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Adding it all up: the macroeconomic impact of Basel III and outstanding reform issues[1]

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Abstract

As the Basel III package nears completion, the emphasis is shifting to monitoring its implementation and assessing the impact of the reforms. This paper presents a simple conceptual framework to assess the macroeconomic impact of the core Basel III reforms, including the leverage ratio surcharge that is being considered for global systemically important banks (G-SIBs). We use historical data for a large sample of major banks to generate a conservative approximation of the additional amount of capital that banks would need to raise to meet the new regulatory requirements, taking the potential impact of current efforts to enhance G-SIBs' total loss-absorbing capacity into account. To provide a high-level proxy for the effect of changes in capital allocation and bank business models on the estimated net benefits of regulatory reform, we simulate the effect of banks converging towards the "critical" average risk weights (or "density ratios") implied by the combined risk-weighted and leverage ratio-based capital requirements. While keeping in mind that quantifying the regulatory impact remains subject to caveats, the results suggest that Basel III can be expected to generate sizeable macroeconomic net benefits even after the implied changes to bank business models have been taken into account.

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Introduction

The Basel III framework is a central element of the post-crisis financial reform agenda. Developed by the Basel Committee on Banking Supervision (BCBS), the new framework seeks to address the weaknesses of the international banking system as exposed by the 2007–09 Great Financial Crisis. These include insufficient loss-absorbing bank capital, unsustainable leverage and credit growth, and inadequate liquidity buffers.

The cornerstone of the Basel III framework is enhanced risk-weighted capital requirements (RWR). Compared with pre-crisis regulations, the RWR have been substantially tightened for all three of their components: the RWR numerator (ie the definition and quality of bank capital), the denominator (ie the computation of risk-weighted assets (RWA)), and the required capital ratio itself. Banks now have to (i) comply with a minimum RWR of 4.5% Common Equity Tier 1 (CET1) capital to RWA; (ii) meet a 6% Tier 1 capital ratio (comprising a more broadly defined Tier 1 capital element as numerator); and (iii) maintain an additional capital conservation buffer of 2.5% (in terms of CET1 capital to RWA).[2]

Several components of the Basel III framework serve to further raise the effectiveness of the RWR. The leverage ratio (LR) requirement, in particular, is designed to restrict the build-up of leverage in the banking sector and to backstop the existing RWR with a simple, non-risk-based measure (BCBS (2014a)). The LR is defined as Tier 1 capital divided by an exposure measure, which consists of the sum of all on-balance sheet exposures, derivative positions, securities financing transactions and certain off-balance sheet items (see Annex). In January 2016, the Group of Central Bank Governors and Heads of Supervision, the BCBS's oversight body, confirmed that the LR would be set at a minimum level of 3%.[3] At the same time, the option of introducing additional LR requirements for global systemically important banks (G-SIBs) was discussed (BCBS (2016a)) and subsequently submitted to public consultation (BCBS (2016c)). Decisions on other main components of the Basel III reforms, such as the calibration of input and output floors,[4] are also pending, but are due to be finalised by end-2016.

This paper assesses the macroeconomic impact of the core Basel III reforms based on the conceptual framework of the BCBS's long-term economic impact (LEI) study (BCBS (2010)). While keeping in mind that quantifying the magnitude of any regulatory impact remains subject to caveats, we find that the Basel III enhancements yield sizeable net economic benefits, in a range of about 0.5% to 2.0% of GDP per year – depending on the extent to which the introduction of total loss-absorbing

2 Tier 1 capital consists of CET1 capital and Additional Tier 1 (AT1) instruments such as, for example, contingent convertible bonds. For further information on the Basel III capital requirements as well as on other parts of the enhanced framework, see BCBS (2011) and BIS (2013).

3 The BCBS and national authorities started testing the LR at an initial minimum level of 3% from 1 January 2013 (the so-called parallel run). Banks began publicly disclosing their consolidated LRs on 1 January 2015.

4 Input floors (such as, for example, a minimum probability of default) restrict the parameters banks use as inputs in their internal models to calculate risk weights and, hence, RWA. Output floors, by comparison, restrict the output of such models, by defining a minimum risk weight level (eg relative to the risk weights applying under standardised approaches).

capacity (TLAC) standards for G-SIBs is going to discipline banks' risk-taking and on how a potential G-SIB leverage ratio surcharge (henceforth "LRS") would be calibrated. We assess the robustness of these findings by also considering the impact of possible bank business model adjustments in response to leverage ratio regulation – in the form of simulated "RWA compression" and "risk-shifting" effects. Our simulation points to the possibility of sizeable increases in G-SIBs' RWA for high calibrations of the LRS. Yet, even at these conservative levels, the overall impact of balance sheet optimisation on net economic benefits is rather limited, within a range of about –0.02% to +0.11% of annual GDP across various scenarios.

The rest of this paper is organised as follows. The next section discusses the building blocks of the LEI framework, which guide our approach to estimating the costs and benefits associated with the Basel III reforms. This section also includes a discussion of possible options for calibrating a potential LRS for G-SIBs, one of the outstanding components of the overall regulatory post-crisis response. Based on this conceptual framework, we estimate the resulting macroeconomic impact of the regulatory reforms in the second section, using comprehensive data for a sample of large internationally active banks. To complement the assessment, in the third section, we consider the additional impact of the newly adopted TLAC standards for G-SIBs. In addition, we evaluate how some of the main assumptions underpinning our assessment strategy (ie static balance sheets and the absence of any Modigliani-Miller offset) may influence our results. The final section concludes.

1. A simple conceptual framework

A useful template for an analysis of the macroeconomic costs and benefits of the post-crisis regulatory response is the BCBS's 2010 long-term economic impact (LEI) study. The LEI report investigates the combined impact of the new Basel III liquidity requirements (ie the Liquidity Coverage Ratio and the Net Stable Funding Ratio) and the enhanced risk-weighted capital requirements (RWR), as described above.[5] The key finding of the LEI report is that even large increases in bank capital requirements from their pre-crisis levels are unlikely to result in macroeconomic costs that outweigh the associated benefits in terms of reduced crisis costs. In this section, we summarise the main building blocks of the LEI and explain how these can be adjusted to (i) incorporate the recent academic literature on the cost of banking crises and (ii) account for regulatory changes that have been implemented or finalised since the original LEI report.[6]

The LEI's main building blocks

The LEI methodology separates the assessment of the macroeconomic impact of regulation into two steps (Table 1). First, it assesses the expected benefits of higher capital requirements in the new (ie post-reform) steady state that arise from the reduction in the expected output losses from systemic banking crises ("benefit component"). Second, it compares these benefits with the expected costs of higher

5 For more details, see BCBS (2010).

6 On the costs and benefits of cost-benefit analysis for financial regulation, see Cochrane (2014).

capital requirements in terms of foregone output ("cost component"). In deriving these estimates, the LEI adopts an explicitly conservative approach: it makes assumptions that tend to raise cost estimates and downplay expected benefits, introducing a downward bias into the estimates of expected net benefits.

Conceptually, the LEI's benefit component is derived by multiplying the probability of systemic banking crises, given minimum capital requirements, with the expected macroeconomic costs of such crises should they occur. To derive the first of these elements (Table 1), the LEI uses a range of probit models as well as portfolio credit risk analyses that treat the banking system as a portfolio of banks. Averaging the results from these models, it then yields a functional expression of crisis probabilities and capitalisation levels ("crisis probability schedule") with diminishing marginal returns (ie the extra effect of additional capital declines as the capital level increases).

The main building blocks of the cost-benefit analysis — Table 1

(+) Benefit component	
Crisis probability schedule (from LEI)	
Crisis cost estimates	
	• Original estimate (from LEI)
	• Updated estimate (various sources/reflecting academic literature)
(–) Cost component	
Regulatory cost estimate (from LEI)	
(=) Net benefits	
Adjustment for new regulatory definitions	
Adjustment for the effects of TLAC	

Source: Authors' illustration, based on BCBS (2010).

