focused on the effects of capital and liquidity standards implemented under the Basel III reforms, which are a central element of the Basel Committee on Banking Supervision's (BCBS) response to the global financial crisis.[6] Regulatory standards are mapped into selected bank balance sheet ratios and their effects on selected economic variables. At the time FRAME was launched, it included 139 quantitative impact estimates from 83 studies. Most of the impact estimates focus on the effects of bank capital and liquidity standards on bank lending (Boissay et al. 2019).

Addressing the systemic and moral hazard risks associated with systemically important banks (SIBs) has been a core element of post-crisis financial sector reforms. Reforms addressing the issue of too-big-to-fail have three elements: higher capital requirements for SIBs, improved supervision, and frameworks for the recovery and resolution of banks.

One important metric for assessing the effects of these reforms is the funding costs of banks. Expectations that a bank, when in distress, is "too big to fail" and therefore might receive public support can lead to an implicit government subsidy. Creditors, expecting to be bailed out, demand a lower risk premium. Banks benefiting from this implicit subsidy would not internalize the effects that their behavior has on overall risk in the financial system. The purpose of the reforms has thus in (large) part been to internalize the systemic risk externalities of financial institutions. Successful reforms would operate to a large extent through changes in the funding costs of systemically important institutions.

Attributing changes in funding costs to reforms, however, is challenging. The funding costs of banks differ for many reasons other than implicit bailout guarantees, including due changes in the macroeconomic environment and the many financial sector reforms implemented at the same time. These and other factors can affect funding costs. In addition, moral hazard and systemic risk are unobservable. For this reason, it is important to assess the effects of reforms on the basis of a large body of evidence, to take confounding factors into account, and to follow careful identification strategies when making causal statements.

The purpose of this paper is to explain how studies on implicit funding subsidies have been included in FRAME and how the repository is structured. It does not aim to draw any inference from these studies, nor does it provide a meta-analysis.

Section 2 explains the economics of too-big-to-fail in more detail and provides an overview of the TBTF reforms. Section 3 explains the structure of the TBTF section in FRAME and illustrates how to interpret the estimates. Section 4 concludes the paper and outlines avenues for future research and analysis.

(http://www.cochranelibrary.com), or, for development economics, J-PAL (https://www.povertyactionlab.org/) or the International Initiative for Impact Evaluation (www.3ieimpact.org).

6 See https://www.bis.org/bcbs/publ/d424.htm for details.

2. The economics of too-big-to-fail (TBTF)

a) Too-big-to-fail and systemic risk externalities[7]

The costs of financial crises for the economy and for the taxpayer can be substantial. In the global financial crisis of 2007/2008, governments spent considerable amounts of public money in order to prevent a failure of large financial institutions, a meltdown of markets and to mitigate negative repercussions for the real economy.

While all banks benefit from a stable and sound financial system, they differ with regard to their systemic importance. Financial institutions can become so large and interconnected that their failure would have severe negative feedback effects for the economy. In the absence of appropriate safeguards, governments may need to intervene in the event of distress. Such bailouts can take the form of the injection of capital into distressed banks in exchange for an equity stake or a guarantee for the liabilities of a failing financial institution.[8] During crises, implicit support has often turned into explicit support. Financial institutions that are deemed "too-big-to-fail" (TBTF) are thus a recurrent theme in the history of financial crises.[9]

The likelihood of government interventions can affect the pricing of securities issued by banks. Risk premia paid on private markets may not fully reflect the risk of failure, thus leading to a funding cost advantage for SIBs vis-à-vis other banks. This funding cost advantage can be expected to vary across the different funding sources of a bank: unsecured debt issued and uninsured deposits are likely to benefit the most from an implicit guarantee, as cash flows become more isolated from the risk of default. Equity investors, borrowers, and employees of the banks benefit as well through higher returns on equity, lower risk-adjusted borrowing costs, and higher compensation for employees.

Implicit subsidies affect incentives. Incentives amongst investors to monitor and control risk-taking may be reduced, and market discipline tends to be weakened.[10] Market prices may not necessarily reflect the actual financial health of banks that are systemically important. SIBs would thus face more abundant and cheaper financing for their debt than would normally be

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7 This section partly draws on the FSB's too-big-to-fail consultation report (FSB 2020), which provides an in-depth background and detailed explanation of the TBTF problem and a description of the implementation as well as the evaluation of the TBTF reforms.

8 For an overview of rescue operations during the Global Financial Crisis, see Congressional Budget Office (2018) and Congressional Oversight Panel (2011) for the United States, the German Ministry of Finance (Zimmer et al., 2011) for Germany, the European Commission (2011) for Europe, and Laeven and Valencia (2010) and FSB (2015) for selected systemically important institutions that failed or received official support.

9 For surveys of the costs of financial crises, see Laeven and Valencia (2008, 2012) and O'Hara and Shaw (1990). For earlier contributions to the literature on TBTF and deposit insurance schemes, see, inter alia, Berlin, Saunders and Udell (1991) and Hughes and Mester (1993).

10 The role of market discipline is discussed in Calomiris and Kahn (1991) and Calomiris (1999). Bliss and Flannery (2001), Flannery (2001) as well as Hellwig (2005). They provide a structured overview of the distinction between different notions of market discipline. Avery, Belton and Goldberg (1988) and Gorton and Santomero (1990) are early studies analyzing the monitoring function of market discipline. Flannery (1998) provides an extensive survey on the early evidence in this literature strand.

the case, given the actual risk they represent. This, in turn, provides incentives for managers and owners of banks to engage in activities which are riskier than what is optimal from a social point of view. Such actions may include decisions on size and complexity, asset allocation, funding structures and leverage. At the bank level, one might also observe higher wages and (executive) compensations, together with higher equity returns.

This constitutes a systemic risk externality: the probability of failure of banks may increase beyond socially optimal levels because managers and owners do not have to carry the full costs associated with their decisions. They reap potential profits but only partially bear potential risks. This excessive risk-taking has costs for society: if risks materialize, taxpayers may face costs related to the need to rescue the bank. Through changing patterns of competition, banks that do not benefit from a TBTF subsidy will also be affected: SIBs may increase their market shares at the expense of banks that do not enjoy implicit funding subsidies.

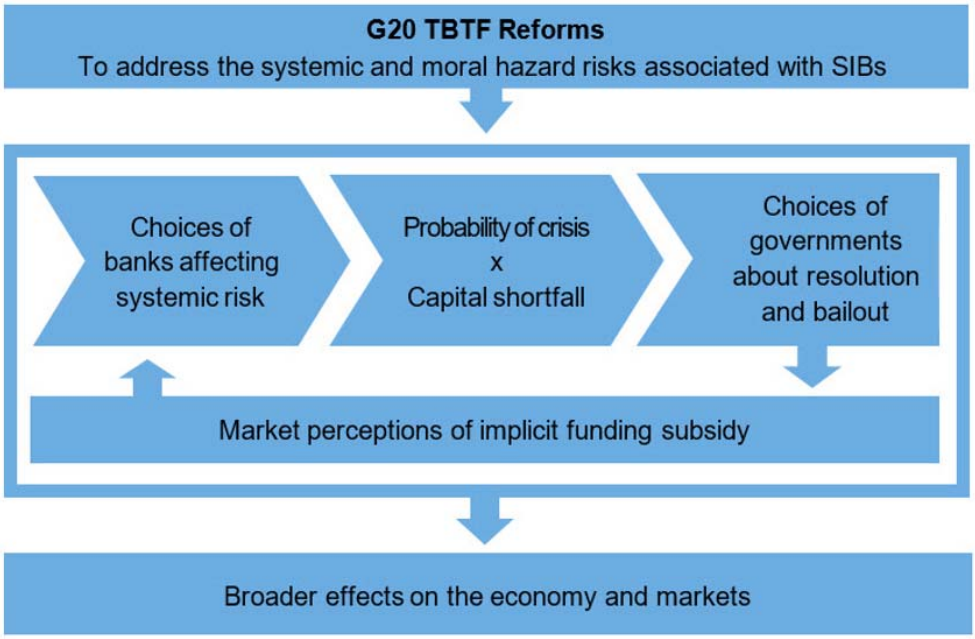
Regulatory changes addressing the issue of too-big-to-fail affect the incentives for banks to take on risks. They are comparable to situations where subsidies are withdrawn. These subsidies can be explicit, in the form of transfers, or implicit, in the form of unaccounted systemic risk externalities. Reducing subsidies can similarly be explicit, by cutting transfers, or implicit, by introducing tax-like instruments to internalize external effects. Both types of changes in policy can be expected to trigger adjustment processes at the level of individual banks and of the entire financial sector.

