BANK FOR INTERNATIONAL SETTLEMENTS

Assessing the economic costs and benefits of TLAC implementation

Report submitted to the Financial Stability Board by an Experts Group chaired by Kostas Tsatsaronis (Bank for International Settlements)

November 2015

JEL classification: E37, E47, E60, F41, G01, G28, G32

Keywords: Creditor bail-in, bank resolution, cost of funds, macroeconomic costs and benefits.

The views expressed are those of the authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).

ISBN 978-92-9197-297-5 (print)
ISBN 978-92-9197-298-2 (online)

Table of contents

Introduction and Summary

This report presents the results of the Economic Impact Assessment Group (EIAG). The report summarises the results and explains the methodology used in assessing the microeconomic and macroeconomic impact of the implementation of TLAC. The key objectives are to gauge the costs of meeting the requirements as laid out in the Consultative Document (http://www.financialstabilityboard.org/wp-content/uploads/TLAC-Condoc-6-Nov-2014-FINAL.pdf) for individual G-SIBs and to assess the balance between the macroeconomic costs and benefits to the economy as a whole.[1]

The benefits of TLAC come mainly from enhancing market discipline, thus containing risk-taking by the G-SIBs and reducing the likelihood of these institutions coming under stress. Existing academic research points to market discipline exerted by subordinated debt holders on risk-taking by banks. Based on this literature, the TLAC requirement is estimated to improve bank resiliency by at least one-third. Safer G-SIBs reduce the likelihood of the occurrence of systemic crises with their accompanying high costs to economic activity. Additionally, TLAC reduces the fiscal costs of dealing with crises when they do occur. In expectation, the overall annual benefits in terms of GDP range between 45 and 60 basis points. These are significantly higher than the costs.

The results point to rather contained microeconomic costs for the majority of G-SIBs and, consequently, the very limited macroeconomic costs in terms of downward pressure on GDP from possible increases in credit costs. Depending on the calibration of TLAC requirements, the average annual microeconomic costs to the G-SIBs range from between €400 to €950 million. Given the size of the loan books of these firms, this increase in funding costs can be compensated by increases in lending interest rates of between 5 and 15 basis points (bps) that, in turn, correspond to a drag on annual GDP in the range of 1.9 and 5.3 bps.

The rest of this report is organised in six sections. The first section sets out the terminology used throughout the document and explains the rationale behind a set of assumptions that underpin the analysis. The second section focuses on the size of the current shortfalls of G-SIBs with respect to TLAC requirements, which are the basis of the rest of the analysis. The third section estimates the increase in G-SIBs' funding costs that results from replacing existing liabilities with higher-cost ones that are TLAC-eligible. The following section assumes that G-SIBs will pass the additional funding costs to their clients in the form of higher loan rates and uses macro-economic models to estimate the impact on GDP. This is the macroeconomic cost estimate of TLAC. The fifth section analyses the macroeconomic spillovers to economies that are host to G-SIBs countries as well as those that are transmitted through trade and financial channels. Finally, the sixth section presents the analysis of the benefits from the implementation of TLAC.

1 The Term Sheet on which this analysis is based provided a range of possible values for the requirement rather than specifying a precise value. Consequently, we evaluated the impact of several different possible TLAC calibrations. The finalised Term Sheet does specify a precise requirement; This specification is examined in Annex 1.

1. Maintained assumptions

This section lists the key assumptions that underpin the economic impact analysis. These are maintained throughout the different components of the exercise, providing consistency and coherence to the whole analysis. It also clarifies the terminology that will be used in referring to different calibration scenarios.

- The analysis is based on the published **consultation of the TLAC standard**.

The analysis uses the Term Sheet as proposed in the Consultative Document (http://www.financialstabilityboard.org/wp-content/uploads/TLAC-Condoc-6-Nov-2014-FINAL.pdf). Thus, subsequent amendments to the final Term Sheet are not incorporated in this version of the analysis. This also means that the report is based on data submitted by the 30 banks on the G-SIB list as of end-2014.

- The analysis is based on **calibration ranges**.

Since the Term Sheet does not specify precise values for the TLAC requirement, the analysis examines only the low and high ends of the calibration range proposed in the Consultative Document.[2] In particular, it examines four combinations of the required ratio of TLAC to banks' Risk-Weighted-Assets (RWAs) and the ratio to bank's Exposure Measure (EM), ie the key calibration parameters of the minimum TLAC requirement. The FSB proposed a specific range the RWA-requirement (16-20% of RWAs), while the leverage requirement was proposed to be set at two times any Basel III leverage ratio. For the purpose of this analysis we assume that this results in a TLAC requirement between 6 and 10% of leverage exposures. Cost estimates are produced for the four cases shown by the combinations of parameters in Table 1. The terminology Calibrations 1 to 4, or 16/6, 20/6, etc., will be used interchangeably but consistently across the Report to refer to these four combinations. As it becomes evident in the subsequent analysis, the four calibrations rank in increasing order of costs. Calibration 1 is typically the least demanding and Calibration 4 the most costly.

Minimum TLAC: four calibrations — Table 1

	16% of RWA	20% of RWA
6% of EM	Calibration 1 OR (16/6)	Calibration 2 OR (20/6)
10% of EM	Calibration 3 OR (16/10)	Calibration 4 OR (20/10)

- The analysis focuses on the **additional impact of TLAC,** taking the other elements of regulatory reform as given.

Basel III (fully phased-in and implemented version) is taken as a starting point. The impact assessment considers the economic cost and benefit of changes to bank practices from that point onward. In practical terms, for those G-SIBs that do not meet the new capital requirements we convert non-capital liabilities to capital prior to computing their shortfall with respect to TLAC.

2 See Annex 1 for an estimate of the costs related to the calibration proposed in the finalised Term Sheet.

- The cost-benefit analysis aims to be **fair but conservative**.

We strive to provide a fair assessment of the costs and benefits, but confronted with equally plausible alternatives the choice is biased towards those that err on the side of higher costs and/or lower benefits. In doing so, we tend to underestimate the net benefits.

- The analysis takes a **long-horizon** perspective.

The purpose of the study is not to predict what will happen upon implementation but to present a fair assessment of the longer-term costs and benefits from the introduction of TLAC on the basis of currently available information. For this purpose, it strives to look through the specifics of current market conditions, such as the level of policy rates and/or the macroeconomic environment. However, consistent with the desire to provide a conservative assessment, the analysis discusses the extent to which this approach underestimates the costs.

- In mapping out the responses of banks, banks are assumed to **follow the lowest-cost path** to compliance with the requirement.

For instance if a bank has a shortfall of TLAC-eligible liabilities compared to its required level, we assume that it will achieve compliance by substituting non-eligible liabilities with the highest cost with TLAC-eligible ones. This way it follows the strategy that entails the lowest additional cost. For reasons that have to do with particular circumstances of individual firms, actual responses might differ from those assumed in the study. We assume that bank management assesses that these strategies are more beneficial to the institution due to factors not considered in our study or that these choices cannot be attributed to the TLAC standard per se.

2. Bank-specific shortfalls

The calculated shortfalls with respect to the required levels of TLAC vary widely across the 30 G-SIBs that submitted data to the QIS exercise. Some banks have insignificant (near zero) shortfalls for the lowest calibrations while others have very large shortfalls for all calibrations. Table 2 and Graph 1 provide an overall picture of the distribution of shortfalls across the universe of G-SIBs.

The shortfall calculation reflects common standards across banks. Shortfalls correspond to the difference between required TLAC (calculated as the maximum of the requirement based on the RWA or the EM basis as per the specific calibration) and available eligible liabilities. It includes as eligible liabilities those reported under Case 1 of the QIS template (ie includes instruments that meet the TLAC Term Sheet criteria, including subordination). As mentioned above, it assumes that Basel III requirements are fully met, and consistently with the Term Sheet it excludes capital resources that are required to meet the capital buffer requirements that each bank is subject to. It also excludes senior unsecured debt that qualifies as a result of concessions in the Term Sheet that can lead to a reduction of the shortfall up to 2.5% of RWAs in some cases.

For Calibration 1 (the lowest calibration), the median shortfall is €14.3 billion, but ranges from a shortfall of 0 to a shortfall of €98.1 billion. The collective shortfall across all institutions is just over €750 billion. For the median bank, shortfalls rise more rapidly as the requirement based on the EM increases than when the

TLAC shortfalls after meeting Basel III requirements

In EUR billion | Table 2

Calibrations	16% of RWA		20% of RWA	
6% of EM	Average:	25.6	Average:	46.3
	Min:	0.0	Min:	0.0
	Median:	14.3	Median:	34.5
	Max:	98.1	Max:	151.8
	Total:	767.4	Total:	1,388.3
10 % of EM	Average:	45.5	Average:	58.5
	Min:	9.5	Min:	0.0
	Median:	48.1	Median:	53.0
	Max:	104.7	Max:	151.8
	Total:	1,365.0	Total:	1,755.0

Source: Economic impact assessment group's estimates

requirement based on RWAs increases, but the maximum is more sensitive to the RWA-based requirement. In Calibration 2, the median shortfall increases to €34.5 billion and the collective shortfall is equal to €1,388 billion. In Calibration 3, the median shortfall is €48.1 billion and the collective shortfall is €1,365 billion. Not surprisingly, Calibration 4 results in the highest shortfalls. Here the median shortfall is €53.0 billion and the collective shortfall is €1,755 billion.

A diffused distribution of shortfalls

In EUR billion | Graph 1

Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

The diffused nature of the distribution of shortfalls is clearly evident in Graph 1. For each calibration assumption (each panel in the graph) five to seven institutions at the right hand end of each set of bars have significantly higher shortfalls than the average G-SIB. Looking more closely at the distribution of the shortfalls across individual G-SIBs we note that the EM based requirements are less of a binding constraint for the banks with the highest shortfalls. This is seen at the right hand end of the distribution, there is practically no difference between the bars in the top row panels and the bottom row panels.

Comparison of shortfalls to other debt liabilities

To put the shortfall amounts into perspective, we compare them to the size of other selected marketable liabilities (OSMLs) that meet some, but not all, the criteria for TLAC eligibility.[3] The comparison provides a gauge of the resources that the banks can convert to meet the requirement. The ratios are shown in Graph 2. Note the different scales for the blue coloured bars. These correspond to three banks that have very few marketable liabilities.

A key reference point here is the 100 percent threshold. This would be the score for an institution with a shortfall equal to the amount of available OSMLs. Institutions with ratios that exceed 100 do not have enough almost-eligible liabilities to convert in order to completely eliminate the shortfall. To achieve this goal they will need to convert other liabilities, presumably at a more elevated cost.

As expected, there is an increase in the average level of the ratio as the calibration becomes more demanding. While the ratios exceed the 100% threshold only for a minority of the G-SIBs in Calibration 1, this number increases for the other calibrations. The median ratios of shortfalls to OSMLs for Calibrations (1), (2), (3), and (4) are 45 percent, 84 percent, 112 percent, and 146 percent respectively.

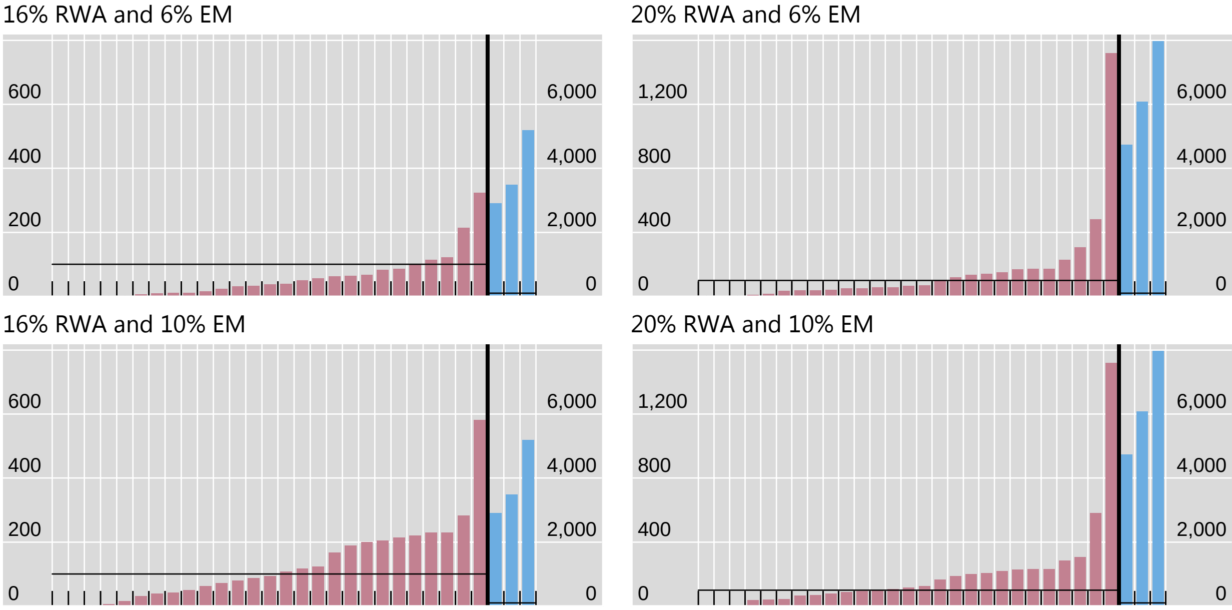
There is also considerable dispersion of these ratios in the cross section of banks. The dispersion increases particularly with the calibrations that consider a 10% of EM. In all calibrations, four banks have a particularly high ratio indicative of a serious shortage of OSMLs.