GDP impact measures ("crisis cost estimates"), in turn, are derived from academic studies of historical crisis experiences. The LEI study found that the median cost of systemic banking crises in these studies is 63% of GDP in net present value terms. But the variation in these cost estimates is large and later studies have generated both higher and lower estimates (see Romer and Romer (2015) for an example at the lower end).[7]

A shortcoming of most of these studies of the cost of financial crises is that they rely solely on pre-2007 data, missing the impact of the most recent crisis episode. An exception is Haldane (2010), who places the present value of output losses from the recent crisis at somewhere between 90% and 350% of world GDP, depending on the strength of permanent effects. More recently, Ball (2014) broadly confirms these results, with estimates implying that the weighted average cumulative loss from the global financial crisis across all OECD countries amounts to about 180% of pre-crisis

[7] In line with the original LEI approach, the results from later studies are converted to cumulative losses assuming a 5% discount rate. For Romer and Romer (2015), information from their Figure 3 shows that output costs for a moderate crisis (7 on their scale) fluctuate between 3% and 4.2% for 4.5 years, when impulses cease to be significant. Assuming that crises on average last this time and have an average impact per year of 3.5% implies cumulative losses of 16%. A severe crisis (the two episodes coded as 14 in their work) implies about twice this amount in output losses.

GDP.[8] Ball also finds that the growth rate in potential output has declined by 0.7 percentage points per year since the crisis and that there has been little sign of a reversal.[9] To the extent that this decline in potential output is permanent, crisis costs would be significantly higher, strengthening the case for preventive action.

In the widely used data set by Laeven and Valencia (2012), around 25% of the crisis observations relate to the most recent episode. Hence, assuming cumulative output losses of the recent crisis at 200% (the average of the Haldane (2010) and Ball (2014) estimates) and losses from previous crises of 63% (in line with the original LEI) gives a back-of-the-envelope estimate of about 100% of GDP in net present value terms, based on the weighted average loss of output per crisis.[10] For comparison, Atkinson et al (2013) provide a conservative crisis cost estimate for the United States at 40–90% of GDP, while suggesting that crisis costs are likely to be greater than 100% if additional factors, such as increased government presence in the economy, are also considered. Estimates by the European Commission (2014) based on the contraction of EU GDP during the Great Financial Crisis imply costs of similar magnitude (98.59% of a weighted average of EU GDP). Cline (2016), in turn, documents crisis costs in a (wide) range of 10–450% of GDP, based on a variety of different assumptions and country cases, with a 100% loss used as one (out of three) baseline scenarios. In what follows, net present value estimates of both 63% (ie the original LEI estimate of the median cost of a systemic banking crisis) and 100% of GDP are used as alternative (moderate/updated crisis costs) benchmark values.

To derive the expected net benefits of an increase in capital requirements, the above benefits are compared with the estimated costs of regulation ("regulatory cost estimates"). The latter are derived from the assumption that banks counterbalance any decline in their return on equity by raising their lending spreads. As a result, real economy borrowing costs may rise, translating into lower investment and equilibrium output. More specifically, the LEI feeds the estimated increase in lending spreads into a variety of macroeconomic models (that is, the dynamic structural general equilibrium models, semi-structural and reduced form models in use at participating central banks) to assess the resulting impact on GDP.

New regulatory environment

A number of regulatory changes that have been implemented or finalised since the original LEI report need to be accounted for in order to map the key LEI estimates into the new regulatory framework. These changes include (i) the calculation of regulatory capital ratios, including both more restrictive capital definitions (ie CET1 and Tier 1 capital) and more stringent requirements regarding the calculation of RWA; (ii) the introduction of the LR, including a possible LRS; and (iii) higher loss

8 Ball (2014) finds that the recent crisis decreased potential output in OECD countries in 2015 on average by 8.4% relative to before the crisis. Using a discount rate of 5% (BCBS (2010)), this decline yields a cumulative output loss of about 180% in net present value terms.

9 On the long-term effects of boom-bust cycles on labour allocation and productivity growth, see Borio et al (2016).

10 This figure refers to the net present value of the cumulative loss in output, allowing for the possibility that banking crises have a permanent effect on the level of GDP (ie crises may induce a downward shift in the growth path). For more information on the methodology, see BCBS (2010), in particular Annex 1.

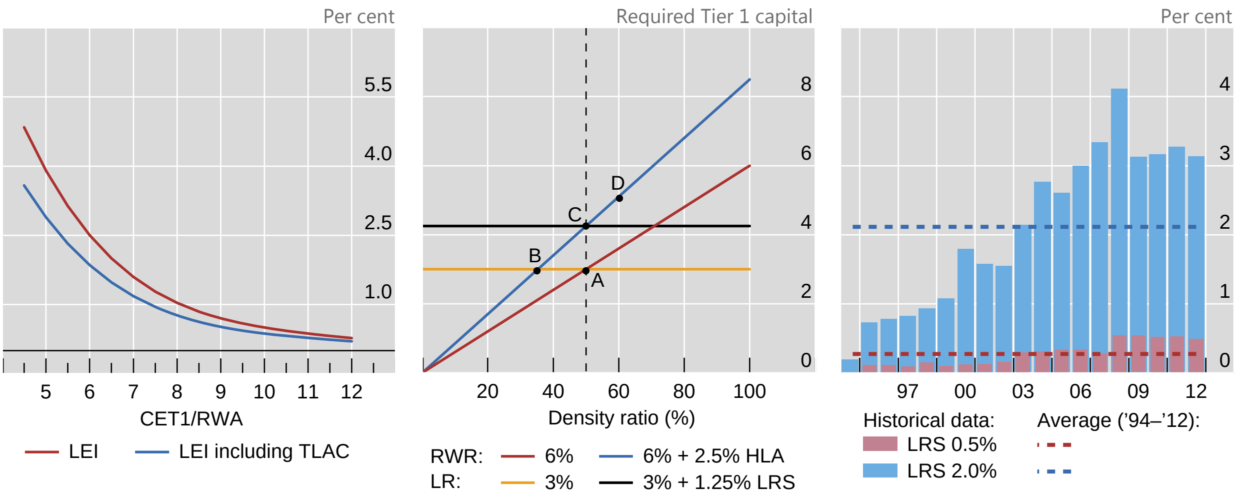
absorbency (HLA) requirements for G-SIBs in terms of a (CET1) capital surcharge. The impact of each of these changes is discussed below.

The original LEI estimates are based on a measure of tangible common equity (TCE) to RWA under the then prevailing definitions. To restate these estimates in terms of the new CET1/RWA metric, or alternatively in terms of Tier 1/RWA, we need to account for the impact of the more stringent definition of regulatory capital as well as the increase in RWA given the new regulatory framework. Based on publicly available data, we estimate that the conversion factor for the transition from Basel II to Basel III capital ratios is about 0.78, ie CET1/RWA (Basel III) ≈ 0.78 * TCE/RWA (LEI).[11]

Graph 1, left-hand panel (red line), illustrates the resulting crisis probability schedule from the LEI after adjustment for the new regulatory definitions. On this basis, the Basel III minimum RWR of 4.5% CET1/RWA is associated with a probability of a systemic banking crisis of about 4.8%, after taking the effects of the Net Stable Funding Ratio (NSFR) into account.[12] Adding the Basel IIII capital conservation buffer of 2.5% CET1/RWA reduces the probability to 1.6%.