The withdrawal of implicit TBTF subsidies results, ceteris paribus, in an increase in funding costs. Like the introduction of a pollution emission tax, an increase in funding costs will be perceived as a cost of reforms by private market participants. At the same time, “emissions” and costs of financial crises to the taxpayer decline.

Regulatory reforms aimed at internalizing externalities through, for example, higher loss-absorbing capacity and provisions to facilitate the orderly resolution of TBTF banks, thus have the potential to increase social welfare. But such reforms will come at a net private cost for the affected banks: these banks will forgo the net private benefit associated with risk-taking before regulatory reforms, incur costs related to compliance with the new regulation, and funding may become more costly.

Figure 1 summarizes the transmission channels between the behavior of individual banks, decisions of governments, market perceptions of implicit funding subsidies, and aggregate outcomes. The systemic importance of banks depends on their choices with regard to size, asset structures, funding, and risk. This, in turn, determines the system-wide probability of distress (crisis), the amount of recapitalization needed in the event of distress, and the expected loss to the economy. If governments cannot credibly commit to a no-bailout policy, they provide an implicit subsidy to systemic banks which, in turn, affects their funding cost advantages and, consequently, their strategies. These feedback mechanisms affect the economy more broadly such as the overall resilience of the financial system and the provision of finance.

Figure 1: Transmission channels of TBTF reforms



Source: FSB

b) Too-big-to-fail reforms

In 2009, as a response to the global financial crisis, G20 leaders called on the FSB to propose measures to address the systemic and moral hazard risks associated with systemically important financial institutions (SIFIs). In 2010, the FSB proposed a policy framework for reducing the moral hazard posed by SIFIs, which was further specified in 2011 (FSB 2010, 2011). In 2013, the FSB took stock of the progress made in implementing the FSB's policy framework and set out further actions required to complete the policy initiative to end the TBTF problem (FSB 2013).

The FSB policy framework to address the TBTF issue has three key elements:

(i) **Effective resolution regimes** and resolution plans as well as resolvability assessments to strengthen authorities' powers to resolve failing financial firms in an orderly manner.

(ii) **Additional loss absorption capacity** above the Basel III minimum through total loss absorbing capacity (TLAC)[11] and capital surcharges.

(iii) **Enhanced supervision** as well as higher supervisory expectations.

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[11] The TLAC standard specifies the loss-absorbing and recapitalization capacity that is available to a globally systemically important bank in resolution by defining a minimum requirement for instruments and liabilities that can be bailed in. See https://www.fsb.org/2015/11/total-loss-absorbing-capacity-tlac-principles-and-term-sheet/ for details.

Since 2011, the FSB has published an annual list of global systemically important banks (G-SIBs). The identification of G-SIBs is based on the assessment methodology of the Basel Committee for Banking Supervision. The assessment methodology follows an indicator-based approach and uses bank size, interconnectedness, substitutability, global cross-jurisdictional activity and complexity as inputs to obtain what is known as a G-SIB score. G-SIBs are required to have an additional capital buffer, which ranges from 1% to 2.5% of their common equity tier 1 capital (CET1). The buffer depends on the bank's systemic importance, as measured by its score (BCBS 2011). In 2019, 30 G-SIBs were identified (FSB 2019).

In 2012, the G-SIB framework was extended to cover domestic systemically important banks (D-SIBs) (BSBC 2012). While not all D-SIBs are systemically important from a global perspective, their failure could cause harm to their domestic economy, with the potential to generate spillover effects across borders. While G-SIBs are identified by the FSB, in consultation with the BCBS and national authorities, D-SIBs are identified by the respective national authorities, taking into account the particular circumstances of the individual jurisdiction. In 2018, 132 banks were designated as D-SIBs in FSB jurisdictions (FSB 2020).

In 2019, the FSB started an evaluation of the TBTF reforms, and the results were published for consultation in June 2020. The report argues that the coverage of studies on funding costs is patchy in terms of the countries and time periods covered (FSB 2020). Given the gaps in the literature that have been identified, the FSB's TBTF evaluation performed its own impact assessments. Results are included in the consultation report. The final report of the evaluation is currently in preparation, and it is expected to be published in 2021. Upon publication of the final report, the underlying studies included can be added to FRAME, and the codes be shared.

c) Estimation of funding cost advantages and identification issues[12]

Higher implicit subsidies due to perceived TBTF status should be reflected in the higher funding cost advantages enjoyed by SIBs. Isolating the effects of systemic importance on funding costs may rely on identification strategies exploiting the cross-sectional or the time series variation in the data. Exploiting cross-sectional variation implies comparisons of funding costs across different types of banks (systemic versus non-systemic) or across large banks versus large non-financial corporations. In FRAME, this dimension is captured by breaking down empirical results by treatment and control group. Exploiting the time series dimension involves using data for the same institution and compares funding costs before and after certain treatment events through the breakdown option "Regime (period)". Alternatively, funding costs for a specific year can be compared using the option "Sample year" (Box 1).

In order to assess differences in funding costs across banks, some studies rely on the prices of financial market instruments such as the differences on subordinate bond yields, unsecured

[12] The strengths and weaknesses of different approaches to estimating funding cost advantages are discussed in Kroszner (2016), IMF (2014), or Siegert and Willison (2015). See also Antill and Sarkar (2018) for a recent analysis.

deposits rates, CDS prices, or equity prices between SIBs and non-SIBs. Some studies compare the costs of different funding instruments of the same bank, which are likely to benefit to a different extent from funding cost advantages due to the expectation of government support.

Another approach to estimate the funding cost advantage is based on the comparison of a theoretical fair value and actual market prices, using data on equity securities, options, and credit default swaps (Schweikhard and Tsesmelidakis 2012, Tsesmelidakis and Merton 2013). Starting from equity prices and options data, a contingent claims approach can be used to estimate the theoretical fair valued CDS that would compensate the holder in the event that the bank is in distress without reflecting the probability of a bail-out. The CDS price observed in the market should reflect both, the probability of the bank getting in distress and of a potential government support. By comparing the theoretical and actual market CDS prices, an assessment of the probability of government support can thus be obtained. This assessment is however based on the assumption of a high level of market efficiency and a pricing of equity securities that is unaffected by bailout expectations.

An alternative approach exploits different types of credit ratings. Some credit rating agencies estimate a support rating that includes only government support, whilst others consider both support from the parent bank and from the government.[13] The support rating measures the probability of external support. The stand-alone rating is an assessment of a bank's inherent financial strength and creditworthiness, assuming no exogenous support. The issuer credit rating or "overall" credit rating combines the stand-alone and the support rating, adjusted for expectations of the likelihood and extent of government support in the event of distress. The number of rating notches by which the issuer credit rating is higher than the stand-alone rating is the "rating uplift". This rating uplift can be converted into a measure of the funding cost advantage based on either historical or concurrent data on the typical bond spreads for each credit rating (IMF 2014).

The underlying assumption of the credit rating approach is that the bank's actual bond spread reflects its overall rating (with support), whereas, in the absence of its perceived TBTF status, the bank's funding cost would reflect its stand-alone rating. Hence, it is assumed that credit rating agencies can assess how markets would price debt instruments of banks depending on whether they are perceived as TBTF. However, the expectations of support tend to vary across credit rating agencies and also depend on the methodologies used.