[3] In particular, OSMLs are securities reported as Category 2(i), 2(ii), 3, 4(i), or 4(ii) in the BCBS QIS location template. The categories reported in that template are defined as follows:

- Category 1: TLAC-eligible liabilities (subordinated issued by the resolution entity);
- Category 2(i): subordinated liabilities issued by subsidiaries other than the resolution entity (not TLAC-eligible);
- Category 2(ii): senior unsecured liabilities issued by subsidiaries other than the resolution entity (not TLAC-eligible);
- Category 3: senior unsecured liabilities issued by the resolution entity that are not subordinated (not TLAC-eligible);
- Category 4(i): other subordinated liabilities issued by the resolution entity (liabilities excluded in the TLAC Term Sheet besides deposits, tax liabilities, and derivatives); and
- Category 4(ii): other senior unsecured liabilities issued by the resolution entity (liabilities excluded in the TLAC Term Sheet besides deposits, tax liabilities, and derivatives).

Ratio of shortfalls to OSMLs

In percent Graph 2



Note: Bars depict the ratio of the bank-specific shotrfalls to the corresponding amount of other selected marketable liabilities (OSMLs). A ratio of 100% indicates that available OSMLs would be exactly equal to the firm's shortfall vis a vis the TLAC requirement shown at as a panel header. Red bars are on the left-hand scale, blue bars on the right-hand scale. Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: QIS and EIAG estimates.

Comparison of shortfalls to loan portfolios

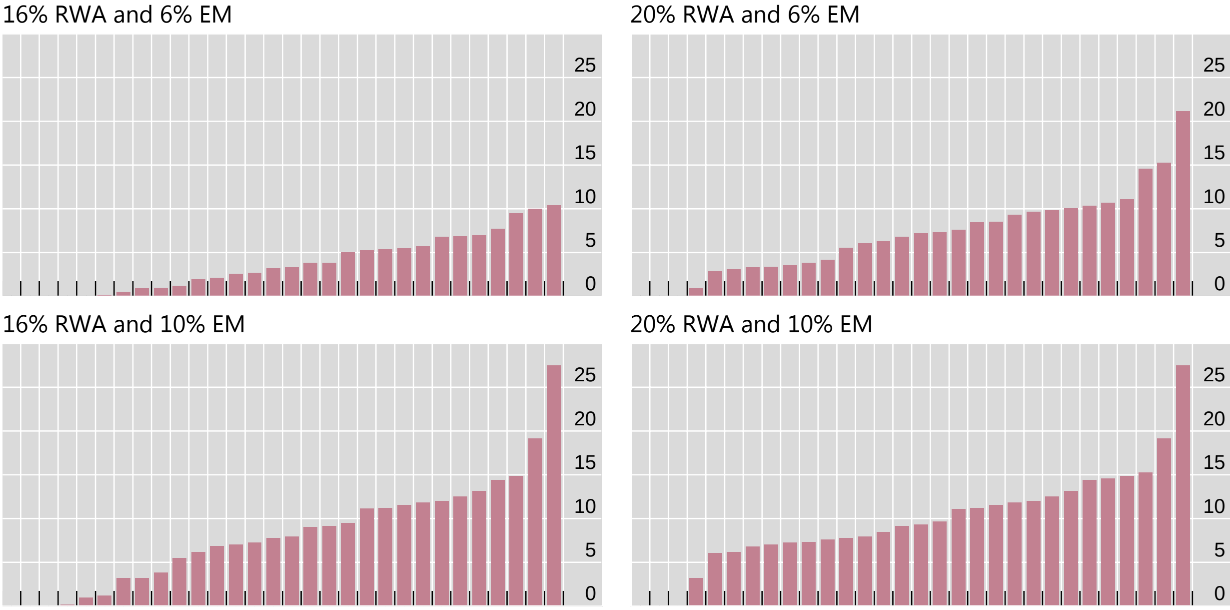
The analysis of the macroeconomic costs will be based on the assumption that G-SIBs will recover the higher funding costs due to TLAC by increasing their lending spreads. As a precursor to this forthcoming analysis, we compare banks' shortfalls to their loan portfolios, and Graph 3 depicts the distribution of these ratios.

In Calibration 1, the median bank has a shortfall equivalent in size to about 3 percent of its loan portfolio. The banks with ratios at the lowest quarter of the distribution have ratios below 1 percent, while banks at the upper quartile have shortfalls in excess of 5.7 percent of loans.

The jumps in the size of the amounts of the shortfalls for different calibrations are readily apparent for this statistic. The median ratio of shortfalls to loans increases to 7.0 percent in Calibration (2), to nearly 8 percent in Calibration (3), and to 9.3 percent in Calibration (4).

Shortfalls compared to bank's loan book

In percent Graph 3



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: QIS and EIAG estimates.

3. Micro-economic costs of compliance with TLAC

The estimates of the cost of meeting the TLAC requirement are based on the idea that institutions will have to replace existing securities with more expensive TLAC-eligible securities until they fill their shortfall. We implemented this substitution based on a number of assumed principles listed below.

- The "least-cost" approach assumption requires that they will replace their most expensive OSMLs first followed by the next most expensive securities and so on. However, we also assume that institutions keep the distribution of their issuance across jurisdictions constant.
- We also assume that institutions will generally maintain their existing long-term/short-term debt profile (ie we assume that institutions that reported having a significant portion of liabilities with a maturity of less than one-year have a business reason for doing so and will not be able to convert these to TLAC-eligible securities).
- Relatedly, since the micro-macro cost and benefits estimates are supposed to take a long-term perspective, we assume that all reported non-TLAC securities mature and are replaced with TLAC eligible securities and ignore any frictional costs associated with replacing non-TLAC securities that would only mature after the TLAC requirement has become effective.

In applying those principles, we ended up with approaches that are common in spirit, but specific by institution and jurisdiction. We have checked the approaches used with the representatives from jurisdictions home to the G-SIBs in order to agree that they are reasonable given the specific conditions applicable in each country.

Our estimates are generally conservative. Eg they assume that the z-Spread of certain non-eligible instruments that we do not have detailed data on is zero (which pushes up the relative cost of TLAC). Also, we assume that the cost of issuing TLAC is in line with a firms' current average cost of TLAC-eligible liabilities (which includes eg certain legacy capital instruments) rather than the cost of the cheapest TLAC-eligible instruments. This suggests that they are not comparable to other estimates (eg by credit or equity analysts), who focus on estimating the *expected* cost of TLAC rather than an upper bound.

Increases in funding costs

We constructed estimates of the weighted average cost of funds implied by the z-spreads for all TLAC-eligible liabilities and OSMLs, before and after converting some of the latter to meet the minimum TLAC requirement.[4] This allows us to get a sense of the change in the institutions' cost of funding. It should be noted that this calculation pertains only to the cost of funding for the marketable securities portion of liabilities and not for the entire balance sheet as it excludes deposits and equity. These increases in the weighted average costs of funds are reported in Table 3. When institutions need to convert securities that are not enumerated in the QIS spreadsheets as being close to meeting the TLAC criteria we assume that these securities had a z-spread of zero prior to conversion. In other words, we assume that these were priced identically to the relevant risk-free curve. This assumption is extreme but reduces the implied cost of funds pre-conversion to a minimum and provides an upper estimate of the conversion costs, thus following the conservativism principle.

Changes in weighted-average cost of TLAC and OSMLs

In basis points

Table 3

Calibrations	16% of RWA		20% of RWA	
6% of EM	Low quartile:	0.8	Low quartile:	16.7
	Median:	42.7	Median:	81.8
	High quartile:	94.3	High quartile:	124.8
10 % of EM	Low quartile:	25.5	Low quartile:	43.8
	Median:	99.5	Median:	114.9
	High quartile:	173.1	High quartile:	173.1

Note: The figures represent descriptive statistics for the difference between G-SIB's volume-weighted average cost of liabilities, before and after converting existing securities to meet TLAC requirements. They represent an increase in funding costs per unit of liability. A figure of 40 means that after conversion funding costs will increase by €4 for each €1000 in liabilities. The computation encompasses only the liability classes that are involved in the conversion (ie it excludes equity, deposits and other liabilities that are not affected).

Source: QIS and EIAG estimates.

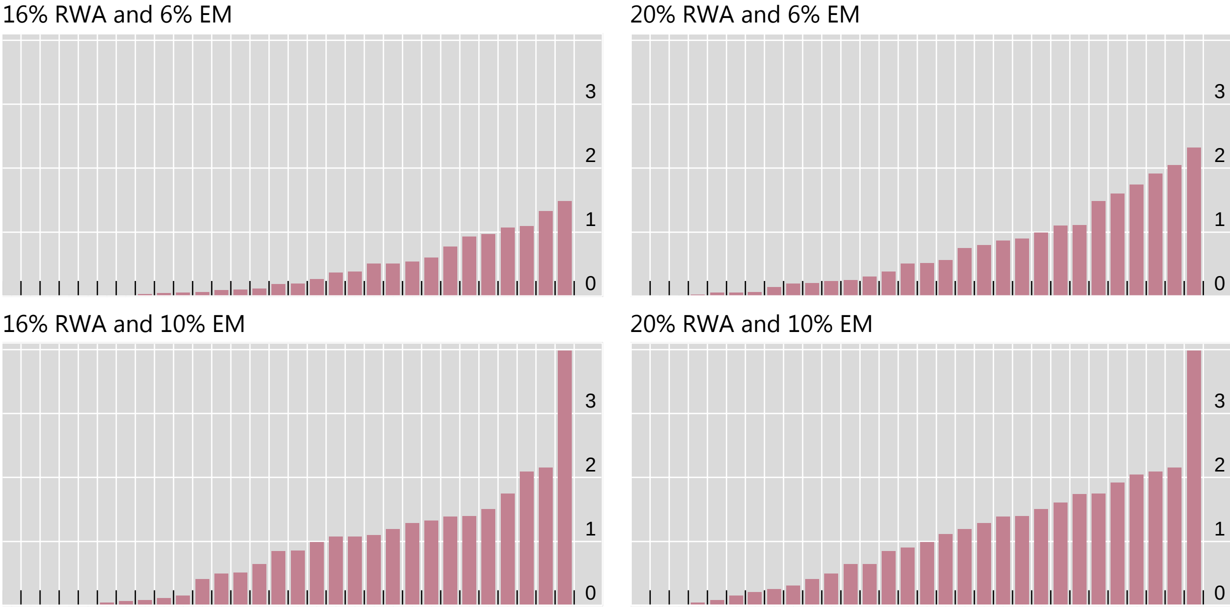
In Calibration (1), the change in the weighted average cost of funds for the relevant securities will be less than 100 basis points for a majority of institutions.

4 The z-spread measures the difference between the yields of a bond and the yield of a (risk-free) government bond with the same maturity.

Indeed, the median increase is 42.7 basis points. In Calibrations (2), (3), and (4), the median increases in the weighted average cost of funds for the relevant securities are about 80 basis points, 100 basis points, and 115 basis points respectively. Again, moving between the high and low EM-based calibration makes a larger impact on funding costs than moving between the low and high RWA-based calibrations.

The distribution of annual funding cost increases

In EUR billion | Graph 4



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

The four panels in Graph 4 present the distribution of the amounts that these changes represent (converted in EUR). These are obtained by multiplying the change in the z-Spreads on the liabilities converted by the amount of each type of liability converted.

- For Calibration (1), the total annual cost aggregated across all G-SIBs is €11.7 billion. The distribution of these costs is shown in the upper left panel of Figure 4. For the median institution, the annual cost would be about €195 million. For four institutions, the cost would exceed €1 billion, while for twelve other institutions the cost would be below €100 million.
- Increasing the requirement with respect to RWAs to 20 percent (Calibration (2)), would lift the total cost to about €21 billion per year. In this configuration, the annual cost would be above €1 billion for eight institutions while less than €100 million for seven institutions. For the median institution, the annual cost would be about €511 million.
- The costs associated with Calibration (3)—where the requirement with respect to the exposure measure is 10 percent—total about €26.5 billion per year for all G-SIBs. The cost for the median institution would be about €850 million and the cost would be above €1 billion per year for 13 institutions; for eight institutions would the cost be below €100 million per year.