Elements of the new regulatory environment — Graph 1

Banking crisis probability[1] — Setting a consistent leverage ratio[2] — Estimates of Tier1/RWA shortfalls[3]



[1] Probability of a systemic banking crisis for a given level of bank capital; based on the LEI estimates. Total loss-absorbing capacity (TLAC) requirements are assumed to reduce the probability by 26% based on the central estimate of BIS (2015). [2] Capital required to meet (i) the 6% (Tier 1/RWA) risk-weighted minimum capital requirement (RWR); (ii) the RWR and a 2.5% (CET1/RWA) higher loss absorbency (HLA) requirement; (iii) the 3% (Tier 1/EXP$_{LR}$) minimum leverage ratio (LR) requirement; and (iv) the LR and a LR surcharge (LRS) of 1.25% (Tier 1/EXP$_{LR}$), ie calibrated at 50% of the HLA requirement. [3] Unbalanced sample including 24 G-SIBs as per the 2015 list of G-SIBs (FSB (2015)).

Sources: Brei and Gambacorta (2014); BCBS (2010, 2014b); BIS (2015); Fender and Lewrick (2015); FSB (2015); Bankscope; authors' calculations.

[11] Calculations are based on BCBS (2010), Table A5.1 (average for US and euro area banks) and BCBS (2014b), Tables A12 and A13. The adjustment reflects an increase in RWA, given the more stringent rules for calculation, and a decline in capital, given the more restrictive eligibility criteria for regulatory capital.

[12] Brooke et al (2015) derive updated crisis probability schedules based on different methodologies that provide mid-values in a very similar range, confirming the original LEI estimates.

In terms of the cost of regulation, the transition of capital and RWA definitions suggests that a 1 percentage point increase in the CET1/RWA ratio translates into a 0.12% median decline in the level of output relative to its baseline (with the corresponding value for the liquidity requirements being a one-off 0.08% decline in the output level).[13]

To provide a comprehensive assessment of the Basel III impact, we also need to include in the LEI framework the minimum LR requirement and any potential LRS. This raises a number of challenges. For one, we need to derive possible calibration choices for any LRS, as discussed below. In addition, the LR has been designed as a backstop to the RWR, introducing a supplementary, but not additive, capital requirement for banks. Hence, assessing the impact of the LR requires an estimation of the additional amount of bank capital net of any capital raised by banks to meet the RWR. To do so, we follow the approach taken in Fender and Lewrick (2015b). As discussed in the next section, this approach is based on using historical bank data to conservatively approximate the amount of capital that banks would have needed to raise to meet the LR, assuming that such a requirement had been in place during the period of observation. We then compare these estimates with the available public data from the BCBS's Basel III monitoring exercise (BCBS (2016b)).

Calibrating a G-SIB leverage ratio surcharge (LRS)

One way to approach LRS calibration is to assume symmetry with the existing RWR. Under this approach, with the LR requirement now set at 3%, an additional LRS would be added for G-SIBs to align their total LR requirement with the risk-based higher loss absorbency (HLA) requirement established by the G-SIB framework (BCBS (2013a)). HLA requirements currently imply a CET1 surcharge of 1% to 2.5% of RWA, based on allocating G-SIBs into four different buckets (Table 2). A fifth, initially empty bucket, with a HLA requirement of 3.5% of RWA, has been established to provide disincentives for G-SIBs to become even more systemically important.

Symmetry between the possible LRS and the existing HLA requirements makes calibration rather straightforward. The LRS for G-SIBs would be calibrated such that the LR is as likely to bind for G-SIBs as for other banks, given the G-SIBs' higher RWR resulting from the HLA requirement (BCBS (2013b)). To clarify this point, it is useful to recall the relationship between the LR, RWR and the density ratio (DR). The DR is equal to the ratio of RWA and the LR's denominator, the so-called exposure measure (EXP_{LR}). The LR can thus be stated as:

$$LR = \frac{T_1}{EXP_{LR}} = \frac{T_1}{RWA} \times \frac{RWA}{EXP_{LR}} = \frac{T_1}{RWA} \times DR$$

For non-G-SIBs, the LR is calibrated at 3% and the minimum Tier 1 capital ratio (T_1/RWA) is set at 6% (or 8.5%, if the capital conservation buffer is included). This implies "threshold DRs" of 50% (= 3%/6%) or 35.3% (= 3%/8.5%), respectively, which define the DR level for which the capital requirements due to the LR and the RWR would be exactly equal. Graph 1 (centre panel) illustrates the relationship between these requirements. Assuming a constant exposure measure, an increase in RWA

[13] The original result of 0.09% is stated in terms of tangible common equity over Basel II RWA, which corresponds to about 0.12% in terms of CET1/RWA, given our estimated conversion factor of about 0.78.

raises the bank's DR and the amount of capital required to meet the RWR (red line). The LR, by contrast, remains constant (yellow line). For a "threshold DR" of 50%, the amount of capital due according to either requirement is exactly equal (point A). Adding an HLA requirement, in turn, increases the slope of the RWR schedule (blue line). This makes the LR relatively less constraining since only G-SIBs with a DR below the level indicated by point B (ie less than 50%) need to hold more capital to meet the LR than they need to meet the combined RWR and HLA requirements. Introducing a consistent ("symmetric") LRS (black line) raises the "threshold DR" back to 50% (point C).

Based on the equation above, a schedule for a consistent LRS can be derived by multiplying the HLA requirements with the threshold DR.[14] Table 2 depicts the resulting LR surcharges for the five buckets of the current G-SIB framework. Given an LR of 3% and a scaling factor of 50%, for example, the overall LR requirement for G-SIBs would be in a range of 3.5% to 4.8%, whereas a scaling factor of 35.3% would result in requirements ranging from 3.4% to 4.2%.

Calibrating G-SIB leverage ratio surcharges Table 2

G-SIB bucket	1	2	3	4	5
HLA requirement (CET1/RWA)[1]	1.0	1.5	2.0	2.5	3.5
LR surcharge (T1/RWA; 50.0%)[1]	0.5	0.8	1.0	1.3	1.8
LR surcharge (T1/RWA; 35.3%)[1]	0.4	0.5	0.7	0.9	1.2
Number of G-SIBs (Nov 2015)	19	5	4	2	0

[1] In per cent.

Sources: BCBS (2013a); FSB (2015); authors' calculations

Ensuring consistency with the RWR for G-SIBs is one aspect of calibrating an LRS, but other considerations could also be taken into account.[15] A flat LRS, for example, would provide for a somewhat simpler framework. On this basis, several calibration choices can be considered. One option would be to choose a simple average of the LR surcharges presented in Table 2. This would yield an LRS of around 1.0%, if a scaling factor of 50% is used. Alternatively, a surcharge could be calibrated at the upper end of the schedule presented in Table 2 in order to provide a more constraining requirement and to incentivise a reduction in G-SIB leverage. One such choice would be a 2.0% surcharge, ie calibrated slightly above the currently empty bucket #5 and using a 50% scaling factor.

14 A similar approach has been proposed by the Bank of England's Financial Policy Committee for the calibration of the "additional leverage ratio buffer" for banks that are systemically important for the UK economy (Bank of England (2016)).

15 "Consistency" refers to G-SIBs' combined leverage ratio requirements (ie LR and LRS) on the one hand, and their minimum RWR ("Pillar 1") and HLA requirements on the other hand. Additional RWR, such as those imposed by supervisors to address bank-specific risks ("Pillar 2"), would argue in favour of setting a higher LR and/or LRS to ensure consistency.

2. Macroeconomic impact assessment

Based on the conceptual framework discussed above, this section provides quantitative estimates of the costs and benefits associated with the Basel III regulatory reforms. In the first part of this section, we briefly discuss the historical bank data set used in our analysis and how it helps us to derive estimates of the additional capital that banks would have needed to raise, given the introduction of the LR and an additional LRS. We use these estimates as broad proxies of how these requirements effectively raise the minimum RWR, which allows us to calculate the expected costs and benefits of the Basel III reforms.

Deriving estimates of additional capital needs

The impact of introducing new regulatory requirements is ideally assessed by taking a forward-looking perspective on how banks are expected to adjust and what these adjustments may imply for the level of bank capital. Absent the necessary data to perform such an exercise, this paper uses a backward-looking approach to gauge the amount of capital that banks would have had to raise, given the introduction of the LR and an additional LRS. The implications of this approach are discussed in greater detail in the next section.