Identifying the effects of a bank being designated as a SIB or being treated through TBTF reforms requires careful identification of a "treatment" from other confounding factors. There are several specification issues that need to be taken into account when modelling and interpreting estimates of funding cost advantages:

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13 For more details, see Schich and Lindh (2012).

- **Other reforms**: Several reform elements of the Basel III reforms were implemented in parallel to TBTF reforms. There are few datasets available that allow tracking the implementation of different regulatory reforms across country or the treatment of individual banks by specific reforms. Hence, most of the studies assessing a "reform" effect use relatively broad proxies of the overall effects of reforms rather than testing the effects of specific reform elements.
- **Bank-level factors**: When estimating funding cost advantages, structural differences between banks need to be taken into consideration. A simple comparison of funding costs across institutions of different size does not suffice. SIBs might enjoy funding cost advantages, in contrast to other banks, for several other reasons, such as differences in financial strength, risk diversification, economies of scale or more liquid markets for their liabilities. Hence, funding differentials that accrue due to scale or other factors need to be isolated from perceptions of government support (Kroszner 2016).
- **Macroeconomic environment**: Estimates of funding costs are affected by the macroeconomic environment. In periods characterized by low interest rates and unconventional monetary policies, funding costs may differ from those in other time periods. This affects changes in levels of funding costs over time and thus complicates attributing changes to specific regulatory events.
- **Benchmarking**: In the period prior to the global financial crisis, asset valuations may not have fully reflected risks, and credit extension has been extensive. Hence, the pre-crisis period may not necessarily be a reliable benchmark.
- **Dynamic adjustment**: Dynamic adjustments within the financial system need to be taken into consideration when assessing the effects of TBTF reforms. Withdrawing implicit funding subsidies is akin to a cost shock to SIBs. In the new steady state, one would expect less activity for the firms affected, pressure on compensation and employment in such firms, and lower bank-level equity returns reflecting lower profits. The transition path to the new steady state is likely to differ across countries. Countries differ pre-crisis with regard to the structure and degree of competition in the financial sector and levels of capital in the banking system. They also differ with regard to the exposure of their financial systems to the crisis and the economic policy mix chosen. These differences and heterogeneities across countries can be used to identify the effects of reforms and potential differences in time trends across countries.

Several empirical techniques are available in the literature that help to address these identification issues (FSB 2017). In addition to using the most suitable empirical method to study the issue at hand, comparing results across different empirical settings, countries, and time periods helps to distill robust results and to engender confidence in empirical regularities. This, in essence, is the purpose of the repository of studies on banks' funding costs, which we shall describe next.

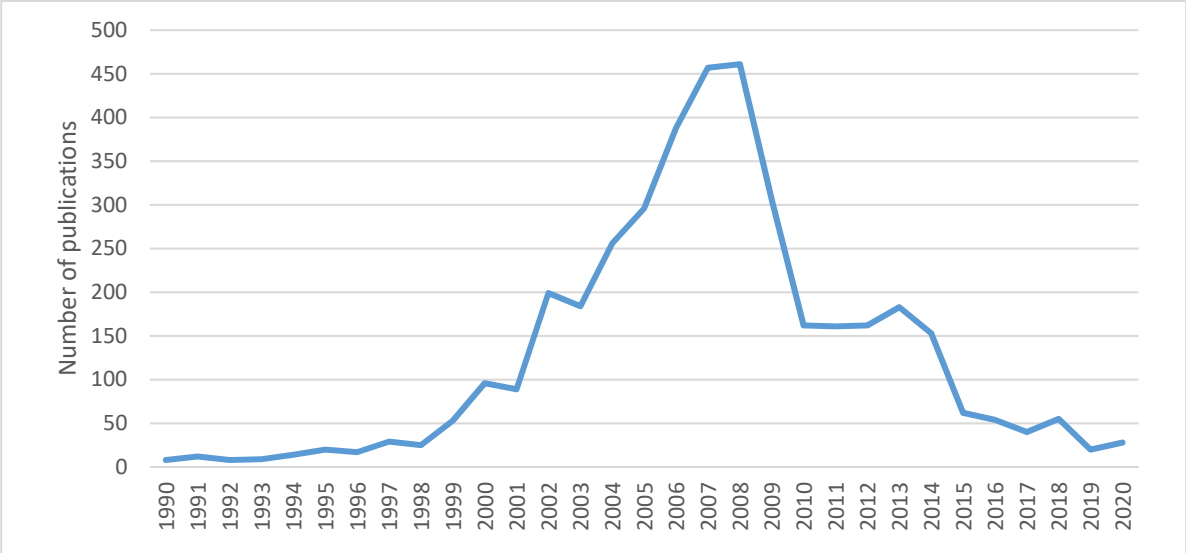
3. A repository of studies on funding costs

The TBTF section of FRAME summarizes the findings of empirical studies on banks' funding costs. The repository contains estimates of the impact of the TBTF reforms on SIBs' funding costs and credit ratings as well as estimates of the impact of bail-in events.

The studies included in FRAME have been taken from a large literature dealing with the issue of TBTF. Figure 2 plots all references included in the online library EconBiz maintained by the Leibniz Information Centre for Economics (ZBW) in Kiel. The database includes published journal articles, working papers, and also policy papers. Coverage of TBTF has clearly spiked during the Global Financial Crisis, reaching up to 450 publications annually. Not all of these publications include estimates of funding costs of banks though, hence only a relatively small subset of these publications has been included in FRAME so far.

Figure 2: Literature dealing with "Too-big-to-fail"

This figure plots counts of entries into the online library "EconBiz" maintained by the Leibniz Information Centre for Economics (ZBW). The information was extracted manually on 3 November 2020 from the website www.econbiz.de using the search term "too big to fail" per year of publication from 1990 to 2020.



Source: EconBiz (www.econbiz.de)

The initial selection of studies that are implemented in the new TBTF section of FRAME has been based on one of the following criteria:

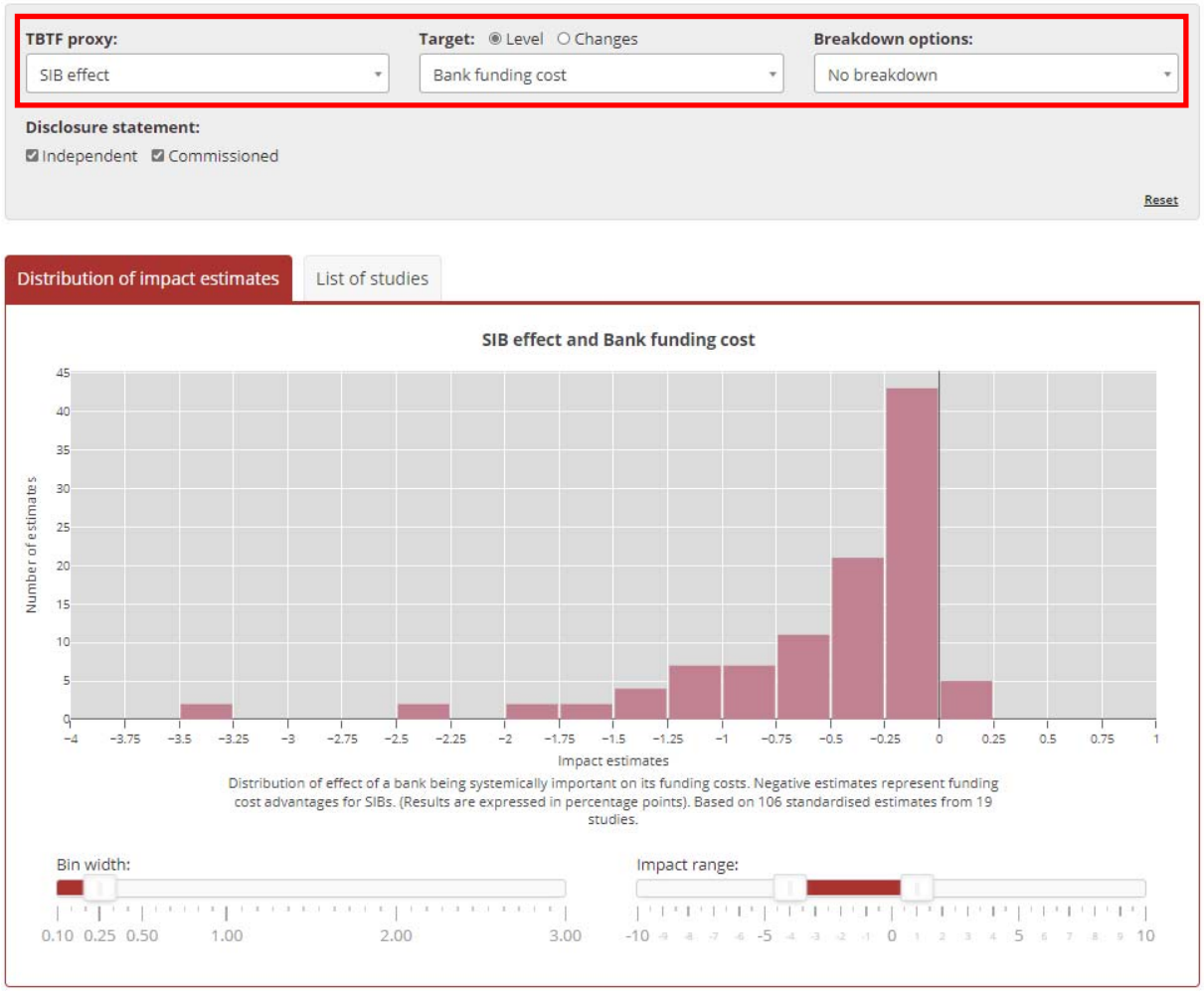
(i) Empirical studies estimating funding costs of systemically important banks.
(ii) Empirical studies assessing the effects of too-big-to-fail reforms or of bail in events.
(iii) Empirical studies relating to both systemically important banks and such reforms.