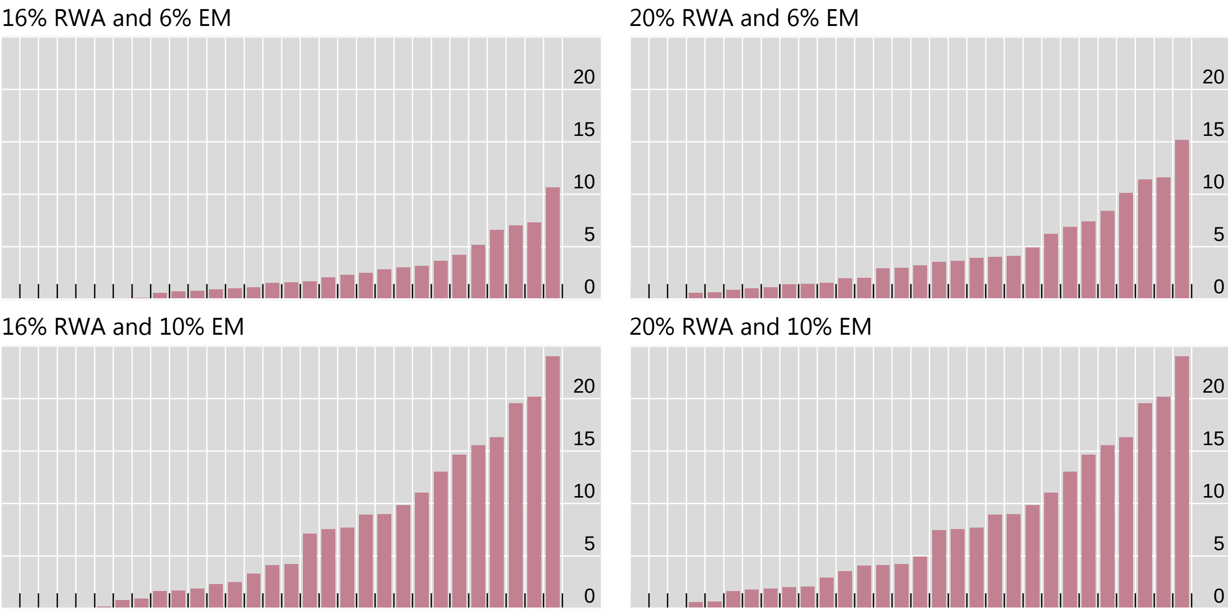
- For Calibration (4), the total cost is estimated to be about €31 billion per year and the cost to the median institution is about €950 million per year. Similar to the preceding calibration, costs exceed €1 billion per year for 14 institutions and are less than €100 million per year for five institutions.

Funding costs increases compared to interest income

The comparison of the rise in funding costs to current (net) interest income provides another perspective of how the increase in interest costs will affect G-SIBs. The higher the ratio of the cost increase to interest income the greater the necessary increase in credit spreads to compensate banks earnings. The distributions of results for the different calibrations are shown in Graph 5.

Increase in funding costs compared to net interest income

In percent Graph 5



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

- In Calibration (1), the increase in interest costs for the median institution is about 1.6 percent of net interest income. The increased costs is greater than 3 percent of net interest income for nine institutions and greater than 6 percent of net interest income for four institutions.
- In Calibration (2) the cost for the median institution is about 3.1 percent of net interest income. Indeed the cost exceeds 3 percent of net interest income for 15 institutions and is greater than 6 percent of net interest income for eight institutions.
- For the median institution in Calibration (3), the cost is 4.1 percent of net interest income and the cost is more than 3 percent of net interest income for 17 institutions. In this calibration, the cost exceeds 6 percent of net interest income for 14 institutions and is greater than 10 percent of net interest income for eight banks.

- In Calibration (4), the cost for the median institution is 4.6 percent of net interest income. The cost exceeds 6 percent of net interest income for 14 institutions and exceeds 10 percent of net interest income for eight institutions.

Robustness analysis: supply surge may increase spreads

A surge in TLAC-eligible debt issuance by G-SIBs may test the absorption capacity of the market and lead to an increase in related spreads. The impact analysis group has performed calculations to gauge this effect using the message from the TLAC Market survey conducted by the FSB that market participants may expect an increase in spreads for TLAC-eligible securities of about 30bps after the rule is implemented.[5] The group has used two approaches to calculate this effect, focusing on the four major markets where G-SIBs have issued liabilities (U.S., Continental Europe, UK and Japan).

The first approach is very straightforward: it applies a flat 30 bps increase to the spreads of TLAC-eligible securities in all jurisdictions.

The second approach is more conservative and more complicated. It backs out an estimate of the implicit elasticity of z-spreads to a surge in supply and uses this estimate to assess the spread impact on each market segment. By construction, this approach means that the supply surge will have larger impact on z-spreads in smaller markets.

The supply surge is proxied by the ratio of the aggregate shortfalls (which represents the new securities that will need to be issued) to the current size of the market (which is in turn proxied by the aggregate volume of Category 1, Category 2 and Category 3 liabilities[6] issued by G-SIBs). This is a very restrictive estimate of the market both because it only accounts for issuance by the G-SIBs and does not capture the volume of subordinated debt issued by other banks (or other financial companies), and because it does not include other junior liabilities of these G-SIBs, such as those reported under Category 4. The calculation is also performed assuming that bond markets are segmented geographically along the lines of current issuance (as reported in the QIS by the geographical distribution of banks' existing debt liabilities). The estimated supply shock is calculated for the four different calibrations and it is quite small for the two largest markets in the U.S. and Europe (with an increase of 2 to 30% depending on calibration), moderate for the UK market (increases of 15 to 51%), and very large for the Japanese market (increases of 70 to 200%).

Adopting the perspective of the individual bank, one can also calculate the ratio of new issuance (above what they can readily convert from Category 2 and Category 3 liabilities) to the total volume of securities (in all three cases) currently issued by the

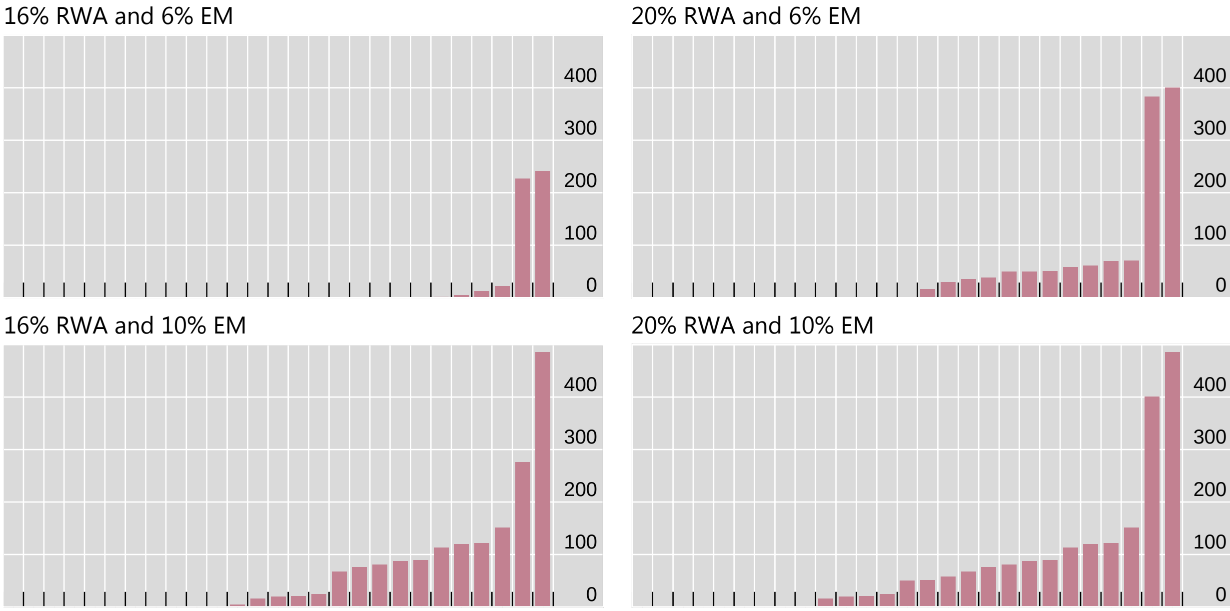
[5] The FSB carried out a market survey to assess the potential impact of minimum TLAC requirements on pricing of TLAC-eligible G-SIB liabilities, investor behaviour and market capacity. See FSB (2015) for a summary of the market survey results.

[6] See footnote 3 for definitions of the categories.

institution. This is a measure of how far each G-SIB would need to expand their current market access. Graph 6 has the results for the four calibrations and 27 G-SIBs.[7]

Ratio of expected net new issuance to current issuance

In percent Graph 6



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

The additional impact on G-SIBs is concentrated heavily on those G-SIBs with large shortfalls (and hence large issuance needs) issuing in thin market segments. For the lowest calibrations (16/6 and 20/6) only a handful of banks need to depart significantly from their current issuance pattern (say by increasing their market access by more than one-quarter). While this group includes all G-SIBs from one jurisdiction, the other affected G-SIBs are dispersed geographically. About half of all G-SIBs have a zero or negligible increase in their net issuance.

The estimate of the elasticity of spreads to the supply shock for each geographic market segment was backed out of the definition of elasticity (the percent change in price for a percent change in supply), using the average current prices for TLAC-eligible debt for each market, assuming a supply shock associated with the 16/6 calibration, and imposing the constraint that the volume weighted global average spread increases by 30bps (which is based on responses to a survey of market participants).[8] Imposing this elasticity and the estimated supply shock, we can then obtain estimates of the spread increases in the four market segments that are

7 The EME-headquartered banks were not included in this calculation because they do not issue in the four main markets, and we do not have sufficient information about the conditions in their local bond markets.

8 Using the supply shock associated with the 16/6 Calibration to estimate the elasticity associated with the 30 basis point increase in z-spreads and applying this elasticity to all calibrations is the conservative approach. Using a larger supply shock to estimate the elasticity would imply that markets are more capable of absorbing the increased supply.

consistent with the global average, the distribution of supply shocks and the size of the local market.

The conceptual difference between the two approaches is that the first treats the global market as completely integrated (ie banks will be able to issue wherever the borrowing rates are most advantageous) while the second treats it as fully segmented and the banks following the current pattern of issuance. Some evidence that the latter approach likely overstates the increases in spreads in some markets comes from the Swiss experience. For instance, when the two large Swiss banks responded to new capital rules and issued low-trigger contingent convertibles (CoCos) in a non-existent domestic CoCos market, demand proved very elastic and able to absorb the sizeable volumes of these new instruments (totaling CHF30bn) at reasonable spreads (in the 150-200bps range over senior unsecured debt).

The last step involves the calculation of the impact of stretching the capacity of the debt market on G-SIB funding costs. The resulting increase in borrowing spreads in each market times the required issuance in each market results in an estimate of the funding cost compared to the benchmark calculation presented in the previous subsection. The estimated impact follows intuitively from the previous calculations. The results from the simpler approach of applying a flat spread increase show more even funding cost increases across the G-SIBs but a significantly smaller increase in the aggregate funding cost. The reason for this is that banks are assumed to have more flexibility in choosing a funding market.

Cost of TLAC compliance for 16/6 calibration: three alternatives

In € million — Table 4

	Baseline	Integrated markets (flat 30bps increase for all new issues)	Segmented markets (market-specific spread increase)
Aggregate (27 G-SIBs)	8,236	9,730	11,775
G-SIB at lowest quartile	18	32	25
G-SIB at median	117	165	128
G-SIB at highest quartile	508	582	518

Sources: EIAG estimates.

Table 4 shows some descriptive statistics for the baseline case, and the two alternative approaches described here: a flat 30bps increase (integrated markets) and market-specific price hike (segmented markets). Compared to the baseline estimate of €8.2bn, the aggregate funding cost increase for the integrated market approach (€9.7bn) is lower than for the segmented market approach (€11.8bn). But the integrated market approach produces increases in costs that are more evenly distributed across G-SIBs. For the median bank, the cost increases by €165 million and €128 million, respectively, under the integrated and segmented market approaches.

The important difference between the integrated and segmented approaches is in the upper part of the cost distribution, particularly the five institutions with the highest costs. Under the baseline, the aggregate cost for the five institutions with the highest costs is €4.8 billion. The total cost for the five institutions with the highest costs under the integrated markets approach is €5.6 billion. The total cost jumps to €8.1 billion for the five institutions with the highest costs under the segmented market approach. The reason for this is that the G-SIBs with the highest costs are also the banks that have issued in the thinner markets and the second approach does not afford them any flexibility in choosing a different funding market.

4. Macroeconomic costs of TLAC implementation

The macroeconomic costs of TLAC are computed by translating the higher funding costs for G-SIBs to equivalent increases in their revenue through higher lending rates, and estimating the GDP losses of these higher costs of credit to bank clients.

Estimated impact on lending rates

In order to translate the higher funding costs to the banks into higher borrowing rates to the economy we compute the increase in loan rates that would be necessary to maintain banks' net interest income constant. In essence, the calculation assumes that banks maintain the same level of profitability (ROE).[9] This is a conservative assumption if one considers that investors in safer institutions may in fact require a lower compensation for taking risk.