We draw on data compiled by Brei and Gambacorta (2014), who combine historical information from the Bankscope vendor database with aggregate data based on one of the BCBS's Quantitative Impact Studies (QIS). This data set provides historical time series on RWA and – in contrast to most other data sets – on the LR exposure measure for a sample of more than 100 banks from 14 advanced economies, covering mainly the period from 1994 to 2012.[16]

Based on these data, we estimate the implied (historical) capital shortfall associated with a 3% minimum LR requirement (see also Fender and Lewrick (2015b)). This is measured as the average supplementary Tier 1 capital (in proportion to RWA) that would have been required to meet the LR requirement, net of any shortfall arising from the minimum 8.5% Tier 1 capital requirement. Overall, the average shortfall over the sample period is relatively limited, amounting to about 0.7% of RWA.

Next, we estimate the capital shortfall implied by a LR surcharge for G-SIBs. Since the calibration of such a surcharge has yet to be decided, we focus on the impact of a flat 0.5% and 2% surcharge, respectively, for all G-SIBs in our sample (based on the November 2015 G-SIB list, see FSB (2015)). This choice keeps the exposition simple and does not require any assumptions about the relative ranking of G-SIB "candidate" banks (ie their allocation to individual buckets) for the different years during the period of observation.[17] In addition, these choices can be broadly interpreted as a

[16] Bankscope data do not have the granularity that would be required to construct LR exposure measures directly – especially in the context of the treatment of reverse repos and cash collateral, derivatives exposures, securities financing transactions and certain off-balance sheet items. To overcome this limitation, QIS data are employed to generate a set of country-level scaling factors that are used to adjust the Bankscope data and derive exposure measure estimates. For more detail on the data set, see Brei and Gambacorta (2014), especially Appendix A.

[17] Given a lack of granular data for the period of observation, it is not possible to (i) identify banks that would have been deemed globally systemically important at the time and (ii) assign G-SIBs to

lower and upper bound calibration, respectively, for the set of calibration options shown in Table 2 above.

Using the historical bank data set, a flat G-SIB surcharge of 0.5% or 2.0% would have required G-SIBs to raise capital ratios, on average, by 0.3% and 2.1% of RWA, respectively (Graph 1, right-hand panel). These hypothetical figures are net of HLA requirements, which, for simplicity, we assume to be 1% CET1/RWA for all G-SIBs in the sample.

Comparing the cost and benefits of the Basel III requirements

The above estimates can be combined to gauge the overall expected macroeconomic cost and benefits of introducing the Basel III reforms. Making the conservative assumption that additional capital needs would be met by CET1 (rather than by typically less costly Additional Tier 1 capital), the combined Basel III requirements would raise the CET1/RWA ratio for the entire banking system by approximately 2.7 to 3.4 percentage points (Table 3, line 1).

Cost-benefit analysis suggests significant room for calibrating the G-SIB leverage ratio surcharge

In per cent — Table 3

	Risk-weighted capital (RWR)	RWR & 3% LR	RWR, LR & 1% HLA	Total, including 0.5% LRS	Total, including 2% LRS
1 Increase in CET1/RWA based on historical data[1]	1.5	2.2	2.6	2.7	3.4
2 Expected marginal benefits					
2.1 Decrease in probability of systemic crises[2]	1.54	1.96	2.15	2.19	2.41
2.2 Expected marginal benefits (LEI cost of crises=63%)[3, 4]	0.97	1.24	1.35	1.38	1.52
2.3 Expected marginal benefits (updated cost of crises=100%)[3, 4]	1.54	1.96	2.15	2.19	2.41
3 Expected marginal costs[4, 5]	0.18	0.26	0.31	0.32	0.41
4 Expected *net* marginal benefits[4, 6]					
4.1 Assuming cost of crises = 63%	0.79	0.97	1.04	1.05	1.11
4.2 Assuming cost of crises = 100%	1.36	1.70	1.83	1.86	2.00

[1] Estimated increase in the banking system's capital ratio (CET1/RWA). The calculation is based on the assumption that any capital shortfall would be met with CET1 (ie not with typically less expensive Additional Tier 1 capital). Based on historical data from 111 major banks, including 24 G-SIBs (1994–2012); see Brei and Gambacorta (2014). [2] Percentage change in the probability of systemic crises given increased capital levels (line 1) from a starting level of 5.5% (CET1/RWA); extrapolated from the original LEI schedule. [3] The expected marginal benefits are given by multiplying the decrease in the probability of systemic crises (line 2.1) by the cost of crises. [4] In per cent of the level of output per year. [5] The expected costs equal the increase in bank capital (line 1) times a drop in output of 0.12% per 1 percentage point increase in CET1/RWA ratios, based on the estimates from the LEI report. [6] The expected net marginal benefits are equal to the difference between expected marginal benefits (lines 2.2, 2.3) and expected marginal costs (line 3).

Sources: BCBS (2010); Brei and Gambacorta (2014); Fender and Lewrick (2015b); Bankscope; authors' calculations.

This comprises: (i) a 1.5 percentage point (ppt) increase due to higher minimum RWR, raising the CET1/RWA ratio from an initial 5.5% (as per the LEI estimate) to 7% (ie the 4.5% minimum and the 2.5% capital conservation buffer); (ii) 0.7 ppt due to

individual buckets in order to calculate their HLA requirements. Banks are thus identified as G-SIBs based on the 2015 G-SIB list (FSB (2015)).

the 3% minimum LR requirements; (iii) 0.4 ppt assuming a (flat) 1% HLA requirement for all G-SIBs; and (iv) 0.1 to 0.8 ppt given the assumption of a 0.5% and 2% LR surcharge for G-SIBs, respectively. To calibrate the impact on bank capital levels of the requirements that only apply to G-SIBs, we assume that these banks account for 40% of the banking system's RWA, broadly reflecting the G-SIB's weighted average lending market share across jurisdictions (BIS (2015)).[18]

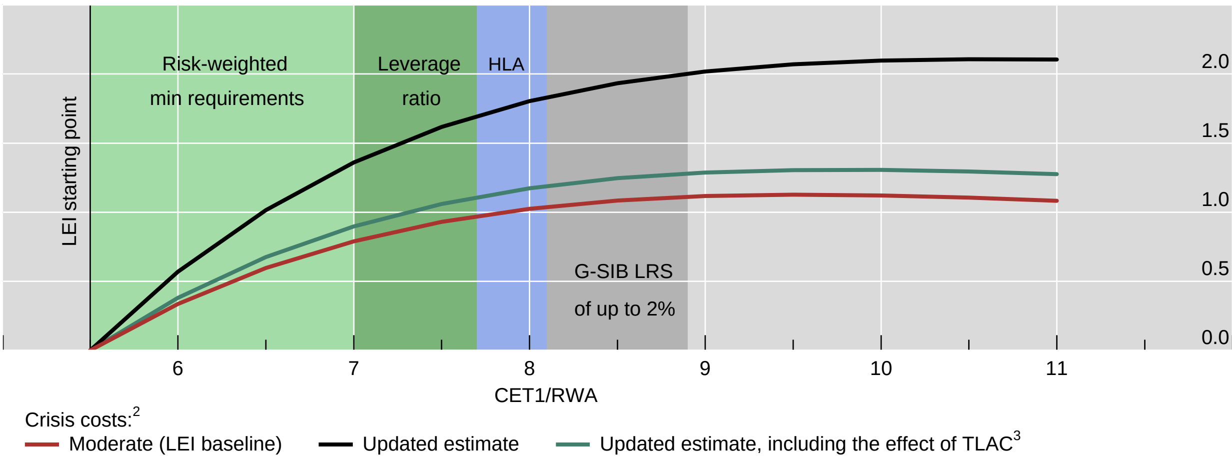
The next element is the reduction in the crisis probability due to higher levels of capital. The associated estimates are based on the LEI schedule, which provides a mapping of capital levels onto crisis probabilities (recall Graph 1, left-hand panel). Starting from a capital ratio of 5.5% CET1/RWA, the LEI schedule estimates a 4.8% probability of a systemic banking crisis (incl NSFR). The amount of reduction in percentage points, given the expected increase in capital, follows from Table 3, line 2.1.