At the time of its launch in November 2020, the TBTF section of FRAME contained over 280 impact estimates from 25 studies selected from the TBTF funding cost literature. This selection

of studies is not final, and authors of relevant studies are encouraged to submit their work to FRAME. Accordingly, the following description of the database is meant to be an illustration of the features of FRAME, not a review of the literature on the issue which would allow drawing inference on questions of interest.

The TBTF section of FRAME contains impact estimates of SIBS' implicit subsidies, captured by their funding cost advantages. Because implicit subsidies are not observable, market prices that reflect the expectations and responses of investors can be used as proxies.

Figure 3: Main categories in the TBTF section of FRAME



The reporting of the estimates in FRAME is organized into three dropdown menus (Figure 3):

(1) **Explanatory variables ("TBTF proxy")**: This menu contains the list of explanatory variables a user may want to see the effect *of*, such as the TBTF reform, a bail-in event, or of a bank being classified as being systemically important.

(2) **Dependent variable ("Target")**: This menu contains the list of outcome variables a user may want to see the effect *on*, such as bank funding costs, bank credit rating or bank contingent claims.

(3) **Breakdown options**: This menu contains a list of the possible splits of the impact estimates, for example, between pre- and post-reform periods, the treatment and control group, and the statistical significance. Box 1 describes the individual categories and variables in more detail.

Box 1 – Categories and variables in the TBTF section of FRAME

Dependent variables ("Target")

(i) Bank funding cost

Studies use different financial market instruments and methods to analyze funding cost advantages. The breakdown option "Method (target detail)" provides more information on the specific bank funding cost variable.

(ii) Bank credit rating – Support

The credit rating support measures the change of the issuer credit rating in response to a one-unit improvement in the support rating.

(iii) Bank credit rating – Uplift

The credit rating uplift measures the average difference of the issuer credit rating due to the expectation of implicit government support for SIBs (i.e. a potential bailout).

(iv) Bank contingent claims

Bank contingent claims measure implicit claims that banks have on the government in case of a bank's default, thus measuring the implicit government bailout support.

Explanatory variables ("TBTF proxy")

(i) Effect of a bank being classified as being systemically important (SIB effect)

Studies often use a dummy variable that identifies SIBs. The definition of SIBs might differ between studies. The most common identifications are either based on a certain size threshold or rely on the official G-SIB and D-SIB classifications. The SIB dummy helps to distinguish between the funding costs of SIBs (treatment group) and non-SIBs (control group). Some studies rely on an identification strategy which computes the theoretical fair value of funding costs of SIBs and compares these to the actual funding costs of SIBs.

(ii) Reform effect

The effect of a reform is often measured by using a dummy variable that identifies the period after a TBTF reform was announced, approved, or entered into force. The coefficient of the reform dummy aims to measure the amount by which the explained variable has changed due to a TBTF reform, i.e. it estimates the reform effect. Using the breakdown by treatment group, it can be determined whether the reform effect was measured for banks in general or specifically for SIBs.

(iii) SIB x Reform effect

The "SIB x Reform effect" is an interaction term of the SIB dummy and the reform dummy. The aim of the coefficient of the interaction term is to measure the difference of the reform impact on the explained variable of SIBs relative to non-SIBs.

(iv) Bail-in effect

The "Bail-in effect" is a dummy variable that identifies the period after a bail-in event was either announced, was approved or took place. This can be a bail-in of any bank and is not restricted to SIBs. The aim of the coefficient of this bail-in dummy variable is to measure the amount by which the explained variable has changed due to the respective bail-in event, i.e. it estimates the bail-in effect. Using the breakdown by treatment group, it can be determined whether the bail-in effect was measured for banks in general or specifically for SIBs.

(v) SIB x Bail-in effect

The "SIB x Bail-in effect" is an interaction term of the SIB dummy and the bail-in dummy. The aim of the coefficient of this interaction variable is to measure the difference of the bail-in impact on the explained variable of SIBs relative to non-SIBs.

Breakdown options

A crucial feature of FRAME is the possibility of comparing impact estimates of different studies across several dimensions. The most relevant breakdown options are described below:

(i) Regime (period)

The different regimes are determined by the (sub-)sample period over which the impact is estimated. For example, one can compare impact estimates of a pre-reform vs. post-reform period or distinguish between pre-crisis, crisis and post-crisis periods.

(ii) Sample year

The sample year is reported if the impact estimate corresponds to a specific year and not to a certain period. The option provides information on how SIBs' funding cost advantages, for instance, have evolved over time.

(iii) Method (target detail)

The method option provides more information on the methodology and identification strategy used in the study. For example, it shows what kind of financial market instruments (e.g. bond yield spreads, CDS, deposit rates, equity prices, etc.) were used to estimate funding cost advantages.

(iv) Statistical significance

This breakdown option reports the p-value buckets of the impact estimates with respect to the 1%, 5% and 10% levels.

(v) Treatment group

The treatment group corresponds to those banks or institutions that form the focus of the respective study. For example, SIBs are the treatment group if the aim of the study is to estimate the reform effect on SIBs. In contrast, banks are the treatment group if the study is estimating the reform effect on banks in general without distinguishing between SIBs and non-SIBs.

(vi) Control group

The control group corresponds to those banks or institutions that the study uses as a comparison to the treatment group. Note that a control group is not reported for all studies. Examples without a control group are studies that analyze only a sample of SIBs without considering any non-SIBs.