The size of the impact on lending rates is directly linked to the relationship between the cost of eliminating the shortfall and the size of the loan book of the G-SIB (since this is the only source of revenue that is assumed to be impacted), and varies with the calibration of the TLAC requirement. The distribution of estimated increases in loan rates across institutions for the four calibrations is shown in Graph 7. The impact is measured in basis points (bps).

As explained in more detail below, costs are lower for calibrations that correspond to minimum set at 6% of the EM (ie Calibrations 1 and 2), with median bps increases in the single digits. For the calibrations that require TLAC in excess of 10% EM (Graph 7, bottom row panels), the increases in rates are in the teens.

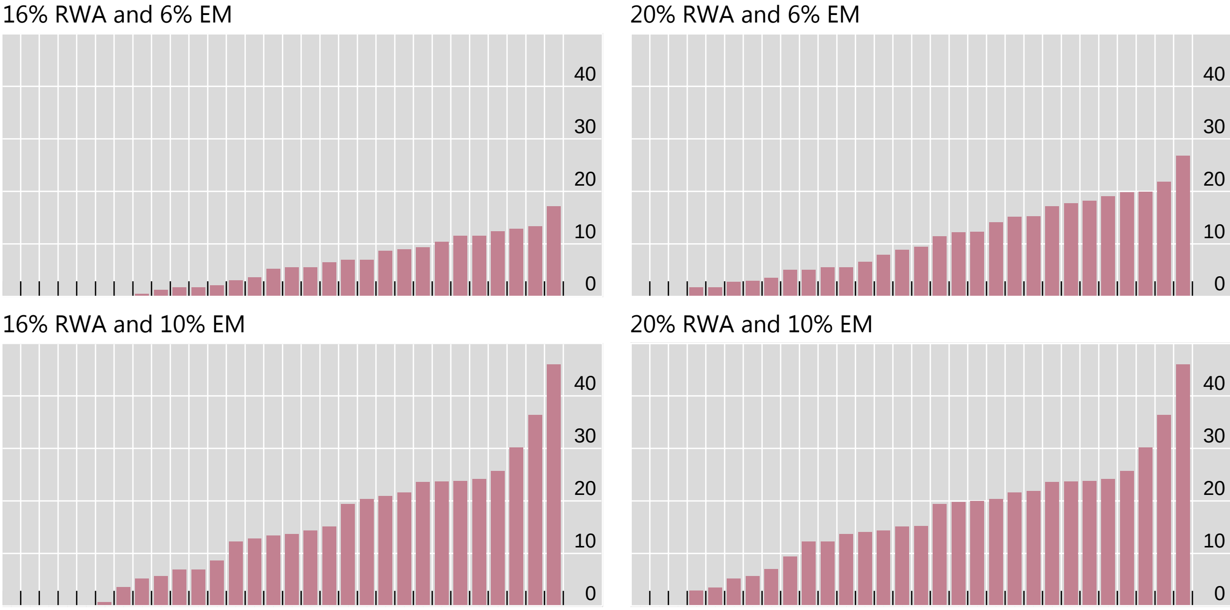
- For Calibration (1), the median rise in loan rates is 5.4 basis points. In this calibration, seven institutions are estimated to increase their loan rates by more than 10 basis points. No institutions are projected to raise loan rates by 20 basis points.
- For Calibration (2), the median institution is estimated to increase rates on loans by 9.2 basis points. In this calibration, 14 institutions are estimated to lift interest rates on loans by more than 10 basis points and one institution is estimated to increase them by more than 25 basis points.
- The median institution in Calibration (3) is estimated to raise loan rates by 13.6 basis points. Here, 18 institutions are estimated to increase interest rates by more than 10 basis points and four institutions are estimated to advance them by more than 25 basis points.
- In the most stringent calibration, Calibration (4), the median institution needs to increase loan rates by 15.2 basis points to keep net interest income constant. A total of 21 institutions are estimated to raise interest rates by more than 10 basis

[9] A similar methodology was used in BCBS (2010a).

points and four institutions are estimated to advance them by more than 25 basis points.

Increase in lending rates to cover for higher funding costs

In basis points Graph 7



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

Macroeconomic costs: impact on GDP

The macroeconomic costs of TLAC are computed by translating the microeconomic impact of higher cost of the G-SIBs' liability structure to equivalent increases in G-SIB revenue through higher lending rates. These higher costs of credit to bank clients are then translated into lower levels of annual GDP.

The calculation is based on three ingredients: the estimated increases in lending rates described above, the market shares of affected institutions, and the "multipliers", namely the estimated negative impact on GDP corresponding to an increase in lending rates. The methodology mirrors the one used in the BIS-FSB Macroeconomic Assessment Group for Basel III (MAG) study.[10] The baseline calculation uses the increase in the lending rate for the median bank in each of the calibrations (as described in the previous section).

As TLAC applies to G-SIBs, only these institutions need to increase lending rates and, consequently, the average borrower in the economy will pay a rate that reflects

[10] The workhorse in the MAG study (which analysed the GDP effect of higher capital and liquidity requirements in Basel III) was a collection of estimates of how higher cost of capital translated into higher lending rates for banks would affect the level of real GDP. The MAG group collected such estimates from different models and provided assessments of GDP impact based on the median-estimated coefficients. (See BCBS 2010b.)

the market power of these banks. The baseline calculation assumes that the average borrowing rate in the economy will increase by an amount equivalent to the product of the increase in the G-SIB intermediated credit and the market share of G-SIBs. The baseline analysis uses a lending rate increase as calculated in the previous section and a market share of 40%, which is the average observed for different jurisdictions. However, the calculation was also performed for a variety of other assumptions about the G-SIB market share. This was done in order to capture in a parsimonious way the potential impact of a number of difficult-to-model factors that have a similar effect on GDP as a larger G-SIB market share. For instance, G-SIBs may be market leaders and thus lead to a generalised increase in the price of credit even by non-G-SIB banks not subject to TLAC. Similarly, the share of G-SIBs in domestic credit may be underestimating their influence if they intermediate in the interbank bank market, for example by providing foreign currency credit to local banks.

The impact of higher lending rates on annual GDP is assessed through simulations using estimated macro models. The baseline calculation uses the median estimate across the more than 80 models analysed by the MAG enriched by more recent estimates obtained by similar models that are maintained in various FSB member institutions. In order to ensure that the assessment of the costs is robust to model error, a range of estimates corresponding to the top quartile (highest quarter of the distribution of estimates) and bottom quartile (lowest quarter of the distribution of estimates) is also used in the calculation. The multipliers in these models suggest that a 10bps increase in spreads would lead to a drop in the benchmark long-run GDP of between 5bps to 17bps, with the median model resulting in a reduction in long-run GDP of about 9 bps.

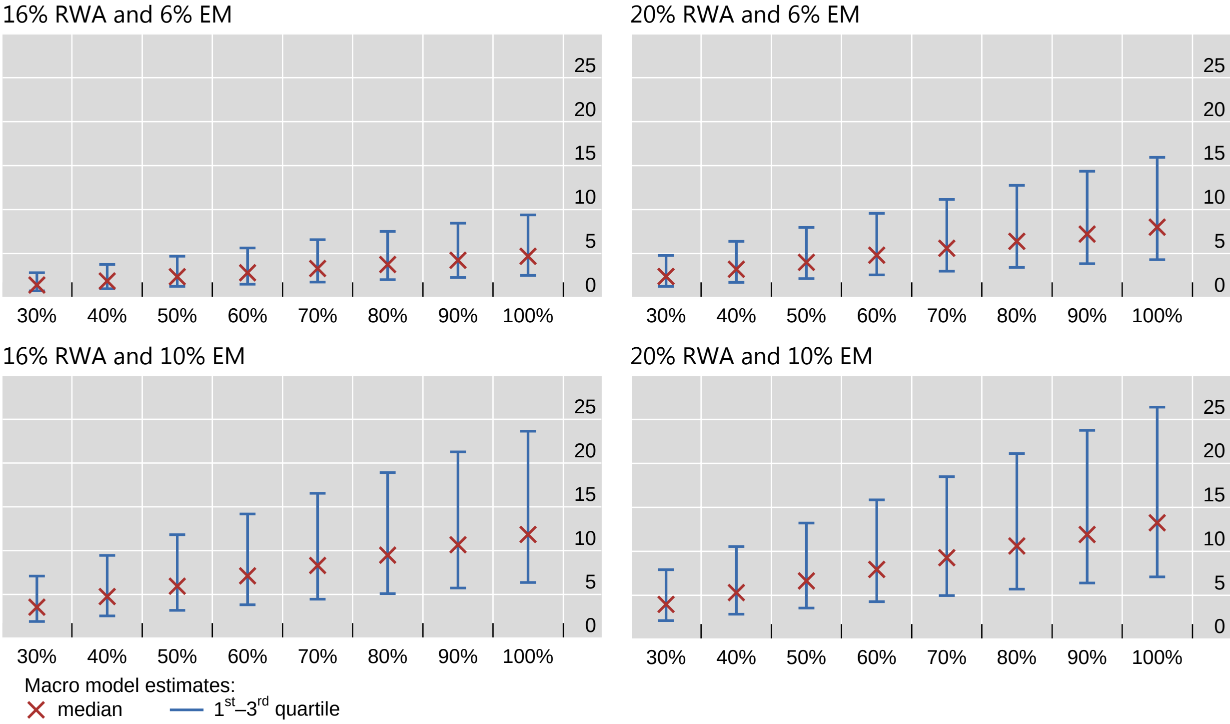
Graph 8 shows the range of long-run macroeconomic effects in each TLAC calibration for a range of market share assumptions and estimates of GDP sensitivities to changes in interest rates. The horizontal axis corresponds to different assumptions for the market share of G-SIBs (from 30% up to 100%). Each line represents the inter-quartile range of estimates using different macro model multipliers, while the red cross plots the median estimate impact of the long-run response of GDP to an increase in loan rates.

The estimated costs are generally small. For Calibration 1, the cost in terms of the reduction in long-run GDP relative to benchmark implied by the median model is less than 5 basis points regardless of the G-SIB market share. Even in the models in which GDP is more sensitive to interest rates, the cost in terms of reduced long-run GPD does not rise above 10 basis points.

For Calibration 2, the median model suggests that, with a 40 percent market share, the reduction in long-run GDP will be about 3 basis points. The reduction in GDP implied by the median model rises to 8 basis points as G-SIB market share increases. The median model suggests that the drop in long-run GDP implied by the increase in interest rates in Calibration 3 will be less than 5 basis points when the G-SIB market share if 40 percent. For all but the highest market shares and sensitivity of GDP to interest rates, the reduction in long-run GDP would be less than 15 basis points. For Calibration 4, the median model suggest that the drop in long-run GDP will be less than 5.5 basis points when G-SIB market share is on the low end of the range and on the order of 12 basis points or 13 basis points for high levels of G-SIB market share. The reduction in long-run GDP would be less than 20 basis points, for all but the highest market shares and models with the highest sensitivity of GDP to interest rates.

Range of macro cost estimates for different market shares of G-SIBs

Impact on annual GDP (in basis points) Graph 8



The panel that corresponds to each calibration shows a range of the estimated reduction in annual GDP for a variety of underlying parameters. The horizontal axis measures different assumed market shares of G-SIBs. The weighted average market share is about 40% and corresponds to the second bar from the left in each panel. A share of 100% implies that all banks in the economy move their lending rates in lockstep with G-SIBs. For each assumed share (horizontal axis) the blue bars represent the impact on annual GDP based on a range of estimates from the macroeconomic models used in MAG. The blue bar captures the inter-quartile range (ie from the lowest 25% to the highest 75%) of the estimated reduction in annual GDP from a 1 ppt increase in the lending rate. The estimates are multiplied by the median lending rate increase necessary to recoup the higher costs of G-SIB funding due to TLAC. The red cross depicts the same calculation based on the median estimated GDP response.

Source: Economic impact assessment group's estimates.

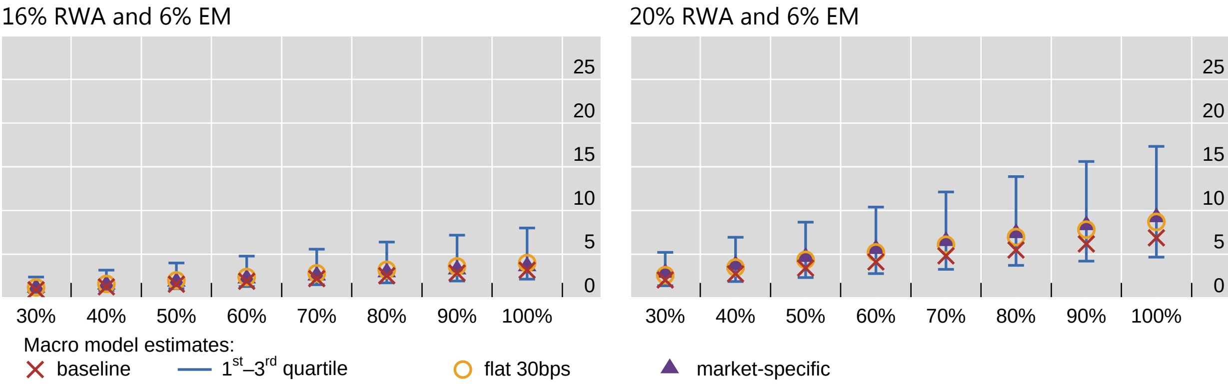
Robustness analysis: GDP cost estimates with higher TLAC spreads

In a previous section, we considered the impact of a generalised increase in the cost of TLAC-eligible securities due to a surge in the supply of such securities on the costs of funding for the 27 G-SIBs headquartered in advanced economies. This section follows up on this exercise by estimating the resulting impact on GDP. Graph 9 plots the associated estimates using a similar template as in Graph 8. While broadly comparable, the reader must bear in mind that the robustness calculations in this section pertain to fewer G-SIBs than those used in the baseline presented in the previous section.