To evaluate the expected marginal benefits (Table 3, lines 2.2 and 2.3), the reduction in the crisis probability that results from raising capital is multiplied by the cost of crises, using the 63% and 100% estimates, respectively (see the discussion in the first section).

Strengthening bank capital levels yields sizeable net economic benefits

Per cent of annual GDP — Graph 2

Expected net marginal benefits[1]



[1] The light green shaded area indicates the increase in the banking system's capital ratio (CET1/RWA) and the associated net marginal benefits due to raising the risk-weighted minimum capital requirements (RWR). The dark green shaded area indicates the additional expected impact due to the introduction of a 3% minimum leverage ratio (LR) requirement. The blue shaded area shows the supplementary increase in the capital ratio for a 1% higher loss absorbency (HLA) requirement for G-SIBs, whereas the grey shaded area indicates the expected additional increase for a G-SIB LR surcharge (LRS) of up to 2% for all G-SIBs, respectively. [2] The LEI baseline estimate assumes a cost of systemic banking crises equal to 63% of GDP; the updated estimates assume a cost of 100% of GDP, with the one accounting for the introduction of TLAC assuming a cost of 94.6% of GDP due to the benefits from avoiding public sector bailouts worth about 5.4 percentage points of annual GDP (BIS (2015). [3] Net benefit estimates also include the impact of a 26% reduction in crises probabilities based on the central estimate of BIS (2015).

Sources: BCBS (2010); BIS (2015); Brei and Gambacorta (2014); FSB (2015); Bankscope; authors' calculations.

[18] This estimate is consistent with earlier analysis, suggesting a G-SIB GDP-weighted average market share of 40% for non-financial private lending and 52% for total banking system assets (BIS (2010)).

The final element of the analysis is an estimate of output costs from higher capital requirements due to any implied changes in lending spreads (Table 3, line 3). Specifically, the LEI report suggests a 0.12% loss in the level of output per percentage point increase in the required CET1/RWA ratio.

In terms of calculations, the expected marginal costs result from combining the estimated increase in capital with the estimated output loss. This yields two sets of net benefit schedules based on alternative crisis cost estimates (Table 3, lines 4.1 and 4.2 and Graph 2; red and black lines).

Overall, despite rising amounts of required additional capital, estimated net marginal benefits remain positive and increasing for the full range of alternative crisis cost assumptions and LRS calibrations. Graph 2 illustrates these results, suggesting considerable room for calibrating an LRS towards the upper range of the benchmarks considered above. On this basis, the net economic benefits (measured by the impact on the level of GDP per year) of higher capital requirements would be exhausted only after a very substantial increase from the baseline level of 5.5% of the CET1/RWA ratio – even if one uses the lower pre-crisis estimate of the cost of a financial crisis.

3. Discussion

The impact of the new TLAC standards on the benefits of capital regulation

The regulatory post-crisis response spans a broad set of measures that go beyond bank capital and liquidity regulation. One such measure is the introduction of TLAC standards for G-SIBs, which complement the core Basel III reforms by supporting authorities in implementing an orderly resolution of a failing G-SIB. The standards' main element is that a G-SIB's TLAC (ie its stock of eligible liabilities that are available for loss absorption in resolution) needs to amount to at least 18% of the resolution group's RWA as well as to at least 6.75% of the group's LR exposure measure (EXP_{LR}) as from 1 January 2022, following a phase-in period starting in 2019.

The TLAC standards are expected to reduce the likelihood and the cost of systemic banking crises. In doing so, the standards affect the cost-benefit analysis presented above, despite the different focus of the two sets of measures.[19] By design, the more effective the TLAC standards are in reducing crisis costs and probabilities, the lower are the marginal benefits of the Basel III capital and liquidity reforms. Yet, given that this reduction is fully offset by the net benefits that arise from the TLAC standards, it should not be confused with the overall increase in economic benefits that is realised due to the combined effect of both sets of reforms.

In the following, we focus on the central estimates of the TLAC impact assessment (BIS (2015)) and consider how they change the net benefits calculation of the Basel III reforms. These estimates include (i) a decline in the cost of crisis from avoiding public sector bailouts equivalent to about 5.4 ppt of annual GDP, reducing

[19] In broad terms, TLAC can be classified as a "gone concern" tool, aimed at mitigating the cost of bank failures. By comparison, bank capital (particularly CET1 and Tier 1 requirements) and liquidity requirements are predominantly "going concern" tools that seek to reduce the bank's probability of default.

our cost estimates to 57.6% and 94.6% of GDP, respectively; and (ii) a decline in the crisis probability of 19% to 34%, depending on the assumed strength of the disciplining effect of bail-in, for an average G-SIB market share. This decline reflects the impact of improving market discipline on G-SIBs exerted by investors in TLAC-eligible securities.

Table 4 depicts the net marginal benefits associated with the Basel III reforms after taking account of the TLAC standards' impact on the cost and likelihood of a systemic banking crisis. The main message from Table 4 is that, even for a strong disciplining effect on G-SIB's risk-taking (which reduces the benefits of raising capital requirements most strongly) and moderate crisis costs, net marginal benefits are positive and increase for higher calibrations of the LRS. Graph 2 visualises the impact of TLAC on net marginal benefits, suggesting additional room to further raise capital requirements before these benefits start declining. Intuitively, to the extent that TLAC reduces both the cost of a crisis and its likelihood (see also Graph 1, left-hand panel), it will lower the marginal benefit of increases in minimum capital requirements (as well as of any other measures designed to cut crisis costs) – as illustrated by the downward shift in the updated net benefits schedule (green line). Clearly, higher crisis cost estimates, as suggested by a number of studies (eg Boyd et al (2005), Atkinson (2013), Ball (2014)), or lower estimates of the cost of regulation (such as from any Modigliani-Miller "offset"; see below) would shift the results in favour of even higher capital levels.

How total loss-absorbing capital (TLAC) standards affect the impact of Basel III

Expected net marginal benefits, in per cent of annual GDP — Table 4

	Strength of estimated disciplining effect of bail-in[1]		
	Weak effect	Central estimate	Strong effect
1 Basel III, with *no* G-SIB LRS[2]			
1.1 Assuming cost of crises = 57.6%[3]	0.69	0.60	0.50
1.2 Assuming cost of crises = 94.6%[4]	1.33	1.19	1.03
2 Basel III, with *0.5%* G-SIB LRS[2]			
2.1 Assuming cost of crises = 57.6%[3]	0.70	0.61	0.51
2.2 Assuming cost of crises = 94.6%[4]	1.35	1.21	1.04
3 Basel III, with *2.0%* G-SIB LRS[2]			
3.1 Assuming cost of crises = 57.6%[3]	0.72	0.62	0.51
3.2 Assuming cost of crises = 94.6%[4]	1.44	1.28	1.10
Memo item: Net benefits of TLAC[5]			
Assuming cost of crises = 57.6%[3]	*0.37*	*0.48*	*0.58*
Assuming cost of crises = 94.6%[4]	*0.53*	*0.71*	*0.87*

[1] The calculation is based on the estimated reduction in the crisis probability due to the introduction of bail-in requirements/TLAC (BIS (2015)) for an average G-SIB market share. The crisis probability, as estimated by the LEI, is reduced by 19% (weak effect), 26% (central estimate) and 34% (strong effect), respectively. [2] Includes RWR, LR, HLA and G-SIB LR surcharge (LRS). [3] Moderate cost of crisis (63% of GDP) as per the LEI estimate, net of TLAC crisis cost reduction (5.4 ppt of GDP). [4] Updated cost of crisis (100% of GDP), net of TLAC crisis cost reduction (5.4 ppt of GDP). [5] Baseline estimates; see Table 6, BIS (2015).