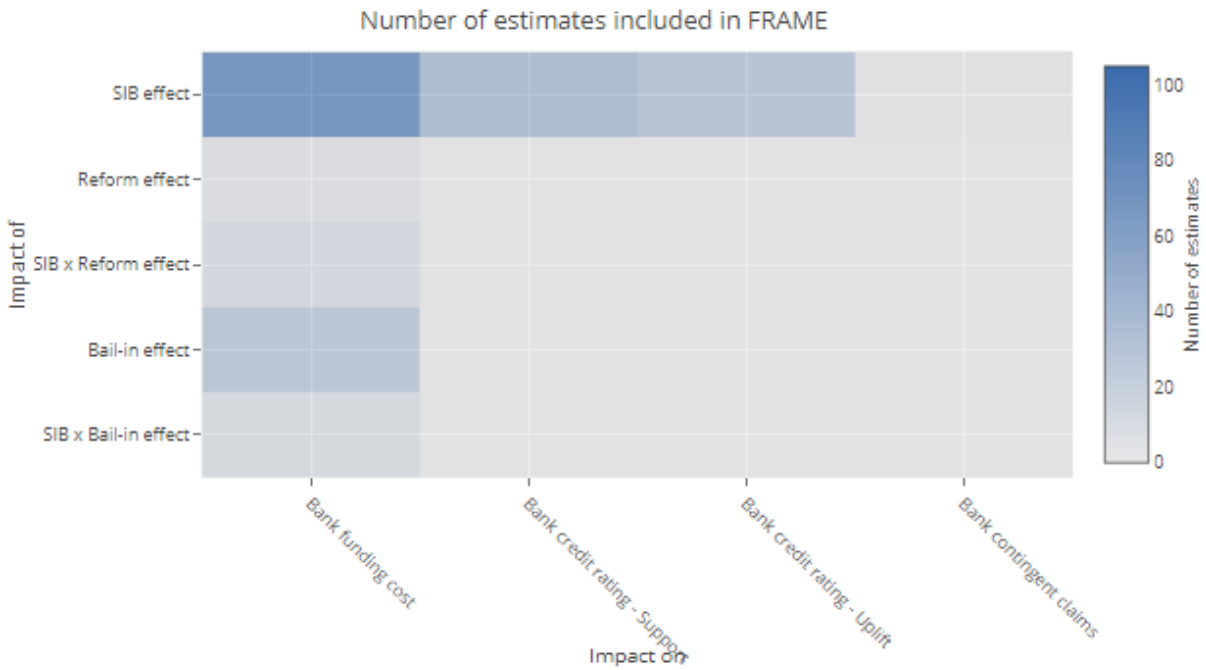
Disclosure statement

Studies that are included in FRAME need to be public and accompanied by a disclosure statement as to whether they were sponsored (e.g. by the private sector) or conducted independently (e.g. by academics).

The tab “List of studies” (Figure 3) contains information on the underlying references and the formulas used to standardize estimates. In order to make estimates from different studies comparable, the estimates need to be uniform. This standardization depends on the target variable. For example, funding costs should be expressed in percentage points. If some studies express their results in basis points, those estimates need to be transformed into percentage points.

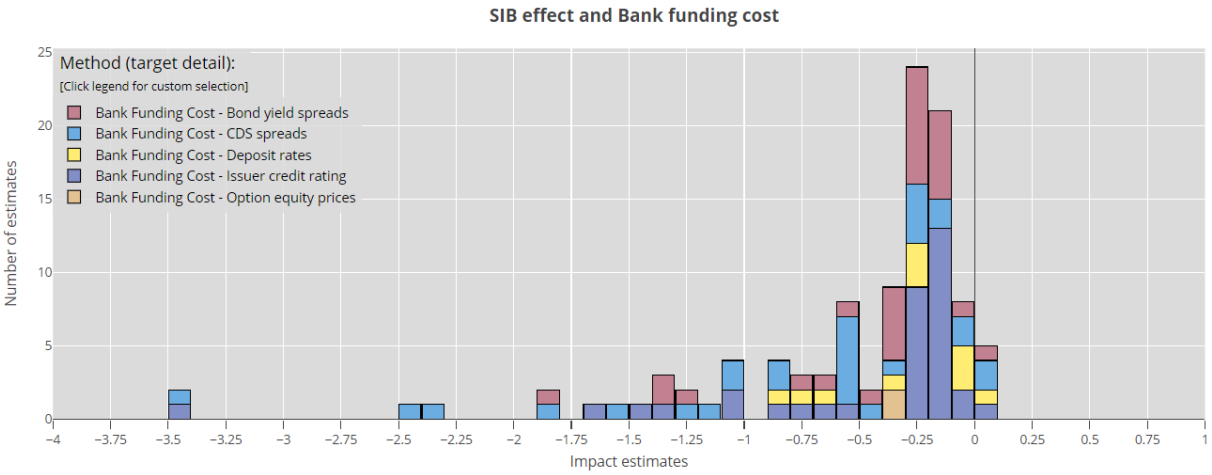
The TBTF section consists of two types of impact estimates. One type provides information on the amount by which the variable of interest (“Target”) has changed due to a certain event (“TBTF proxy”). The second type of impact estimate provides information on the level of the variable of interest during a certain period, before or after a TBTF related impact. The different types of estimates can be chosen by selecting “Level” or “Changes” on the FRAME website.

Figure 4: Number of estimates included in the TBTF section of FRAME



Most of the documented impact estimates show the effect of a bank being systemically important ("SIB effect") on its (relative) funding costs (Figure 4). The distribution of these impact estimates, the effect of a SIB status ("SIB effect") on its funding costs, is illustrated in Figure 5. The distribution of impact estimates is based on 106 standardized (uniform) estimates from 19 studies. Negative estimates represent funding costs that are lower for SIBs than for the respective control group.

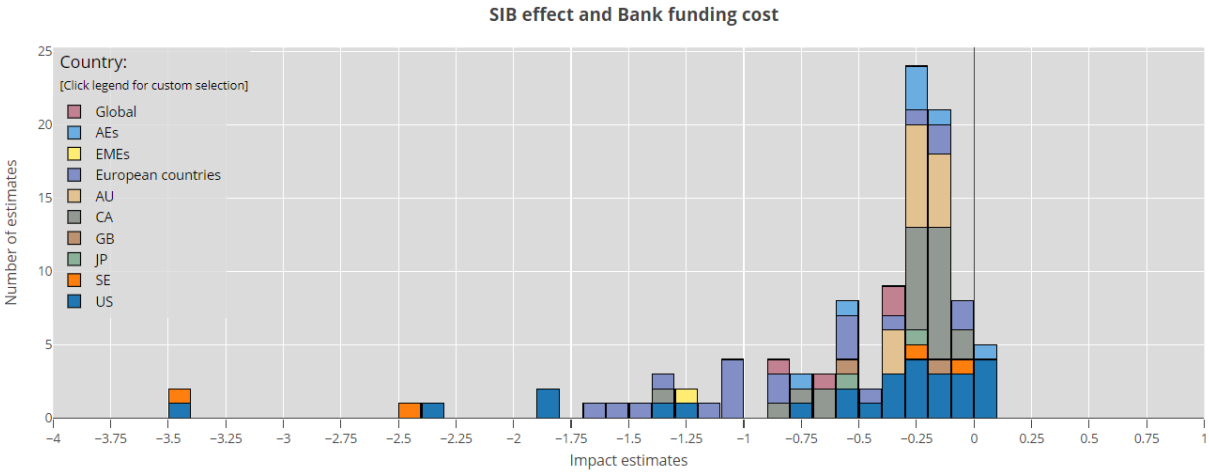
Figure 5: Funding cost advantage for SIBs by method used



Distribution of effect of a bank being systemically important on its funding costs. Negative estimates represent funding cost advantages for SIBs. (Results are expressed in percentage points). Based on 106 standardised estimates from 19 studies.

The size of the funding cost advantage for SIBs ranges from around zero up to 3.5 percentage points. The breakdown option “Method” provides information on the specification used. Studies estimate the funding cost advantage using various prices of financial market instruments such as bond yield or CDS spreads. Figure 6 plots the same distribution of impact estimates using the breakdown option “Country”. Most of the impact estimates are based on data for the United States (9 out of 19 studies), Canada (2 studies), and European countries (5 studies). Other markets, in particular emerging markets, are not very well covered by the existing literature.