The two panels of Graph 9 show the range of GDP estimates for the two calibrations those based on 6% of EM (ie the two lowest calibrations). The red cross corresponds to the median estimate using the baseline calculation.[11] The yellow circle denotes the median estimate for the integrated markets approach (ie the flat increase in spreads by 30bps), and the blue triangle denotes the median estimate for the segmented markets approach.

Range of macro cost estimates: Robustness calculations

Impact on annual GDP (in basis points) Graph 9



The panel that corresponds to each calibration shows a range of the estimated reduction in annual GDP for a variety of underlying parameters. The horizontal axis measures different assumed market shares of G-SIBs. The weighted average market share is about 40% and corresponds to the second bar from the left in each panel. A share of 100% implies that all banks in the economy move their lending rates in lockstep with G-SIBs. For each assumed share (horizontal axis), the blue bars represent the impact on annual GDP based on a range of estimates from the macroeconomic models used in MAG. The blue bar captures the inter-quartile range (ie from the lowest 25% to the highest 75%) of the estimated reduction in annual GDP from a 1 ppt increase in the lending rate. The estimates are multiplied by the median lending rate increase necessary to recoup the higher costs of G-SIB funding due to TLAC. The red cross depicts the same calculation based on the median estimated GDP response.

Source: Economic impact assessment group's estimates.

The messages from this exercise are intuitive. For the lowest calibration there is very little difference in macro costs between the baseline and the two alternative approaches. As already shown in Graph 7, the average increase in funding costs is small in comparison to G-SIBs' loan books and it results in a small increase in loan spreads. Things are different in the higher calibration. While the average spread increase (and thus GDP impact) under the integrated markets approach is not too different from the baseline, the segmented markets approach leads to higher costs. The reason is that a more demanding calibration exacerbates the asymmetry in the costs increases across G-SIBs by putting even more pressure on the firms issuing in tight markets. This non-linear effect lifts the average impact more than in the case of a flat 30bps increase. That said, and keeping in mind the conservative nature of the underlying assumptions, the annual GDP costs remain below 15bps in all but the most extreme assumptions about the market share of G-SIBs and in the macro models with the highest sensitivity of GDP to interest rates.

11 Any difference in the values of the median and interquartile range between Graphs 8 and 9 is only due to the exclusion of EME headquartered G-SIBs from the latter.

5. Spillovers

In the previous section, we examined the potential impact on economic activity from the implementation of TLAC on average G-SIB home economies individually. In this section, we focus on the macroeconomic impact that is transmitted across countries through different channels: international trade, financial linkages and commodity price linkages. This allows us to capture the impact on a wider set of economies (both home and host to G-SIBs) and differentiate among them on the basis of the strength of these spillover effects.

The workhorse for this analysis of the global macroeconomic costs and spillovers is the IMF's Global Macrofinancial Model (GFM), a structural macroeconometric model of the world economy, disaggregated into forty national economies.[12] Following the same methodology as in the analysis of macroeconomic costs, the funding costs of satisfying TLAC are mapped onto credit spread increases in G-SIB home and host countries. These interest rate spread increases are phased in linearly over two or four year implementation periods. The analysis assumes an increase in lending spreads of 10 bps for G-SIBs or their subsidiaries and that monetary policy does not respond to the shock of tighter lending terms during the implementation period but does respond after implementation. The assumed spread increase is well within the range of increases associated with various calibrations scenarios discussed above. Given the linear structure of the model, the results are scalable to any other assumed spread increase.

The other input to the analysis is the share of domestic banking activity that corresponds to G-SIB intermediated credit. We obtained these shares from a variety of sources. The most direct source was a survey of home and host countries. For countries where we did not have direct evidence, we based the estimate on a survey that was conducted in 2010 and on the analysis on international banking statistics that show the cross-country lending activity assuming that the majority of this activity is intermediated through G-SIBs.

Output spillovers are transmitted across economies in the GFM via trade, financial, and commodity price linkages. These financial linkages encompass cross-border bank lending, portfolio debt and portfolio equity exposures, as well as contagion effects. An interest rate spread increase in a G-SIB home country reduces private consumption and investment locally but also export demand in other countries. In addition, the interest rate spread increases in G-SIB host countries reduce aggregate demand locally. Furthermore, the interest rate spread increase in the G-SIB home country partially passes through to other countries via cross-border bank lending linkages, raising their effective cost of credit and reducing their private consumption and investment. Finally, energy and non-energy commodity prices fall with world output.

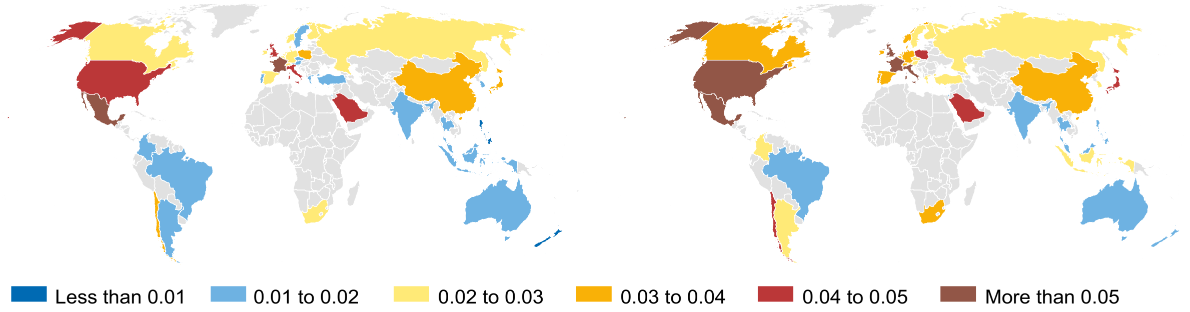
The heatmap in Graph 10 illustrates the GDP impact for a range of home and host countries. The heatmap shows the peak output loss in each country in the model. Because monetary policy is taken as exogenous and assumed not to offset the impact of TLAC on the economy until after the implementation period, longer implementation period result in larger GDP impacts.

12 For a description of the model see Vitek (forthcoming).

Heatmap of peak macro costs across home and host jurisdictions

Percentage points of annual GDP assuming exogenous monetary policy | Graph 10

Two-year implementation | Four-year implementation



Source: EIAG estimates based on Vitek (forthcoming)

For G-SIB home countries, abstracting from monetary policy responses, the estimated median peak output loss is 3-4 bps depending on the length of the TLAC implementation period, of which 1 bp is accounted for by spillovers. That is, spillovers transmitted via trade, financial, and commodity price linkages account for about one quarter of the estimated median peak output loss, with cross-border bank lending linkages being the most important conduit. For host and other countries, abstracting from monetary policy responses, we estimate a median peak output loss of 2-3 bps depending on the length of the TLAC implementation period. The peak impact occurs at, or shortly after, the TLAC implementation period.

The implied estimated median elasticities of the peak output loss with respect to the interest rate spread increases are broadly consistent with those reported in MAG (BCBS 2010b). But the relative contributions from spillovers are larger, because they account for interest rate spread increases in G-SIB host countries transmitted via subsidiaries, as well as cross-border bank lending from G-SIB home to G-SIB host and other countries.

6. Assessing the benefits from TLAC

This section provides an assessment of the benefits of TLAC. These benefits derive to a large degree from the disciplinary effect on G-SIBs' risk-taking of introducing a structured framework for debtholders to share the loss-bearing burden as the firm enters resolution. This microeconomic benefit of reducing the probability of failure of individual G-SIBs, has a macroeconomic counterpart, in the form of bringing about a reduced likelihood of a system-wide financial crisis. However, the macroeconomic benefits include also a reduction in the cost of crises as in the event of a crisis the impact on government finances will be contained in the absence of a bail-out of large banks. These microeconomic and macroeconomic effects will be discussed in separate sub-sections below, but before we analyse the benefits we need to set out the benchmark against which TLAC benefits can be assessed. This is the focus of the next sub-section.

What is the benchmark/counterfactual?

The benefits of TLAC and orderly resolution of G-SIBs must be measured against a clear counterfactual: what would happen if a G-SIB failed without having sufficient resources to implement an orderly resolution?

The G20 leaders have publicly committed not to use public funds anymore to bail banks out. In fact, public authorities in many G-SIB home jurisdictions face now more stringent legal, political, and financial constraints in providing such support than they did in the past. Hence, absent sufficient amounts of readily bail-in-able liabilities, a disorderly failure of a G-SIB may be the most likely outcome. Such a disorderly failure is likely to be associated with large costs to others and the economy at large through the contagious effects of possible asset fire-sales and uncertainty among holders of operating liabilities (eg derivative counterparties).

While disorderly failure may be the most appropriate counterfactual to TLAC going forward, benchmarking the economic benefits of orderly resolution compared to this alternative presents serious empirical difficulties. The reason is that we do not have sufficient historical evidence of the counterfactual scenario for a systemically important bank. So for the purpose of this analysis we assume that in the absence of sufficient bail-in-able resources, a G-SIB would still be bailed out.

Our choice makes the counterfactual less adverse and, hence, it underestimates the benefits of TLAC. In this sense it is consistent with the conservatism principle. Governments bailed-out banks because, compared with the implications of a disorderly failure, an incentive-distorting bailout was considered socially less costly. In addition, the political decision by G20 leaders to rule out bail-outs has been driven, at least in part, by distributional and fairness concerns around bail-outs. However, our impact assessment explicitly abstracts from such distributional concerns.

Finally, we recognise that TLAC is only one of the necessary conditions for bail-in to work. Our working assumption is the other institutional and operational conditions for orderly resolution will be satisfied by the time TLAC is implemented. The elimination of the too-big-too-fail perception would depend primarily on the credibility of the framework and authorities' intent to apply it. If the TLAC requirement is not perceived as sufficiently robust this could undermine the effects on market discipline, which is a key driver of the benefits considered below.

The microeconomic benefits of TLAC

The main source of microeconomic benefits from the implementation of TLAC is linked to neutralising the distortions that stem from the expectation of public sector bail-outs for bank management and external stakeholders. More often than not, faced with the prospect of a disorderly failure of a financial institution with a large systemic footprint public authorities have opted for providing financial assistance and support that effectively limits losses borne by debt holders. This creates disincentives for this class of stakeholders to monitor and discipline management, provides a form of implicit subsidy to the firm since it lowers funding costs, and promotes excessive risk-taking. The TLAC framework provides a structured way to approach resolution of a failing G-SIB and, importantly, ensures that the firm will have financial resources that can be energised to fund resolution (ie absorb losses and recapitalise the institution). By making the resolution process more predictable and providing a framework for the bail-in of junior liability holders, TLAC enhances the effect of external discipline on bank management and should reduce risk-taking.

The economics literature provides ample discussion on the distortions from the expectation of bail-outs as well as the disciplinary impact that debtholders can have on bank management (either through activism or by requiring higher compensation for default risk) when they are faced with the concrete risk of loss bearing in the event of the firm becoming troubled. These different strands in the literature provide a good basis for the quantification of the likely impact of TLAC and a clearer resolution framework on G-SIBs' risk profile.

One strand of the literature focuses on the effect of "too-big-to-fail" perceptions on risk taking. It allows us to quantify the impact of eliminating the expectation that government support will be forthcoming in the event that the institution enters resolution on G-SIBs' probability of failure. This literature provides empirical evidence that "too-big-to-fail" perceptions encourage banks to take higher risks (for example, see Afonso et al, 2014). The empirical literature typically focuses on the impact of marginal changes in the assumed likelihood of government support on risk-taking. However, if we extrapolate these results they suggest that a complete withdrawal of government support assumptions would lower a systemically important bank's probability of failure by approximately **one third**. To put this into perspective, assume that in any given year a hypothetical G-SIB currently threatens to fail with a probability of 1.5%. In the absence of any government support assumptions, the bank would take actions to reduce this probability to 1%, eg by choosing more conservative investment strategies (see Annex 2 for a more detailed discussion).