Sources: BCBS (2010); BIS (2015); Brei and Gambacorta (2014); Fender and Lewrick (2015b); Bankscope; authors' calculations.

Conservative bias

In this section, we discuss two key assumptions of our analytical framework and how they affect our measures of the macroeconomic benefits that arise from the Basel III reforms: (i) the backward-looking, "static" balance sheet approach used to approximate the additional amount of capital that banks would need to raise to meet the LR and LRS; and (ii) the estimated funding cost of higher capital requirements given by the LEI. We argue that both assumptions tend to bias the results in the direction of lower estimated net benefits, providing some additional leeway in calibrating any outstanding requirements, such as the LRS, towards the upper end of the benchmarks discussed in this paper.

Balance sheet optimisation

One key source of conservatism is that our historical sample data overstate the true capital shortfall from new capital requirements, because they cannot account for any adjustment in balance sheets that would have resulted from imposing an LR requirement or LRS at the time. For comparison, mid-2015 Basel III monitoring data (BCBS (2016b)) suggest that only about one third of the banks covered by the BCBS are constrained by the LR, ie that these banks require more capital to meet the 3% minimum LR requirement than they need to meet the RWR. Overall, starting from a CET1/RWA ratio of 7%, BCBS (2016b) suggests that banks need to raise only another €24.8 billion of additional capital to achieve their "target" levels (ie ignoring any transitional arrangements and including the 2.5% capital conservation buffer and capital surcharges for G-SIBs, as applicable). Adding the leverage ratio would bring the combined shortfall to €29.2 billion, according to BCBS data – the equivalent of 0.09 percentage points of total RWA; a relatively small amount.[20]

Clearly, banks optimise their balance sheets to reduce their capital costs in response to new regulatory constraints (eg by adjusting the way capital is allocated across different business units). In the example given in Graph 1 (centre panel), a G-SIB positioned at point B may respond to the introduction of an additional LR surcharge (black horizontal line) by raising its DR, moving in the direction of point C. This "risk-shifting" would allow the bank to take on more risk without raising its regulatory capital requirements. By the same logic, a G-SIB with a DR above the threshold level (eg one positioned at point D) has an incentive to reduce its DR ("RWA compression"), suggesting that the LR requirement provides an incentive for banks to converge to similar DR levels. We find some support for this convergence in the historical bank data set, by exploiting the fact that Canadian and US commercial banks were subject to national LR requirements during the period of observation.[21] As shown in the upper part of Table 5, which excludes the crisis period, the standard

[20] As of mid-2015, only seven of the roughly 200 banks monitored by the BCBS would not have met a fully phased-in minimum Basel III LR of 3%. These banks reported an aggregate shortfall of about €4.4 billion, which was less than 1.5 basis points of total RWA of the banks monitored by the BCBS and significantly less than the 0.7 percentage points implied by the historical bank data.

[21] In the United States, a leverage ratio requirement was first introduced in 1981, following a number of bank failures and concerns over falling capitalisation levels. Canada, in turn, followed the US example in 1982, with the requirement being tightened in 1991 See D'Hulster (2009) and Wall (1989).

deviation of DRs of Canadian and, to a lesser extent, US commercial banks is lower than for banks in other regions.[22,23]

Banks adjust their balance sheets to the regulatory environment — Table 5

By economy:[1]	Number of banks	Standard deviation	Density ratio (1999–2008)[2] Median	25th percentile	75th percentile
Canada	5	0.04	41%	38%	45%
United States[3]	11	0.12	63%	56%	68%
Europe (excl euro area)	9	0.16	44%	38%	52%
Euro area	26	0.17	56%	45%	64%
By bank type:			Density ratio (2008–2012)[2]		
G-SIB	22	0.13	33%	25%	43%
Other	63	0.15	46%	35%	61%
By credit risk model:[4]					
IRB approach[5]	43	0.13	37%	28%	46%
Standardised approach	31	0.15	60%	48%	67%

[1] Based on a balanced sample of banks. Europe (excluding euro area) comprises Sweden, Switzerland and the United Kingdom; the euro area comprises Austria, Belgium, France, Germany, Italy, Netherlands and Spain. [2] Average of yearly observations. [3] Excludes large US investment banks that were not subject to the LR requirement. [4] Unbalanced sample; average number of banks shown in the first column, rounded to nearest whole number. [5] Banks applying the foundation internal ratings based (IRB) approach, the advanced IRB approach or mix of both approaches; based on information available from SNL.

Sources: Brei and Gambacorta (2014); Bankscope; SNL; authors' calculations.

RWA compression, however, is a broader phenomenon, especially for G-SIBs. Following the Great Financial Crisis, G-SIB DRs have trended downward and have declined to levels often clearly below those of other banks (Table 5, lower part). Differences in business models and how these have changed over time are one factor behind this development. Yet, the introduction of the internal ratings-based (IRB) approach for credit risk, a key element of the Basel II reforms (BCBS (2006)), is also likely to have contributed to this decline (Behn et al (2016)). DRs of banks that make use of the IRB approach report significantly lower DRs than those using the standardised approach, which offers banks less leeway in calculating RWA. Importantly, the observed difference in DRs remains sizeable and statistically significant even after controlling for differences in metrics proxying banks' business models (Table 6). Matching the bank data set with supplementary information from SNL on banks' asset composition and their chosen credit risk calculation methodology, our estimates indicate that the use of IRB models is associated with a

22 Standard groupwise heteroscedasticity tests (which exploit the fact that sample observations may be defined in terms of group membership, with observed data variance differing across groups) suggest that the variance of the Canadian banks' DRs and the US commercial banks' DRs, respectively, is statistically different from those of other regions.

23 Several factors may contribute to the relatively large standard deviation of US banks' DRs found in the data set. For one, the original LR requirement in the United States was based on a more narrowly defined denominator (ie exposure measure) than the one underpinning the calculations in Table 5. In addition, banks were subject to different LR requirements depending on how highly they were rated under the supervisory rating system (D'Hulster (2009)), which implies different threshold DRs and may thus be blurring the results.

reduction in a bank's total RWA (relative to exposures) of about 9%, and more than 11% if only considering European banks.

Determinants of banks' density ratios (2006–15) Table 6

Dependent variable: density ratio (in logs)	(1)	(2)	(3)	(4)	(5)	(6)
Use of internal ratings-based (IRB) approach[1]		–0.089*	–0.089**	–0.096**	–0.107**	–0.115***
		(0.045)	(0.043)	(0.042)	(0.043)	(0.042)
Total assets (in logs)	–0.085	–0.169**	–0.174**	–0.149**	–0.149**	–0.229***
	(0.064)	(0.068)	(0.068)	(0.071)	(0.070)	(0.076)
Customer loans[2]	0.455***	0.402***	0.408***	0.348***	0.393***	0.371**
	(0.086)	(0.135)	(0.131)	(0.109)	(0.115)	(0.146)
Bank loans and deposits with banks[2]	0.045**	0.049	0.053*	0.014	0.018	0.070
	(0.021)	(0.030)	(0.029)	(0.015)	(0.014)	(0.047)
Held-to-maturity (HTM) securities[2]	0.014***	0.017**	0.017**	0.014**	0.012**	0.014**
	(0.005)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
Available-for-sale (AFS) securities[2]	–0.019	–0.009	–0.008	–0.020		–0.002
	(0.016)	(0.021)	(0.021)	(0.015)		(0.022)
Trading securities[2]	0.007	0.039	0.040			0.003
	(0.036)	(0.030)	(0.031)			(0.030)
Other financial assets[2]	–0.016	–0.017				0.000
	(0.034)	(0.033)				(0.033)
Region	All	All	All	All	All	Europe
Number of banks	70	68	68	72	73	52
Observations	420	337	337	354	358	300
R-squared	0.269	0.284	0.282	0.255	0.249	0.316

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors, clustered by bank, in parenthesis. All regressions include a constant term as well as bank and year fixed effects. [1] Dummy variable, with value equal to one if the bank's credit risk calculation is based on the foundation IRB approach, the advanced IRB approach or a mix of approaches; based on SNL. [2] As a share of total financial assets; in logs.