Figure 6: Funding cost advantage for SIBs by country

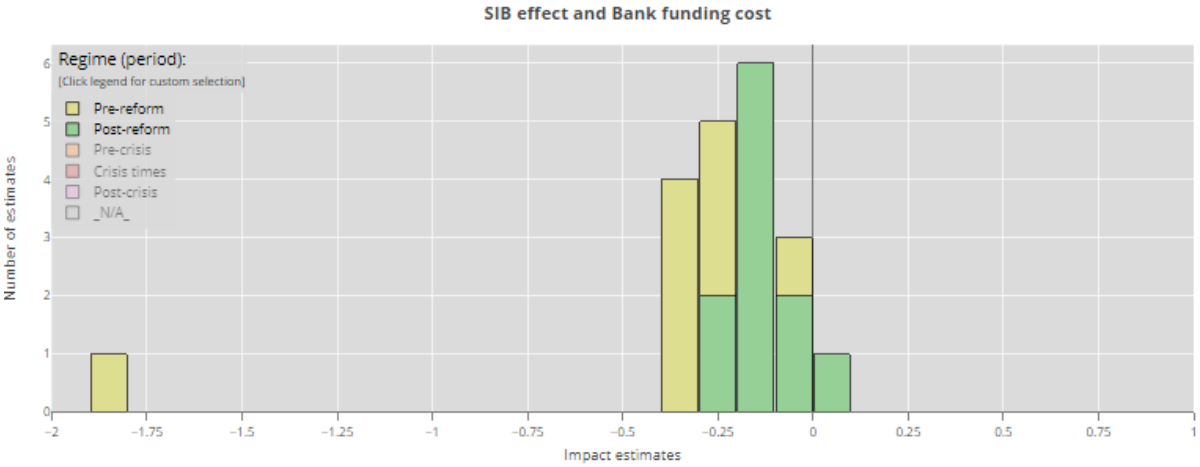


Distribution of effect of a bank being systemically important on its funding costs. Negative estimates represent funding cost advantages for SIBs. (Results are expressed in percentage points). Based on 106 standardised estimates from 19 studies.

Figures 7 and 8 plot the distribution effect that systemic importance has on a bank’s funding costs, showing changes over time (by “Regime (Period)”). Figure 7 distinguishes between impact estimates during the pre-reform period (light green) and the post-reform period (dark green).[14] Most of the estimates are negative, indicating that SIBs have lower funding costs than non-SIBs or compared to a theoretical fair value, depending on the study. On average, the estimates during post-reform periods are smaller than those for pre-reform periods. This can be interpreted as evidence in favor of a smaller post-reform funding cost advantage for SIBs.

[14] Studies may differ with regard to the exact specification of the pre- and the post-reform period. More information on the specific reform period can be obtained from the respective study reported under “List of Studies” on the FRAME website.

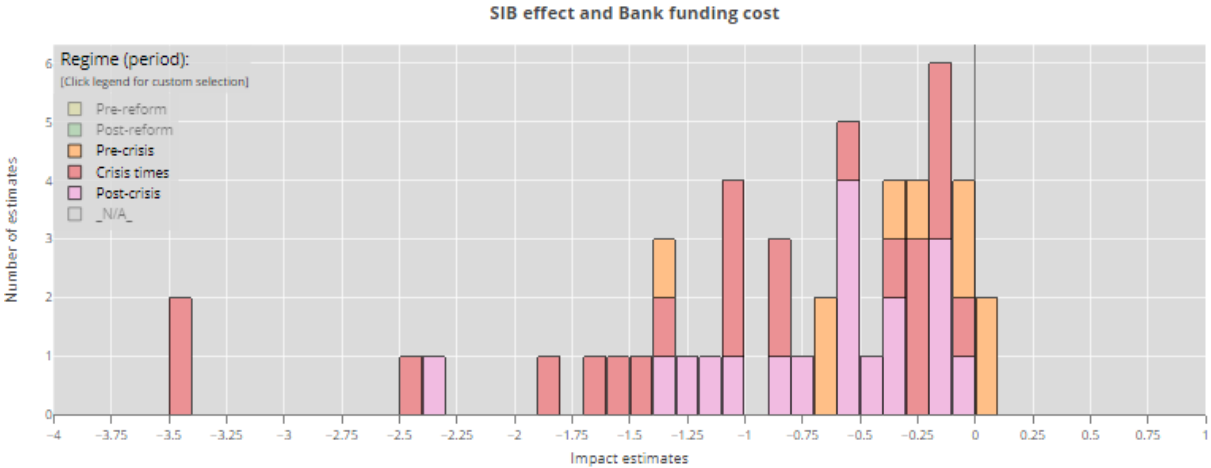
Figure 7: Funding cost advantage for SIBs in the "post-reform" and "pre-reform" period



Distribution of effect of a bank being systemically important on its funding costs. Negative estimates represent funding cost advantages for SIBs. (Results are expressed in percentage points). Based on 20 standardised estimates from 4 studies.

Figure 8 distinguishes the estimates across three periods: pre-crisis (orange), crisis (red) and post-crisis (pink). Estimates during a crisis have the largest negative values on average, which represent the largest relative funding cost advantage for SIBs. Note that most of the "crisis periods" impact estimates included in the TBTF section of FRAME refer to the global financial crisis of 2007/2008. During that period, implicit funding subsidies turned into explicit subsidies through the public sector rescue operations for distressed banks. Market participants demanded lower risk premia when lending to SIBs, leading to higher funding cost advantages for these banks.

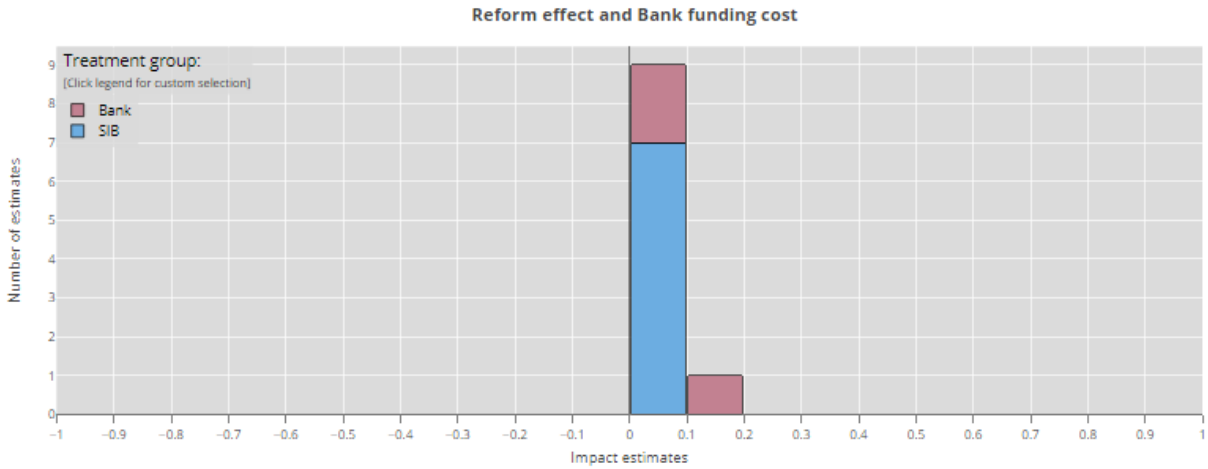
Figure 8: Funding cost advantage for SIBs during crisis periods



Distribution of effect of a bank being systemically important on its funding costs. Negative estimates represent funding cost advantages for SIBs. (Results are expressed in percentage points). Based on 49 standardised estimates from 12 studies.

Figure 9 plots the distribution of standardized estimates of the impact of TBTF reforms on bank funding costs. The positive estimates represent an increase of funding costs due to a reform event that either affected banks in general (red) or SIBs in particular (blue). Since the selected combination of categories currently includes only 10 estimates from 3 studies, care should be taken when drawing general conclusions.