The other strand of the literature highlights the disciplinary impact of subordinated debt for banks. If subordinated debt holders do not expect to be bailed-out, they have a stronger incentive to intervene when they feel that bank management is taking excessive risk, for instance by seeking higher profits in (too) risky investments or by increasing leverage. Debtor-induced discipline is complementary to shareholder discipline because of the nature of their respective payoffs. This means that for any level of bank capitalization, increased investor discipline should reduce banks' probability of failure.[13] The empirical research in this area provides estimates of very sizeable effects on banks' probability of default.[14]

Conceptually, both of these approaches are about the same thing: the risk-reducing influence of debt liability holders who expect to suffer losses in resolution. In what follows we focus on estimates based on the first strand, because it provides for a more direct way of assessing the effects of "ending too-big-to-fail". If the TLAC requirement is calibrated to cover plausible but extreme loss absorption and recapitalisation needs, the assumption that bail-in should replace expectations of bail-outs in all but the most extreme scenarios seems plausible. And even in the most extreme scenarios the amount of support that a government may have to extend should be significantly reduced. That said, in our robustness checks we consider

[13] We use the term "failure" as including both actual defaults and bail-outs.

[14] See eg Nguyen (2014) or Ashcroft (2008) for recent evidence on the effect of subordinated debt. Evanoff et al (2011) discuss the rationale for subordinated debt requirements and provide evidence that subordinated creditors are indeed able to assess the riskiness of a firm. However, the effect of subordinated debt appears to depend strongly on whether subordinated creditors expect to be bailed out in case a bank runs into trouble (see Flannery et al, 1996 or Sironi, 2003) and there is considerable heterogeneity in the estimates.

estimates that are informed by the second strand of literature, which tend to be significantly larger.

Macroeconomic benefits from TLAC and pre-funded resolution

The analysis of the macroeconomic benefits of TLAC implementation distinguishes between two main effects:

1. A *reduced likelihood of a systemic crisis*, which is a direct consequence of the reduction in the probability that each individual G-SIB fails (due to the disciplining role of debt liabilities that can be easily bailed-in).
2. *Reduced cost of crises*, which derive from the replacement of an ad hoc and uncertain process of bail-outs by an orderly framework based on ex ante rules. Avoiding bail-outs allows governments more fiscal leeway, does not inflate public debt levels, and mitigates increases in sovereign yields that serve as the benchmark for private sector funding rates.

Arguably, these are not the only benefits from bail-in and orderly G-SIB resolution. For example, following a bail-in, banks would be restructured and/or (partially) wound down. We would expect this process to allow inefficient firms to exit markets and to make room for more efficient new entrants. However, there are no easy ways to quantify this type of macro benefits and, consequently, we will ignore them in the analysis that follows.

Impact on the probability of a crisis

In line with previous impact assessment exercises (eg BCBS, 2010 and 2013) our central estimates of the benefits of prudential requirements focus on the impact of such requirements on the probability of a banking crisis rather than on the failure of individual banks. However, in the case of systemically important banks the two are closely related. While the failure of one G-SIB may not be in itself sufficient to trigger a banking crisis, a G-SIB that fails at a time when other banks are already struggling may be pivotal in turning a period of stress into a system-wide crisis. Hence, we should be able to link changes in G-SIBs' probability of failure with changes in the probability of a crisis.

To do so, we base the calculations on a portfolio credit risk model. The model uses as inputs the volatility and correlation of equity prices of large UK banks together with their leverage to infer the volatility and correlation of banks' asset values. This allows us to assess the probability that in a given year, the system-wide value of banks' assets fall abruptly creating losses in excess of 5% of GDP. This is the threshold of losses used by Leaven and Valencia (2012) to identify banking crises.[15] The probability of such an event occurring determines our measure of systemic risk. Subsequently, we ask the question of how this metric changes as we reduce risk-taking by all G-SIBs in the system while keeping constant their level of capitalisation. To do this, we exogenously reduce the asset value volatility for each G-SIB by the amount necessary to reduce that G-SIB's individual probability of failure by a fraction that is in line with our microeconomic evidence.

[15] While there are different indicators for a banking crisis that we could use, the approach by Laeven & Valencia (2012) is widely accepted. Moreover, while Laeven & Valencia (2012) also present different criteria, this one is most closely related to a solvency shocks our model simulates.

The reduction in the probability of a crisis is a key source of macro benefits from TLAC. Hence, we provide a number of sensitivity checks. First, we consider how the effect varies with the importance of G-SIBs relative to the banking system as a whole. The impact of making all G-SIBs in a home jurisdiction safer clearly depends on the number and size of G-SIBs relative to the overall banking sector. For our estimates we use three representative levels of G-SIB importance on the basis of the actual distribution of their banking market share in their home jurisdiction. An average share of 60%, a high share (75%), and a small share (25%).

Estimates of the reduction in likelihood of crisis

In percent of estimate without bail-in

Table 5

Share of G-SIBs in the banking market	Strength of estimated disciplining effect of bail-in		
	Weak effect	Central estimate	Strong effect
Low	9%	13%	17%
Average	19%	26%	34%
High	25%	35%	44%

NOTE: The figures represent the estimated reduction in the likelihood of a systemic crisis because of reduced moral hazard after the introduction of explicit bail-in of TLAC-eligible liabilities. The numbers refer to the relative reduction in the probability of a crisis as a percent of the original likelihood (in the absence of bail-in). The columns correspond to different assumptions about the impact on discipline on risk taking (weak= a 20% reduction in probability of default, central= a 30% reduction in PD, and strong= a 40% reduction in PD). The rows correspond to different assumed importance of G-SIBs (measured by consolidated G-SIB assets relative to overall banking assets (on an ownership basis). The ratios we use are Low= 25%, Average=60% and High=75%).

Source: EIAG calculations.

Second, we consider scenarios that are based on different assumptions on the (microeconomic) effect of TLAC on moral hazard and a G-SIB's probability of failure. Our central scenario is based on the academic evidence on the effects of "too-big-to-fail" expectations discussed above. This literature suggests that a removal of government support assumptions reduces the probability of a G-SIB failure by one third. However, to provide some sensitivity checks, we also consider scenarios where we *assume* that TLAC reduces the probability of failure only by one fifth (20%), or by two fifths (40%). The latter scenario can be justified by academic evidence on the effect of subordinated debt, which suggests significantly larger effects than the ones we consider in our central scenario. An overview over the various estimates is given in Table 5.[16]

The absolute impact of TLAC on the probability of a crisis (ie the impact in percentage points) depends on the probability we use as a baseline. We assume that in the baseline scenario (ie without TLAC) the probability of a crisis is accurately

[16] A 20% reduction in the probability of a G-SIB failure corresponds to a scenario where a withdrawal of "support assumptions" has only two thirds of the effect suggested by the existing literature. This might be the case if reductions in "support assumptions" have (strongly) decreasing marginal effects that are not captured in the empirical estimates. The assumption of a 40% reduction can be justified by evidence on the effect of subordinated debt. Nguyen (2014) finds that an increase in subordinated debt by c. 2% of RWAs reduces an 'upper bound for default risk' by 54.7%. We use an (extremely conservative) factor of 40% for an increase in the subordinated debt ratio by 8-12% of RWAs to account for the fact that the impact on actual default risk may be smaller. Our more conservative assumption is also driven by the fact that the estimates of Nguyen (2014) appear to be large relative to studies on the effects of capital (or credible resolution).

predicted by the LEI (BCBS, 2010). In this case TLAC would reduce the probability of a crisis in a given year from 2.3% to 1.7% (ie assuming a 26% effect).[17]

It may be interesting to note that the estimated effect of requiring G-SIBs to hold sufficient TLAC on the probability of a crisis is similar to an increase in system-wide capital requirements by one percentage point (which according to BCBS (2010) reduces the probability of a crisis by c. 30%).

Impact of TLAC on the cost of a crisis

As discussed above, we compare the scenario where a G-SIB has sufficient TLAC to allow for an orderly resolution to a counterfactual scenario where the G-SIB would be bailed out. By doing so, we do abstract from the legal and political constraints on government financed bail-outs, thus underestimating the actual benefits of TLAC. However, this allows us to draw on past evidence in order to quantify the counterfactual.[18] We assume that in the case of government bail-outs of systemically important banks, the average cost of a crisis would be in line with historical evidence. The LEI (BCBS, 2010) and MAGD (BCBS, 2013) summarized various studies that suggest that the median present value of the cost of a crisis is 63% of annual GDP. We separately consider estimates that do not allow for any permanent effects of a crisis (19% of GDP) and an average across studies that do allow for such permanent effects (158% of GDP). Previous studies have found that the cost of crises is largely unaffected by increases in regulatory capital and liquidity requirements (see BCBS, 2010). Hence, using these numbers is likely to still be appropriate (despite of the transition to higher Basel III capital requirements).

In evaluating the impact of orderly resolution funded by TLAC on the cost of crises we examine two complementary effects. The first is the direct effect on aggregate expenditure and output stemming from the fact that bail-in shifts the financial burden of resolving a G-SIB (loss absorption) from the public sector to private debtholders. The second is the indirect effect through lower sovereign yields and their role as benchmark rates for private sector borrowing costs. These are examined in the two sub-sections below.

Loss absorption

The move from bail-outs to bail-in changes the balance of loss bearing between governments and private creditors:

- Governments do not have to inject money into failing banks. This gives them more financial leeway to either provide targeted fiscal stimuli, or avoid spending cut backs during the crisis or in the future when they need to repay debt incurred

17 In the baseline banks have to satisfy a minimum total capital requirement of 8% of RWAs, a capital conservation buffer of 2.5% of RWAs and an average G-SIB buffer of 1.3%. Using an average of the conversion factors between "Total Capital" ratios and "Tangible Common Equity" (TCE) ratios for different types of banks that are included in the in the LEI this translates into a TCE ratio of c. 8%. According to the LEI this corresponds to a probability of a crisis of 2.3% (assuming NSFR=1). This can be seen as a conservative estimate, as we are implicitly assuming that G-SIB buffers apply to all banks and not just G-SIBs.

18 Conversely, we do not have any evidence on the consequences of a disorderly G-SIB failure (with the potential exception of the failure of Lehman Brothers). However, Lehman Brothers was considerably smaller than most of the G-SIBs that will be subject to TLAC requirements.

to fund the bail-outs.[19] The macroeconomic benefits of insulating the government's balance sheet can be approximated by estimates of fiscal multipliers.

- Private-sector creditors will be bailed in and may be exposed to losses. Relative to a scenario where losses are absorbed by the government this directly reduces household wealth and reduces private consumption. This effect represents a gross macroeconomic cost of moving from bail-outs to bail-ins.

We would expect the net effect of moving from bail-outs to bail-in to be beneficial. First, governments generally fund themselves via taxation, which is generally found to be socially costly (eg because it distorts labour supply). Government expenditure must be sufficiently beneficial to justify these distortionary costs. So by imposing losses on the government rather than households we may end up crowding out more beneficial spending. Second, in a crisis, governments' ability to further increase debt-to-GDP ratios may be limited. Hence, governments may be forced to cut back on expenditure at a time where doing so is particularly costly.[20] Conversely, empirical estimates of the reaction of household consumption to wealth shocks suggest that households' contemporaneous consumption does not react very strongly to changes in financial wealth.[21] Hence, if a financial loss is absorbed by households it takes longer for the shock to feed through to changes in GDP, and its effects are arguably smaller. Spreading the impact over a longer time should be beneficial since it reduces pro-cyclical behaviour, as well as due to the effects of discounting.

To quantify the impact of TLAC on the cost of a crisis we use a reduced-form model that uses existing estimates of fiscal multipliers and households' marginal propensity to consume to approximate the cost of imposing losses on the government vs. on private creditors. We account for the fact that the increases in debt-to-GDP ratios associated with bail-outs increase sovereign funding costs. This effect makes it more costly for the government to fund bail-outs and increases the cost of imposing losses on the government. Subsequently we estimate the amount of losses that would be absorbed by households rather than the government by using a distribution of G-SIBs' past loss absorption and recapitalization needs (as identified by the separate FSB work stream). We assume that the amount of losses that would now be absorbed by households is the lesser of a bank's actual recapitalization need and 12% of RWAs.[22] This allows us to assess the expected benefit of TLAC conditional on a crisis.

We find that based on past recapitalization needs, TLAC can reduce the cost of a crisis compared with bail-outs by about **3.8 percentage points** of annual GDP. To put this into perspective, using our central estimate of the cost of crises this corresponds to a reduction in the net present value cost of a crisis from 63% of GDP

[19] These two scenarios are conceptually very similar. In the first scenario, we assume that the government *increases* government expenditure *by less* due to the cost of bail-outs. In the second scenario the government *reduces* expenditure due to the cost of bail-outs. So the two scenarios only differ with respect to the assumption on how government expenditure would develop in the absence of bail-outs.

[20] There is robust empirical evidence that the fiscal multipliers associated with government spending are higher in times of a crisis.

[21] See eg Ludwig and Sløk (2004) for estimates for various advanced economies.