Sources: Brei and Gambacorta (2014); Bankscope; SNL; authors' calculations.

One interpretation of the above results is that the introduction of the LR and a corresponding LRS could induce balance sheet optimisation, with banks aiming to move closer to the (regulatory) threshold DR. To quantify the potential magnitude of such optimisation incentives and their overall impact, we simulate the effect on banks' RWA and the associated change in CET1/RWA ratios, as follows: (i) all banks converge to the threshold DR implied by their RWR and the combined LR and LRS by raising/reducing their RWA (*benchmark case*; assuming a "full" adjustment); (ii) banks close only 50% of the gap between their DR and the threshold level by adjusting their RWA ("partial" adjustment). In both scenarios, the banks' LR exposure measure is kept unchanged. In addition to the case of having no LRS (our baseline), we consider the introduction of a (flat) 0.5% and 2% LRS for G-SIBs to provide a lower and upper bound estimate of the impact, respectively, for both scenarios.

Table 7 summarises the implied long-term change in RWA based on the average of yearly observations from 1994 to 2012 for the above scenarios. It also shows the expected net marginal benefits and compares them to those presented in Table 4, based on the central TLAC estimates (Table 4, column 2). While our findings imply sizeable potential increases in G-SIBs' total RWA as a result of increasing DRs, these will tend to be offset (and, in some cases, overcompensated) by the effects of RWA compression in other parts of the banking system (Table 7; column "other banks"). Overall, the impact on the net marginal benefits to be expected from the Basel III reform package remains limited. Notably, net marginal benefits remain basically unchanged for different calibration choices of the LRS (Table 7). This suggests that calibration towards the upper end of the range – ie aiming for a more effective backstop to the RWR – would not compromise the long-term net economic gains of the Basel III package.

Simulating banks' risk-shifting/RWA compression — Table 7

	Estimated change in RWA[1]		Expected net marginal benefits given cost of crisis of:[2]	
Full adjustment, given LRS of:[3]	G-SIBs	Other banks	57.6% of GDP	94.6% of GDP
0%	–21%	–19%	0.58 (–0.02)	1.30 (+0.11)
0.5%	–8%	–19%	0.60 (+0.00)	1.31 (+0.10)
2.0%	+31%	–19%	0.62 (+0.00)	1.27 (–0.01)
Partial adjustment, given LRS of:[4]				
0%	–11%	–10%	0.62 (+0.02)	1.29 (+0.10)
0.5%	–4%	–10%	0.62 (+0.01)	1.28 (+0.07)
2.0%	+16%	–10%	0.62 (+0.00)	1.28 (+0.00)

[1] Average of yearly observations from 1994 to 2012; unbalanced sample of banks. [2] Expected net marginal benefits (in percent of annual GDP). In parenthesis, difference in net marginal benefits (in percentage points) if compared to the corresponding net marginal benefits that take the effect of TLAC into account (Table 3, central estimate); assumes that G-SIBs account for 40% of the banking system's RWA. [3] Assumes all banks adjust RWA to reach the threshold DR, which is equal to the ratio of the banks' combined LR requirement (ie 3% plus LRS for G-SIBs) divided by the sum of the Tier 1 RWR (ie 8.5% plus an HLA requirement set to 1% for all G-SIBs). [4] Assumes that banks only close 50% of the gap between their DR and the threshold DR by adjusting their RWA.

Sources: Gambacorta and Brei (2014); FSB (2015); Bankscope; authors' calculations.

How likely are risk-shifting and RWA compression in practice? The Basel III framework defines, among other things, minimum requirements for bank capitalisation as well as short-term (Liquidity Coverage Ratio) and medium-term funding (NSFR). Banks, as a result, will optimise their business model subject to a variety of regulatory constraints. Targeting the same DR is thus unlikely to be optimal for banks with different business models, suggesting that a significant across-the-board increase or decrease in DRs is also rather unlikely. Indeed, evidence from Canada suggests that other elements of the supervisory framework can effectively mitigate the risk-shifting incentives generated by leverage ratio requirements (Crawford et al (2009)). In future, the TLAC standards, for example, can be expected to enhance market discipline effects for G-SIBs, restricting excessive risk-taking activity. In addition, current regulatory considerations to further constrain the calculation of RWA within the IRB approach (such as risk-weight capital floors (BCBS 2014c)) would tend to raise measured RWA and, in turn, IRB banks' DRs for given levels of risk. At the same time, supplementary RWR to address bank-specific risks (so-called "Pillar 2" requirements) reduce banks' threshold DRs for any given leverage restriction (see the equation above). All these factors help to limit any risk-shifting incentives implied by the LR or LRS.

Bank funding costs

Another key source of conservatism is that the LEI's cost estimates are (intentionally) biased upwards, because they do not take into account that higher capital ratios will – over time – tend to reduce banks' funding costs. By design, therefore, these results are likely to overstate the true costs in terms of reduced lending and forgone output, given the underlying assumption that the Modigliani-Miller theorem[24] is violated even in the long run and that the cost of issuing equity does not change with capital levels. In practice, banks' required return on equity can be expected to decline as their balance sheet leverage and the riskiness of their equity fall (Kashyap et al (2010)).

Indeed, more recent studies confirm the conservative nature of the LEI estimates, which – if anything – look more conservative now than they did back in 2010 (Table 8).[25] With one exception, all of the analyses reviewed in Table 8 point to a decline in economic growth that is lower, often substantially so, than the one resulting from the LEI approach.[26] For example, Miles et al (2013), who seek to take into account the effects of reduced funding costs given enhanced capitalisation (Modigliani-Miller "offset"), find that a 1 percentage point increase in capital ratios reduces long-run GDP by less than 0.05%. Brooke et al (2015), focusing on the United Kingdom, find an effect of 0.01% to 0.05%.

Furthermore, the impact on lending and GDP need not be negative. Both theoretical and empirical considerations suggest that better capitalised banks tend to generate net benefits from a macroeconomic perspective. Given the existence of various externalities, banks have a tendency to pick capitalisation levels that are sub-optimal from a social (as opposed to private) perspective (Kashyap et al (2008)). This is consistent, for example, with the empirical analysis of German bank data by Buch and Prieto (2014), who find a positive long-term relationship between bank capital and loan volume, suggesting that higher capitalisation levels tend to have no negative effect on spreads and output in the long run. Similar effects are found in Gambacorta and Shin (2016), based on a broad set of internationally active banks.[27]

[24] The Modigliani-Miller theorem states that, under certain assumptions (such as the absence of taxes, bankruptcy costs, agency costs and asymmetric information), the value of a firm is unaffected by how that firm is financed (see Modigliani and Miller (1958)).

[25] On this issue, see Cecchetti (2014) and BIS (2016).

[26] Studies finding stronger effects than those estimated by the LEI typically focus on shorter-term, transitional adjustments and not those associated with the new steady state. Yet, even those stronger transitional effects are generally found to be limited from a macroeconomic perspective. See, for example, Mesonnier and Monks (2015) and Fraisse et al (2015) as well as BIS (2010) and Angelini et al (2011).