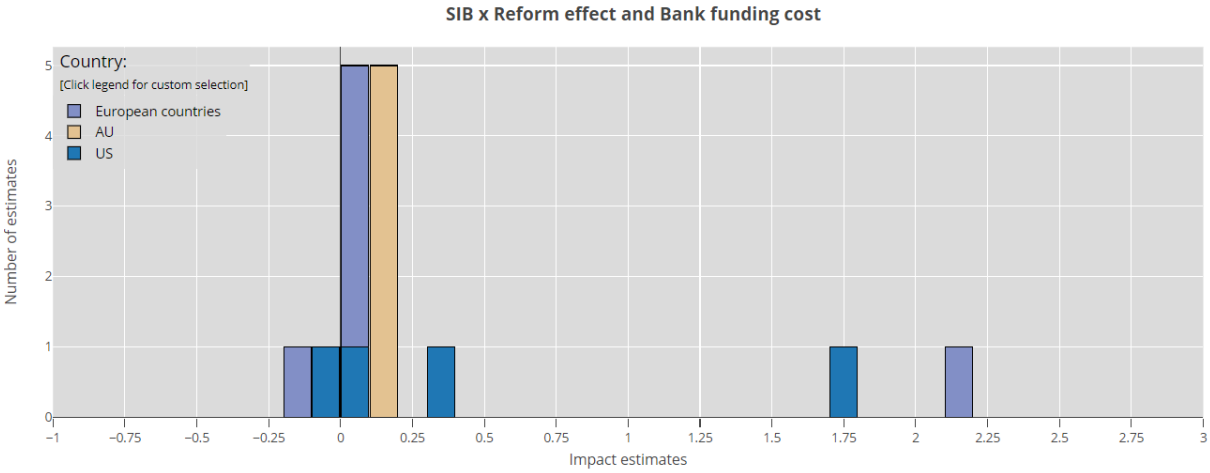
Figure 9: Reform impact on funding costs of SIBs and banks



Distribution of effect of a "too-big-to-fail" reform event on bank funding costs. Positive estimates represent a funding cost increase for banks. (Results are expressed in percentage points). Based on 10 standardised estimates from 3 studies.

Figure 10 illustrates the distribution of the joint effect of SIB status and a TBTF reform ("SIB x Reform effect") on bank funding costs. These estimates compare the effect of reforms addressing the TBTF issue on the change of SIBs' funding costs relative to non-SIBs. Studies cover the United States, Australia, and European countries. Most of the impact estimates are positive, which can be interpreted as an increase of SIBs' funding costs relative to non-SIBs and corresponds to a reduction in the funding cost advantage for SIBs.

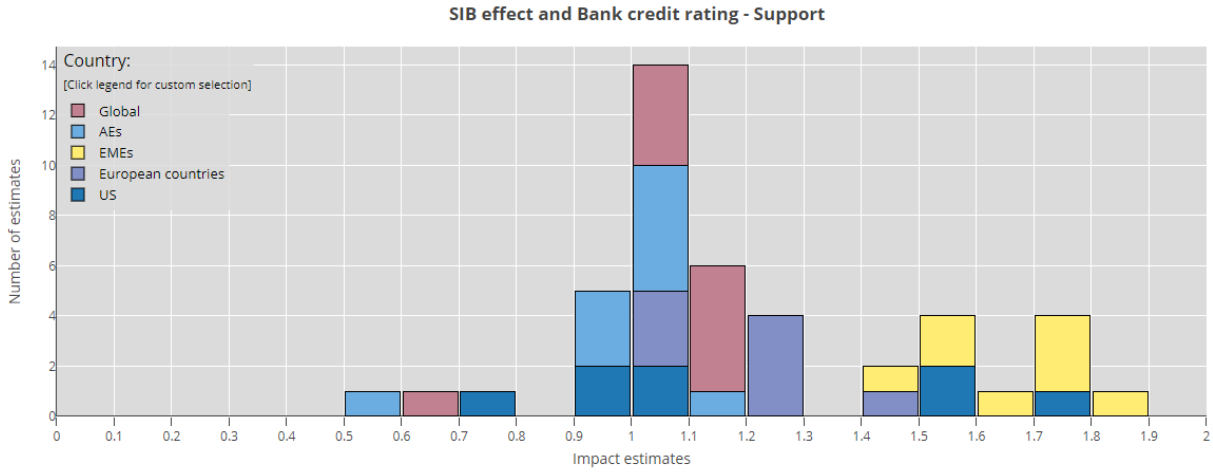
Figure 10: Joint SIB and reform effect on funding costs of SIBs



Distribution of effect of a "too-big-to-fail" reform event on funding costs of systemically important banks (SIBs). Positive estimates represent an increase in the funding costs of SIBs relative to non-SIBs, which is equivalent to a reduction in the funding cost advantage of SIBs. (Results are expressed in percentage points). Based on 15 standardised estimates from 6 studies.

Figure 11 plots the distribution of the effect of an increase, i.e. an improvement, in the SIB's support credit rating by one notch on its issuer credit rating. Such an increase can be interpreted as an increase in the probability of external support, for example, a bailout by the government. Most estimates indicate that the issuer credit rating, i.e. the overall rating, of SIBs improves by at least one notch after their support rating improves by one notch. Impact estimates are reported by different region and country groupings including the United States, Europe, advanced economies and emerging market economies, as well as a global sample. Because the reported estimates – in that chosen combination of categories, at least – are currently based on only two studies, the findings should not be over-interpreted.

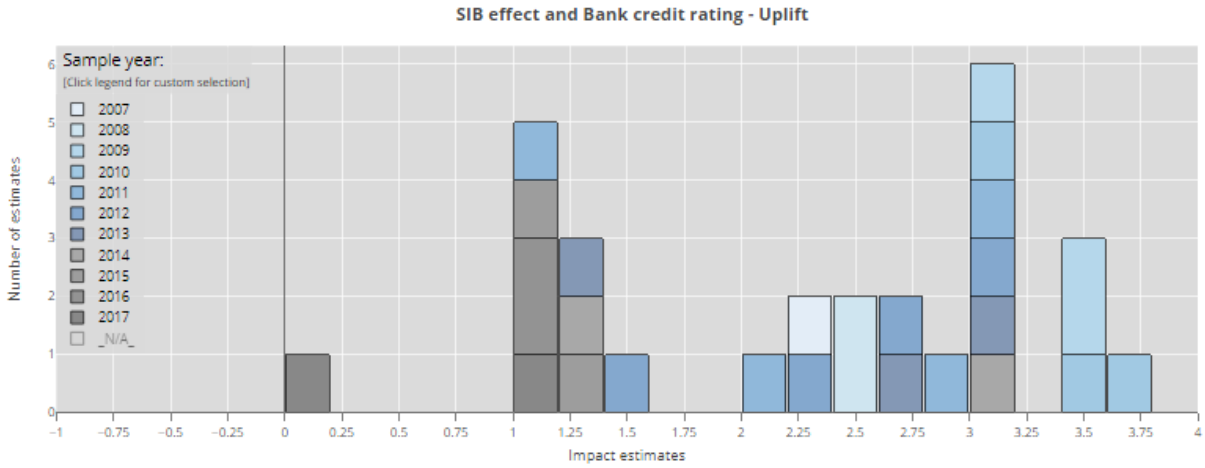
Figure 11: Distribution of impact estimates of SIB effect on bank credit rating – support



Distribution of effect of a one-notch increase in the "Support Credit Rating" of systemically important banks (SIBs) on the "Issuer Credit Rating" level of SIBs. Positive estimates represent an "Issuer Credit Rating" improvement for SIBs. (Results are expressed in notches). Based on 52 standardised estimates from 2 studies.

Figure 12 shows the distribution of the credit rating uplift for SIBs for the period from 2007 to 2017. The estimates correspond to the uplift in the overall issuer credit rating of SIBs, measured in notches, given an expectation of external support (i.e. a potential bailout). Impact estimates are expressed in notches, where a positive estimate represents an uplift in the issuer rating, i.e. a better overall credit rating for SIBs. Impact estimates of the years 2007 to 2013 are shown in blue and those of the years 2014 to 2017 are shown in gray. Credit rating uplift for SIBs was, on average, greater during the years of the global financial crisis (2007-2009) and the European sovereign debt crisis (2011-2013) compared to the years 2015-2017.

Figure 12: Distribution of impact estimates of SIB effect on bank credit rating – uplift



Distribution of effect of the "Support Credit Rating" level of systemically important banks (SIBs) on the "Issuer Credit Rating" level of SIBs. Positive estimates measure the "Issuer Credit Rating" uplift given an expectation of external support (i.e. potential bail-out). (Results are expressed in notches). Based on 28 standardised estimates from 3 studies.