[22] This assumes that the difference between existing Basel III minimum requirements of 8% of RWAs and an assumed TLAC requirement of 20% would be available to contribute to recapitalizations.

to 59.2%. This number could be higher if the TLAC requirement was applied to all banks. However, it is not clear if the exact recapitalisation needs of smaller banks are comparable to those of large systemically important institutions.[23]

As mentioned above, the estimates we consider here do not include any distributional concerns. In other words, we ignore the fact that there may be a preference to impose losses on (potentially more wealthy) households that choose to invest in bank debt rather than the average taxpayer.

Impact on the risk-free yield curve

Avoiding bail-outs can be beneficial since it also avoids putting pressure on the yields of sovereign bonds and by extension in private sector borrowing that is explicitly or implicitly priced off these benchmarks.

A Bayesian VAR model that was estimated using data from twelve advanced countries (10 euro-area countries, the U.S. and the UK) suggests that a 100bps increase in sovereign yields can reduce annual GDP by c. 1.5% for the duration of this shock.

Given the role that sovereign yields have as the benchmark risk-free interest rate for the whole economy, a shock to sovereign yields increases the cost of private borrowing, with an adverse impact on aggregate economic activity through private consumption and investment. However, the analysis does not explicitly model this transmission channel, but connects economic activity directly to the long-term risk-free rate directly.

The analysis is based on two assumptions: First, the bailout is financed by higher government budget deficit and ratio of debt-to-GDP but it is not expansionary. It does not transfer future economic resources to raise current aggregate demand, but simply redistributes the negative effects of a financial shock. Second, in order to distinguish this shock from a monetary policy shock, we assume that within the quarter, monetary policy does not react to the tightening in financial conditions stemming from the bailout by lowering the short-term interest rate.

We can use the path of sovereign yields predicted by the previous model to scale this effect. This exercise suggests that the overall discounted effect of changes in sovereign yields on GDP (conditional on a crisis) is about **1.6 percent of annual GDP.**

Total benefit from reducing crisis costs

The total impact on the cost of crises can be calculates by adding these two effects. This produces an estimate of benefits from avoiding the public sector bail-outs of about **5.4 percentage points** of annual GDP. This reflects an average impact across G-SIB home jurisdictions. The exact impact for a given country will depend on the size of G-SIBs headquartered in that country relative to the overall economy.

Cost of crises benefits not captured in our quantitative estimates

Our quantitative estimates only capture benefits associated with insulating the sovereign's balance sheet. There are a number of additional effects that TLAC and

[23] In line with previous studies, we assume a discount factor of 5% throughout our analysis. This is a much higher rate than the current levels of risk-free interest rates in major currency areas and, hence, it is another source of conservatism for our analysis as it reduces the present value of the costs of crises.

orderly resolution may have on the transitory and/or permanent costs of crises not captured by our analysis. Those related to improving the speed and efficiency of resolution of systemically important banks are a case in point.

Borio, Vale and von Peter (2010) study the resolution of banking crises in the Nordic countries and attribute the efficacy of the Nordic approach to three key factors:

- *Early recognition and intervention:* According to Borio et al (2010), a large portion of the cost of a financial crisis can be explained by sluggish policy responses. In crises where governments failed to intervene swiftly, banks continued to operate with little or no equity over extended periods of time. This distorted banks' incentives and may eg have incentivised banks to 'gamble for resurrection'.
- *Comprehensive and in-depth intervention:* The authors also stress the importance of a comprehensive and in-depth intervention that includes eg a full recognition of losses, sufficient recapitalisations, provision of liquidity assistance or a reduction in excess capacity in the financial sector. A full recognition of losses may make it easier to sell bad assets and to reduce banks' leverage.
- *Balancing systemic costs with moral hazard:* In addition to moral hazard leading to excessive risk-taking prior to a crisis, Borio et al (2010) suggest that moral hazard may distort behaviour in the direct aftermath of bank failures and may hence exacerbate the cost of a crisis.

TLAC and orderly resolution can arguably be beneficial in a number of these dimensions. Having clearly defined mechanisms (and the corresponding financial resources) to recapitalise banks at the expense of bank creditors rather than the taxpayer may make it easier to respond to a crisis in a timely fashion, and to avoid the costs associated with a sluggish policy response.

Having sufficient TLAC in place may make it politically easier to recognise losses and to write down bad assets, since doing so will protect the book value of any equity injections the government may provide. In addition, TLAC may allow for more generous recapitalisations because it avoids the political difficulties associated with bailing out creditors at the expense of the general public. Finally, an orderly resolution regime may remove excess capacity in certain market segments, for instance by ensuring that firms with non-viable business models are wound down in an orderly fashion.

To summarise, there is a variety of effects by which TLAC and orderly resolution can reduce the cost of a crisis that are not captured in our quantitative estimates. However, quantifying these additional effects in a reliable way is very difficult. Hence, we use the numbers discussed above as a conservative lower bound for the effect of TLAC on the cost of a crisis.

Summary of macro benefits

Taken together, the evidence suggests that TLAC may have a non-negligible beneficial impact on the probability and the cost of a crisis. Putting together the reduced likelihood of a crisis and the reduced cost of a crisis, in the event one does occur, our central estimate suggests that for an average G-SIB home jurisdiction. TLAC generates annual benefits of 48 bps of GDP (see Table 6).

However, the exact benefit depends on the baseline cost of a financial crisis, as well as the size of (domestic) G-SIBs relative to the overall banking sector. Hence, we also report results that are based on different assumptions regarding the cost of crises and that consider banking systems with different shares of G-SIBs.

The estimates of the cost of financial crises that we use quantify the net present value cost of crises and are based on a literature review in BCBS (2010). The different estimates are constructed using different assumptions regarding the potential long-term impact of financial crises. We use the (reasonably conservative) estimate of a cost of 63% of GDP as our baseline.

To provide a further sense of the range of estimates of the benefits, we also report results that are based on different assumptions regarding the effects of TLAC on moral hazard and a G-SIB's probability of failure. As noted above, the empirical literature suggests that a removal of implicit government support reduces the probability of a G-SIB's failure by one third. In our sensitivity checks, we assume that this effect is either one fifth (20%) or two fifths (40%) instead.

Range of benefits estimates

In bps of annual GDP

Table 6

G-SIB share	Low crisis cost No permanent impact (19% of GDP)			Conservative estimate Moderate permanent cost (63% of GDP)			Permanent effects of crises (158% of GDP)		
	Discipline effect			Discipline effect			Discipline effect		
	Weak	Central	Strong	Weak	Central	Strong	Weak	Central	Strong
Baseline estimate	18	21	23	37	**48**	58	79	106	133
Range	15-20	16-23	18-26	24-46	30-59	35-71	44-101	58-135	72-167

Source: EIAG calculations

The results point to a wide range for the estimated impact, a direct consequence of the breadth of the alternative estimates for the effect of crises (15% to 167% of GDP). But the main message is that even for the most conservative assumptions (ie low cost of crises and weak disciplinary impact) the benefits are between 15 and 20 bps of annual GDP. These impacts are comparable to the higher end of the range of estimated costs for the most demanding TLAC calibration, the highest sensitivity of GDP to interest rates, and a substantial market shares for G-SIBs (from Graph 8). For other cases that are closer to the average values of market share and sensitivity of GDP to interest rates, the benefits are greater than the costs by a good margin.

These benefit numbers are likely to underestimate the overall benefits since we ignore any legal or other practical constraints that governments may face in providing bail-outs. If we assumed that the counterfactual to orderly resolution was a disorderly failure these numbers would presumably be considerably larger.

The estimates reported in Table 6 are admittedly subject to considerable uncertainty. The benefits of prudential regulation are inherently uncertain and difficult to assess. Moreover, while in the case of regulatory capital requirements we can rely on historical evidence, we have only limited historical evidence that we can draw on to quantify the precise impact of TLAC and orderly resolution.

Further robustness checks and effect of G-SIBs being unconstrained

Some firms are not currently constrained by the external TLAC requirements, eg because they already have sufficient eligible debt issued out of holding companies. The TLAC standard may still have an effect on these G-SIBs' risk-taking incentives, eg because new disclosure or "internal TLAC" requirements provide clarity on how losses will be allocated across different creditors of a group, which may enhance market discipline. Hence, we ignored this issue in our central estimates. However, below we make the conservative assumption that the TLAC standard does not have *any* effect on the behaviour of those G-SIBs that are unconstrained by the external TLAC requirement.

Depending on the calibration, 3-5 G-SIBs are currently unconstrained by the external TLAC requirement. Since we are not able to determine the identity of the unconstrained banks (due to data confidentiality issues), we assume that the unconstrained banks' size corresponds to the G-SIB average and that these banks are evenly distributed across G-SIB home jurisdiction.[24] Table 7 summarises the results under the conservative assumption that 5 G-SIBs are unaffected by the TLAC requirement.[25] It may be interesting to note that reducing the number of G-SIBs that are exposed to more market discipline by eg 10% reduces the effect of TLAC on the probability of a crisis by less than 10%. This can be explained by the decreasing marginal effects of making additional G-SIBs safer: the benefit of making the first 10% of G-SIBs safer is (somewhat) higher than the benefit associated with making the last 10% of G-SIBs safer.[26]

Range of benefits estimates

In bps of annual GDP — Table 7

G-SIB share	Low crisis cost No permanent impact (19% of GDP)			Conservative estimate Moderate permanent cost (63% of GDP)			Permanent effects of crises (158% of GDP)		
	Discipline effect			Discipline effect			Discipline effect		
	Weak	Central	Strong	Weak	Central	Strong	Weak	Central	Strong
Baseline estimate	17	19	21	33	**42**	51	68	91	114

Note: The numbers represent the estimated decline in annual GDP assuming that the implementation of TLAC will not imply any extra disciplining effect for five of the G-SIBs because they already have sufficient amounts of outstanding loss-bearing debt liabilities.

Source: EIAG calculations

[24] Eg if 10% of G-SIBs are unconstrained by external TLAC requirements, we assume that in each country, only 90% of the G-SIBs become safer. Of course, in reality the effect will not be evenly distributed across home jurisdictions. Moreover, in our analysis we ignore integer constraints and act as if we could make eg 'half a G-SIB' in a country safer. However, this assumption is only made in the interest of tractability and does not have any meaningful effect on our quantitative results.

[25] Here we do not distinguish between jurisdictions with different shares of G-SIBs since this robustness check varies the number of (affected) G-SIBs in each country.

[26] Decreasing marginal benefits also imply that it matters in which jurisdictions unconstrained G-SIBs are located. We assume that they are evenly spread across G-SIB home jurisdictions. This overstates the benefits of TLAC relative to a situation where all unconstrained G-SIBs are located in jurisdictions with few G-SIBs (and where the marginal benefits of making additional banks safer are high), but it understates the benefits of TLAC relative to a situation where all unconstrained G-SIBs are located in jurisdictions with a large G-SIB presence (and where marginal benefits are low)

Moreover, our robustness check leaves the estimates of the effect of TLAC on the *cost of crises* unaffected. While the effect of TLAC on the cost of crises is not the key driver of our *central* benefit estimates, it becomes more important (in relative terms) if we assume that the baseline cost of a crisis is low (and hence, reducing the *probability of a crisis* is less important). This explains why the robustness check has a much smaller effect when we assume that the cost of crises is low.

Annex 1: Assessment of the cost of the final calibration

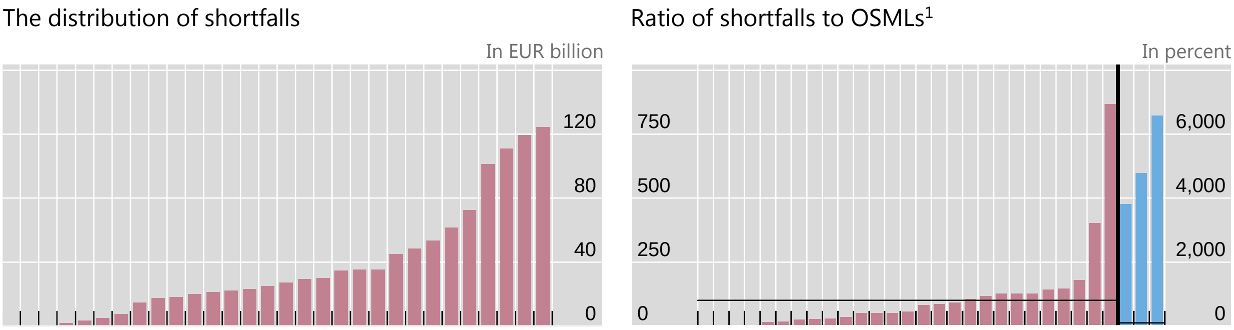
Under the final TLAC standard, the minimum TLAC requirement from 1 January 2022 will be for G-SIBs to hold TLAC eligible securities equal to at least 18 percent of their Risk-Weighted Assets and 6.75 percent of the resolution entity's Exposure Measure. In this Annex, we provide an estimate of the costs on the basis of this calibration. The benefits will be unchanged from what is described in Section 6. Generally speaking, the costs are between those of Calibration 1 and Calibration 2.