[27] A separate class of studies, building on Van den Heuvel (2008), estimates "optimal" capitalisation levels. While different in terms of specific modelling choices, these studies tend to generate inverted U-shape relationships between welfare/bank lending and capital requirements. Tighter requirements reduce the banking system's riskiness, but also bank lending and, hence, GDP. Yet, results for the optimal level of capital differ widely, with estimates ranging between 3% (De Nicolo et al (2014)) and 14% (Martinez-Miera and Suarez (2014) and Begenau (2015)), and interpretation is complicated by different capital ratio definitions. De Nicolo et al (2014), for example, effectively impose a risk weight of 100% for risky assets. Applying a density ratio (ie average risk weight) of 35%, this would translate into a capital requirement of about 8.6% – almost exactly the Tier 1 capital benchmark used in the analysis above.

Finally, given its cyclical features, the minimum LR requirement will tend to bind when profits are ample and raising equity is comparatively cheap. This should further reduce any costs, once the requirement has been fully phased in.

The impact of a 1 percentage point increase in capital ratios: selected estimates[1]

In basis points — Table 8

	Increase in lending spreads	Change in lending volume	Decline in GDP growth, annual rate
BIS (2010)	15 to 17	–100 to –200	4 over 4 years
LEI (BCBS (2010))	13	–	9 permanent
Institute of International Finance (2011)[2]	30 to 80	–80 to –100	6 to 12 over 5 to 10 years
Cournède and Slovik (2011)	8 to 20	–	4 over 9 years
Elliott et al (2012)[2]	5 to 15	–	–
Miles et al (2013)	5.5	–	4.5 permanent
Oxford Economics (2013)[2]	15	–	1.6 over 9 years
Buch and Prieto (2014)[3]	–	+22	–
Brooke et al (2015)	5 to 15	–	1 to 5 permanent

[1] Capital definitions are not necessarily identical across studies. LEI results are stated in terms of the impact of a 1 percentage point change in TCE/RWA, as per the original capital ratio definition used in the LEI. [2] Also includes impact of other regulatory measures. [3] Long-term effect. The original result corresponds to about 0.12% in terms of CET1/RWA, given an estimated conversion factor of around 0.78.

Sources: As listed; Cohen and Scatigna (2014).

The conservative nature of the LEI approach also implies that any indirect effects of increased bank capital requirements are unlikely to materially affect the overall impact assessment, even if these effects are not explicitly taken into account. One such effect could arise from any regulatory impact on banks' ability or willingness to act as market-makers (ie to devote balance sheet in order to support market liquidity) in fixed income markets – an area that has attracted considerable policy interest over recent years (Fender and Lewrick (2015a)). Any reduction in such activity might imply higher liquidity premia and, ultimately, increased costs of issuing debt in normal times.[28] For banks, however, these costs are likely to be marginal and are

[28] The available evidence for any such effects remains mixed, and regulation is only one out of a broad range of drivers; see CGFS (2014, 2016). Dick-Nielson (2013), for example, conjectures that recent regulatory adjustments may have raised transaction costs for US corporate bonds, while Trebbi and Xiao (2016) find only scant empirical evidence of any direct effect of US regulatory measures for fixed income market liquidity. Bao et al (2016) find that the Volcker rule has negatively affected corporate bond liquidity in the context of downgrade events, but that non-Volcker-affected dealers have stepped in to fill part of the gap. Basel III regulations, in turn, do not appear to affect these behaviours. Andersen et al (2016), finally, argue that well-documented arbitrage pricing "anomalies" in derivatives markets can be traced back to so-called FVA adjustments that seek to reflect the cost of funding the cash or collateral needed to enter or maintain unsecured derivatives positions – a reflection of more

counterbalanced by reduced balance sheet risk (Gambacorta and Shin (2016)). For non-bank issuers, in turn, any increase in costs would be expected to be smaller than the LEI-implied increase in bank lending spreads, which serves as a cap in terms of the overall impact on net economic benefits. This is because these issuers can revert to banks as an alternative source of funding.[29]

Concluding remarks

The regulatory community is in the process of wrapping up the Basel III package. While a number of design and calibration choices still need to be finalised, supervisors are shifting their attention to monitoring the implementation and impact of the new regulatory framework. Clearly, the Basel III reforms are only one element of the regulatory response to the lessons learned from the recent crisis experience. Supplementary measures, such as the establishment of enhanced recovery and resolution mechanisms or over-the-counter derivatives reform, will also have a meaningful impact on banks and financial markets more broadly. Against this background, quantifying the impact of any individual regulatory change is challenging and subject to important conceptual and empirical caveats.

Keeping these caveats in mind, this paper presents a simple conceptual framework to assess the macroeconomic cost and benefits of the core Basel III reforms. Building on the Basel Committee's long-term economic impact (LEI) study, we provide a conservative estimate of the amount of additional bank capital that is associated with the Basel III enhancements of the minimum risk-weighted capital requirements, the leverage ratio and different calibration options for a G-SIB leverage ratio surcharge. In addition, we account for the effect of the new minimum requirements on the total loss-absorbing capacity of G-SIBs in resolution and provide estimates of the likely impact on net economic benefits from regulation-implied changes to bank capital allocation (risk shifting/RWA compression).

Overall, our results suggest that the Basel III reforms should be expected to yield sizeable net marginal macroeconomic benefits. In taking the final calibration decisions, the BCBS will focus on not significantly increasing overall capital requirements (BCBS (2016a)). Given the conservative assumptions underlying our results (ie the fact that we are likely to overestimate the associated costs), ample room is available for national authorities to further raise regulatory capital. This should provide policymakers with sufficient flexibility to activate countercyclical capital buffers and similar requirements, as needed.

comprehensive collateralisation and wider bank funding spreads post-crisis. They also find that better capitalised banks tend to apply lower FVA charges, suggesting a beneficial effect from higher capital ratios in terms of banks' ability to conduct arbitrage.

29 The impact of reduced market liquidity on both crisis costs and probabilities would depend on how far non-bank investors underestimate the cost of having to liquidate assets during stressed market conditions ("liquidity illusion") – a risk that should decline as liquidity premia increase, constituting a net economic benefit. See BIS (2016).

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Annex: The Basel III leverage ratio – logic and design[30]

A recurring and defining cause of financial crises is the excessive build-up of leverage, which risk-based capital requirements – the centrepiece of Basel III framework – are not always well placed to constrain. While providing some protection against such build-ups, there are times during which risk-weights significantly understate the actual risks on banks' balance sheets. This is for a variety of reasons, including overly compressed credit spreads and low market volatility during financial booms. In addition, banks that use internal ratings-based (IRB) models to calculate risk-weighted assets are given greater leeway by the regulatory framework to reduce regulatory capital requirements. This may incentivise these banks to "game" the parameters of their models (see, for example, Behn et al (2016)).

To backstop the existing risk-based capital requirements (RWR), Basel III introduces the leverage ratio (LR) as a simple, non-risk-based regulatory metric. The LR numerator is given by the bank's Tier 1 capital. The LR denominator, in turn, consists of the sum of the following items (see BCBS (2014a, 2016c)):

- on-balance sheet exposures (eg loans);
- derivatives exposures at replacement cost (net of cash variation margin, meeting a set of strict eligibility criteria) plus an add-on for potential future exposure;
- exposures from securities financing transactions (SFTs), with limited recognition of netting of cash receivables and cash payables with the same counterparty under strict criteria; and
- off-balance sheet items (eg standby letters of credit).

The minimum level of the LR is 3% as per the Basel III framework (BCBS (2016a)).

Given its broad scope and the fact that it does not try to account for the riskiness of assets, the LR ensures greater robustness of capital requirements against uncertainties and risks that are difficult to model within the risk-weighted framework. Its relative simplicity makes it easier for supervisors and market participants to understand and compare leverage across banks. That said, the LR does not provide information about banks' underlying risk profiles. This insensitivity to risk may incentivise banks to take on riskier positions – an adjustment that, in turn, would be constrained by risk-weighted capital requirements. This suggests that both types or requirements are complements – and not substitutes – within the broader regulatory framework.

[30] For more details, see BCBS (2011, 2014a).

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