4. Summary

Over the decade since the global financial crisis, financial sector reforms have been implemented with the aim of mitigating the systemic risk externalities of systemically important financial institutions. One key channel through which these reforms affect risk-taking incentives is banks' funding costs. Tracking changes in banks' funding costs and analyzing differences across institutions, countries, and time periods is thus important to assess reform effects.

So far, comprehensive and comparable evidence on the determinants of banks' funding costs related to TBTF has been lacking. The FSB's evaluation report also notes that there are gaps in the full implementation of TBTF reforms (FSB 2020), which suggests that tracking the future evolution of funding costs is highly relevant.

This paper describes a new initiative which aims to close this gap by complementing FRAME, an online repository of evaluation studies by the BIS, with studies on the effect of TBTF reforms on the funding costs of banks. FRAME enables users to compare the findings of different studies in an interactive and transparent way. Its value depends on the number of studies included. Replication studies of previous work can be particularly useful as they broaden the

evidence base and enhance transparency. Such studies are important to ensure that policy decisions are based on results which survive changes in the empirical model or the sample. The costs of replication studies have decreased over time on account of easier access to data and the sharing of research protocols. However, incentives to conduct high-quality replication studies are often lacking in academia, as such work is insufficiently rewarded by academic journals.

In order to obtain a broader overview of results in the literature, it is important to increase the number of studies included in FRAME. Authors can use a reporting template on the FRAME website to submit their studies for uploading themselves. Generally, any study that is publicly available can be uploaded. Studies need to be accompanied by a disclosure statement as to whether the study was sponsored or conducted independently. FRAME is updated on a continuous basis and encourages researchers and institutions to report their studies.[15]

Going beyond estimates of funding costs, there are other important elements of the TBTF reforms that provide fertile ground for future research. This includes work on bank behavior, managerial incentives, and effects of reforms on aggregate outcomes. Also, there is relatively little evidence on the effects of too-big-to-fail and implicit government guarantees on institutions outside of the banking sector. In order to facilitate more work on the effects and drivers of resolution reforms, the FSB has compiled a resolution reform index, and data are made available on the FSB's website.[16]

[15] Researchers and institutions may contact the BIS at frame@bis.org.

[16] See https://www.fsb.org/2020/06/evaluation-of-the-effects-of-too-big-to-fail-reforms-consultation-report/

5. Bibliography

Antill, Samuel, and Asani Sarkar (2018). Is Size Everything?, FRB of New York Staff Report No 864. New York.

Avery, Robert, Terrence Belton, and Michael Goldberg (1988). Market Discipline in Regulating Bank Risk. New Evidence from the Capital Markets. *Journal of Money, Credit and Banking* 4: 597-610.

Basel Committee on Banking Supervision (BCBS) (2011). Global systemically important banks. assessment methodology and the additional loss absorbency requirement. Basel.

Basel Committee on Banking Supervision (BCBS) (2012). A framework for dealing with domestic systemically important banks. Basel.

Berlin, Mitchell, Anthony Saunders, and Gregory Udell (1991). Deposit insurance reform. What are the issues and what needs to be fixed?, *Journal of Banking and Finance* 15(4-5): 735-752.

Bliss, Robert, and Mark Flannery (2001). Market Discipline in the Governance of U.S. Bank Holding Companies: Monitoring vs. Influencing, EFA 2001 Barcelona Meetings, Barcelona.

Buch, Claudia M. (2017). Evaluating financial sector reforms – a joint task for academia and policymakers. Statement for the panel discussion Improving Financial Resilience at the T20 Summit Global Solutions. Deutsche Bundesbank. Frankfurt am Main.

Boissay, Frederic, Carlos Cantú, Stijn Claessens, and Alan Villegas (2019). Impact of financial regulations: Insights from an online repository of studies, BIS Quarterly Review. Basel.

Calomiris, Charles (1999). Building an incentive-compatible safety net. *Journal of Banking and Finance* 23(10): 1499-1519.

Calomiris, Charles, and Charles Kahn (1991). The Role of Demandable Debt in Structuring Optimal Banking Arrangements. *American Economic Review* 81(3): 497-513.

Congressional Budget Office (2018). Report on the Troubled Asset Relief Program. March 2018. Washington, D.C.

Congressional Oversight Panel (2011). The final report of the congressional oversight panel. March 2011. Washington, D.C.

European Commission (2011). The effects of temporary State aid rules adopted in the context of the financial and economic crisis, Commission Staff Working Paper. Brussels.

Financial Stability Board (FSB) (2010). Reducing the moral hazard posed by systemically important financial institutions. Basel.

Financial Stability Board (FSB) (2011). Policy measures to address systemically important financial institutions. Basel.

Financial Stability Board (FSB) (2013). Progress and next steps towards ending too-big-to-fail (TBTF), FSB, Basel.

Financial Stability Board (FSB) (2015). Historical Losses and Recapitalisation Needs – Findings Report. Basel.

Financial Stability Board (FSB) (2017). Framework for post-implementation evaluation of the effects of the G20 financial regulatory reforms. Basel.

Financial Stability Board (FSB) (2019). 2019 list of global systemically important banks (G-SIBs). Basel.

Financial Stability Board (FSB) (2020). Evaluation of the effects of too-big-to-fail reforms. Consultation Report. Basel.

Flannery, Mark (1998). Using Market Information in Prudential Bank Supervision. A Review of the U.S. Empirical Evidence. *Journal of Money, Credit and Banking* 30(3): 273-305.

Flannery, Mark (2001). The Faces of 'Market Discipline'. *Journal of Financial Services Research* 20(2): 107-119.

Gorton, Gary, and Anthony Santomero (1990). Market Discipline and Bank Subordinated Debt. Journal of Money, *Credit and Banking* 22(1): 119-128.

Hellwig, Martin (2005). Market Discipline, Information Processing, and Corporate Governance. In: *Corporate Governance in Context. Corporations, States, and Markets in Europe, Japan, and the US*. Klaus Hopt, Eddy Wymeersch, Hideki Kanda, and Harald Baum (eds.), Oxford University Press. Oxford: 379-402.

Hughes, Joseph, and Loretta Mester (1993). A quality and risk-adjusted cost function for banks. Evidence on the too-big-to-fail doctrine. *Journal of Productivity Analysis* 4(3): 293-315.

International Monetary Fund (IMF) (2014). Global Financial Stability Report, April 2014, Washington DC.

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

Laeven, Luc, and Fabian Valencia (2008). Systemic banking crises: a new database. International Monetary Fund (IMF). Working Paper No 8/224. Washington DC.

Laeven, Luc, and Fabian Valencia (2010). Resolution of Banking Crises. The Good, the Bad, and the Ugly. International Monetary Fund (IMF). Working Paper No 10/146. Washington, D.C.

Laeven, Luc, and Fabian Valencia (2012). Systemic banking crises database. An update. International Monetary Fund (IMF). Working Paper No 12/163. Washington DC.

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

Schich, Sebastian, and Sofia Lindh (2012). Implicit guarantees for bank debt: where do we stand?, OECD Journal, Paris.

Schweikhard, Frederic, and Zoe Tsesmelidakis (2012). The impact of government interventions on CDS and equity markets, AFA 2012 Chicago Meetings.

Siegert, Casper, and Matthew Willison (2015). Estimating the extent of the 'too big to fail' problem – a review of existing approaches. Bank of England, Financial Stability Paper No 32. London.

Tsesmelidakis, Zoe, and Robert Merton (2013). The value of implicit guarantees, MIT Working Paper. Cambridge MA.

Zimmer, Daniel, Werner Brandt, Claudia M. Buch, Martin Hellwig, Hans-Hermann Lotter, and Hanno Merkt (2011). Strategien für den Ausstieg des Bundes aus krisenbedingten Beteiligungen an Banken – Gutachten des von der Bundesregierung eingesetzten Expertenrates, Bundesministerium der Finanzen (BMF), Berlin.