The aggregate shortfall for all G-SIBs under this calibration is €1,109 billion (a figure between those estimated under Calibration 1 and Calibration 2). For individual G-SIBs the median shortfall about €26.2 billion with the range being from a minimum of €0 and the maximum shortfall being €124.4 billion (left hand side panel of Graph 11).

Size of the shortfall

Revised Term Sheet calibration

Graph 11



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

[1] Red bars are on the left-hand scale, blue bars on the right-hand scale.

Source: Economic impact assessment group's estimates.

About half of the G-SIBs appear to have sufficient liabilities that satisfy many but not all of the TLAC eligibility criteria and that could potentially be converted into TLAC eligible securities. For the median bank the ratio of the shortfall to outstanding OSMLs is 84.4%, implying that the supply of existing OSMLs is larger than the current shortfall. Thirteen G-SIBs have ratios greater than 100% (implying that the amount of available for conversion debt securities is smaller than the shortfall) and only 6 have ratios of more than 150%.

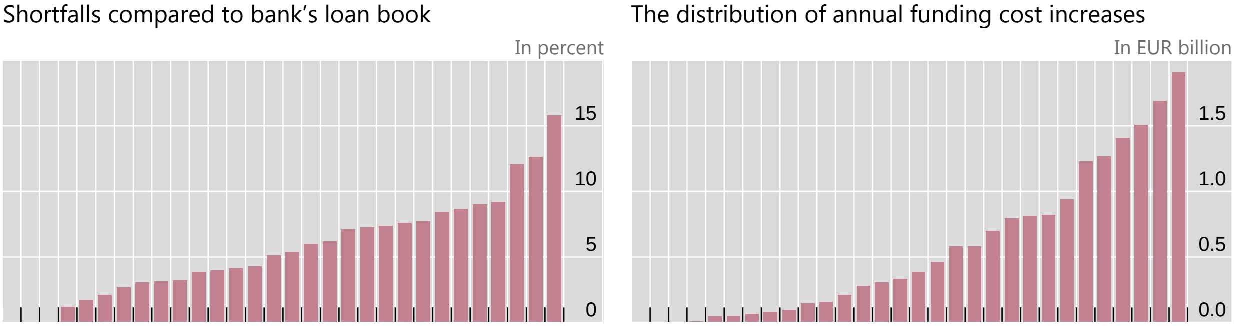
The shortfalls are also generally moderate when compared to the loan portfolios (Graph 12, left hand side panel). The median bank has a shortfall of roughly 5% of its loan book. Looking at the distribution of the ratio for the 30 G-SIBs, the ratio for the eight institutions with the lowest values is less than 3.1% while for the eight institutions with the highest values it exceeds 7.5%.

The median increase in the weighted average z-spread on TLAC and OSMLs is estimated to be about 72 basis points, which translates into extra €360 million annual funding costs for the median G-SIB (Graph 12, right hand panel). The weighted average costs of funding increases are quite dispersed across institutions. They increase by less than 25 bps for 10 banks and by more than 100 bps for eleven G-

SIBs. Six G-SIBs will face increases in their annual funding costs in excess of €1 billion while for nine other institutions the increases will be less than $100 million.

Size and cost of the shortfalls

Revised Term Sheet calibration — Graph 12



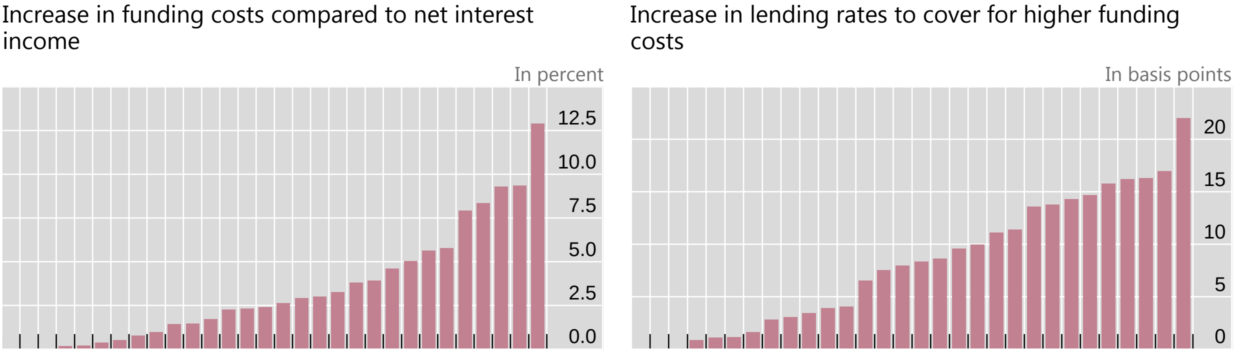
Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

Source: Economic impact assessment group's estimates.

We can compare the rise in costs to net interest income (Graph 13, left hand panel). For the median bank the increase in annual costs is 2.5% of net interest income. For the bank at the lowest quartile of the distribution, the annual cost is 0.7 percent of net interest income, while for the bank at the highest quartile, the increase in the annual cost of funding is about 5% of net interest income.

Impact of the higher funding costs

Revised Term Sheet calibration — Graph 13



Note: Bars depict the relevant statistics for each bank, ranked in increasing order. Individual banks may rank differently across panels in a single graph and across graphs.

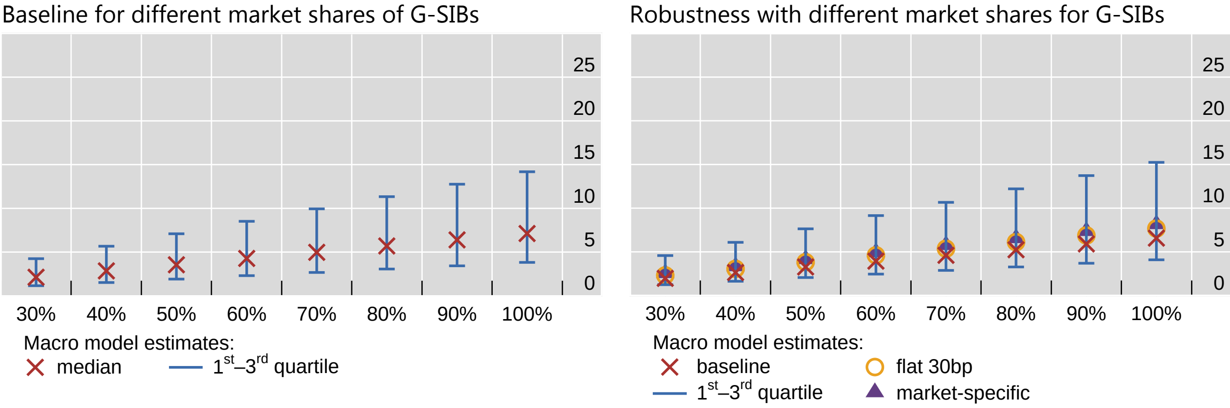
Source: Economic impact assessment group's estimates.

In order to keep the return on equity constant, loan rates will have to rise. We calculate that, for the median bank, the increase in loan rates will be 8.1 basis points (Graph 13, right panel). The increase in loan rates will be less than 10 basis points for 19 G-SIBs. For only one G-SIB are loan rates calculated to rise more than 20 basis points.

The macroeconomic costs are shown in Graph 14. Using the median increase in loan rates, the model with the median sensitivity of GDP to interest rates and applying a G-SIB market share of 40%, the reduction in long-term GDP relative to benchmark will be 2.8 basis points. While the costs increase with both G-SIB market share and the sensitivity of GDP to interest rates, they remain below 15 basis points in even the most extreme parameter values. We also calculated the macroeconomic costs under the assumption that the costs of issuing TLAC will increase with the increased supply of such securities (the "Supply Surge"). The pass through from more expensive TLAC through bank balance sheets results in loan rates rising one or two basis point more than in the baseline approach. Consequently, the macro-economic impacts are a bit larger, but not significantly so.

Range of macro cost estimates using the Revised Term Sheet Calibration

Impact on annual GDP (in basis points) Graph 14



The panel that corresponds to each calibration shows a range of the estimated reduction in annual GDP for a variety of underlying parameters. The horizontal axis measures different assumed market shares of G-SIBs. The weighted average market share is about 40% and corresponds to the second bar from the left in each panel. A share of 100% implies that all banks in the economy move their lending rates in lockstep with G-SIBs. For each assumed share (horizontal axis), the blue bars represent the impact on annual GDP based on a range of estimates from the macroeconomic models used in MAG. The blue bar captures the inter-quartile range (ie from the lowest 25% to the highest 75%) of the estimated reduction in annual GDP from a 1 ppt increase in the lending rate. The estimates are multiplied by the median lending rate increase necessary to recoup the higher costs of G-SIB funding due to TLAC. The red cross depicts the same calculation based on the median estimated GDP response. The panel on the left incorporates information from all 30 G-SIBs. The panel on the right is based on developments and market supply effects of the 27 non-EME G-SIBs.

Source: Economic impact assessment group's estimates.

Annex 2: TLAC and G-SIBs' probability of failure

A large number of studies find evidence that perceived government guarantees for "too big to fail" institutions (which are typically assumed to include G-SIBs, but which are not necessarily limited to G-SIBs) significantly reduce these banks' debt funding costs. For a literature review that also discusses some of the methodological challenges when identifying such funding cost advantages see eg Siegert and Willison (2015).

Unfortunately, most of these papers do not explicitly quantify the implications of such funding cost advantages on firms' risk-taking incentives. However, notable exceptions include Afonso, Santos and Traina (2014) and Marques, Correa and Spriza (2013), which provide clear quantitative evidence on how implicit government guarantees affect banks' risk-taking incentives.

Moreover, we can use the estimates presented in Afonso et al to quantify the implications that a withdrawal of government support assumptions would have on banks' long-term probability of failure (which covers both actual defaults and bail-outs). Afonso et al find that on average, a one notch reduction in Fitch's "support rating floor" (SRF), a measure of government support assumption, is associated with an increase in the impaired loan ratio (one proxy for the riskiness of assets that banks choose to invest in) by 0.2. These results are primarily identified via marginal differences in SRFs. However, extrapolating the results suggests that for systemically important banks that currently enjoy an average SRF of BBB, a complete withdrawal of government support assumptions (which corresponds to an 11 notch change) would increase this measure of risk-taking by 2.2 (or 0.8 standard deviations).

In 2012, all of the G-SIBs in our sample had SRFs of at least BBB+, so the assumption of an average SRF of BBB is conservative. Moreover, in July 2015 only a few G-SIBS benefited from a non-zero SRF, which suggests that the assumption that SRFs will eventually be fully withdrawn is plausible. However, the exact timing of recent ratings actions underlines the fact that we are only assessing overall benefits of credible resolution regimes. We cannot fully identify whether these rating actions were taken because of new TLAC requirements or also because of the implementation of resolution frameworks more generally.

We can use estimates of the impact of such observable changes in banks' risk profile on the probability of failure to translate this into changes in the probability of failure. Evidence presented in Wheelock and Wilson (2000) and Cole and Wu (2009) suggests that the predicted change in risk profiles is associated with a reduction in the probability of failure of c. 20-40%.[27] The estimate of 40% may appear particularly relevant since it is based on a regression that includes the effect on the probability of bail-outs and not only defaults. However, we use the midpoint of this range to make a more conservative assumption.

As a robustness check, we can use estimates of the impact of Moody's "ratings uplift" (another measure of government support assumptions) on banks' z-Scores (a measure of risk-taking) presented by Marques et al (2013). Unless we assume normality of asset returns, it is not straightforward to translate changes in the z-Score

[27] The independent variable in these regressions is the ratio of non-performing (rather than impaired) loans. However, the two are closely related. Data for the largest 200 banks (from 2007 to 2014) suggests that a one percentage point reduction in non-performing loans reduces impaired loans by a very similar amount.

into changes in a bank's probability of failure. However, according to Marques et al a three notch reduction in "ratings uplift" (which in their sample would have typically eliminated a G-SIB's ratings uplift) would have had roughly the same effect on z-Scores as a one percentage point increase in RWA-based capital requirements. If one were to compare this result to the estimates from the LEI regarding the benefits of capital, we would again obtain a reduction in the probability of failure that is broadly in the region of 30-35%.[28] Moreover, results in Leaven & Levine (2009) confirm the relative importance of capital requirements and market discipline.[29]

[28] The LEI estimates are estimating the impact of capital requirements on the *probability of a crisis* rather than idiosyncratic failures. However, the results in Table 1 suggest that a requirement that applies to all banks in a system would have broadly the same impact on the probability of a crisis and any given bank's probability of failure. (Note: This statement is based on the results for the UK and France – two banking systems where the TLAC requirement covers almost all domestic banking assets.)

[29] While Laeven & Levine (2009) do not present evidence on the impact of market discipline the estimated effect of capital requirements is very similar to the one identified by Marques et al.

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