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The leverage ratio over the cycle

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Abstract

This paper analyses how the Basel III leverage ratio (Tier 1 capital/exposure) behaves over the cycle. The analysis proposes a setup to test for the cyclical properties of bank capital ratios, taking into account structural shifts in banks' behaviour during the global financial crisis and its aftermath. Using a large data set covering international banks headquartered in 14 advanced economies for the period 1995–2012, we find that the Basel III leverage ratio is significantly more countercyclical than the risk-weighted regulatory capital ratio: it is a tighter constraint for banks in booms and a looser constraint in recessions.

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Keywords: leverage, capital ratios, procyclicality, global financial crisis.

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1. Introduction

An underlying cause of the global financial crisis was the build-up of excessive leverage in financial intermediaries, both on and off the balance sheet. In many cases, banks cranked up their leverage to perilous levels while maintaining risk-based capital ratios that, to all outward appearance, still looked solid (BCBS (2014a)). To remedy this vulnerability, the new regulatory framework of Basel III has introduced a minimum leverage ratio, defined as a bank's Tier 1 capital over an exposure measure, which is independent of risk assessment (Ingves (2014)).

The aim of the leverage ratio is to act as a complement and a backstop to risk-based capital requirements. It should counterbalance the build-up of systemic risk by limiting the effects of risk weight compression during booms (Borio and Zhu (2012), Adrian and Shin (2013), Vallascas and Hagendorff (2013), Altunbas, Gambacorta and Marques-Ibanez (2014)). In good times, better economic conditions increase the number of profitable projects in terms of expected net present value and hence increase the demand for credit (Kashyap, Stein and Wilcox (1993)). Other things being equal, the increase in the supply of lending and other investments will be reflected in an expansion of banks' exposure measures (independently of how these risks may be estimated by regulators or the banks themselves) and, therefore, in a reduction of the leverage ratio. This will make the regulatory minimum a tighter constraint: Banks with limited capital will be forced either to increase their capital base or to reduce their activities. The leverage ratio is therefore expected to act countercyclically, being tighter in booms and looser in busts. In other words, we should observe that the leverage ratio is negatively correlated with GDP or credit growth.[1]

The Basel III framework requires that the leverage ratio and the more complex risk-based requirements work together. The leverage ratio indicates the maximum loss that can be absorbed by equity, while the risk-based requirement refers to a bank's capacity to absorb potential losses. The use of a leverage ratio is not new. A similar measure has been in force in Canada and the United States since the early 1980s (Crawford et al (2009), D'Hulster (2009)). Canada introduced its leverage ratio in 1982 after a period of rapid leveraging up by its banks, and tightened the requirements in 1991. In the United States, the leverage ratio was introduced in 1981 amid concerns over bank safety due to falling bank capitalisation and a number of bank failures (Wall and Peterson (1987), Wall (1989)). The introduction of a leverage ratio requirement for large banking groups has been announced in Switzerland in 2009 (FINMA (2009)). Similar requirements have been proposed more recently in other jurisdictions (BCBS (2014b)).

This paper is the first empirical investigation of how the new leverage ratio behaves over the cycle. In particular, we shed light on three questions: (i) Is the new leverage ratio more countercyclical (less procyclical) than other capital ratios (for example Tier 1 to total assets, or the capital to risk-weighted assets ratio)?; (ii) What are the components included in the exposure measure definition (the denominator of the leverage ratio) that determine a different sensitivity to the cycle?; and (iii) Are results different in "normal times" as compared with a crisis period? From a policy point of view, the

[1] Following the business cycle theory, in this study we consider as procyclical (countercyclical) a ratio that is positively (negatively) correlated with the cycle. That is, the ratio tends to increase (decrease) when the economy or financial asset evaluation is growing. It is worth noting that procyclicality (countercyclicality) has a different meaning in the context of economic policy. In this context, it refers to any aspect of regulation that could magnify (reduce) economic or financial fluctuations. In other words, we focus on the pure statistical relationship between the ratio and the cycle. The assessment of the effects of the leverage regulation on banks' behaviour and the cycle goes beyond the scope of this study.

answers to these questions can help verify that the proposed design of the leverage ratio is appropriate over a full business/financial cycle and for different types of banks' business model.[2]

Our analysis has to overcome a number of challenges. First, bank-level data are needed over a long time period in order to cover (at least ideally) one or more business/financial cycles. Second, we need detailed bank balance sheet information to reconstruct the new exposure measure. Third, business cycle indicators have to take into account the macroeconomic environment in which each bank operates. Given that many banks in our sample operate across a wide range of jurisdictions, the cycle indicators have to be weighted according the location of banks' ultimate borrowers. And finally, we have to correct for differences in accounting standards across countries when calculating the leverage ratio.

Against this backdrop, in this paper we study the behaviour of the leverage ratio and alternative capital ratios over the cycle using BankScope information on the financial statements of 109 international banks headquartered in 14 advanced economies. The data are available for a long time horizon (1995–2012) that covers various business/financial cycles. However, the BankScope information does not contain all the necessary details to precisely calculate the exposure measure, ie the denominator of the leverage ratio. More specifically, there are differences in national accounting standards that make international comparisons of capital ratios difficult. To mitigate this problem, we have used information derived from the Basel Committee's Quantitative Impact Study (QIS database, BCBS (2013)) to calibrate adjustments for the calculation of a valid proxy for the "exposure measure". Finally, to take into consideration the international activity and exposures of the banks in our data set, we weigh macroeconomic variables to map banks' international operations, using the BIS international banking statistics.

The analysis builds on the econometric model of Ayuso, Pérez and Saurina (2004) allowing in addition for the presence of a structural break in the period 2008–12, which accounts for differences in banks' capitalisation efforts in response to the crisis and the announcement of the Basel III capital regulation. The structural change analysis allows us to disentangle movements in the leverage ratio that react to changes in normal cycle conditions from those that simply reflect banks' need to reduce the overall riskiness of their portfolios, to deleverage in response to the crisis, or to prepare for the introduction of the more stringent regulation of banking institutions.

Our main results are as follows: (i) In normal times the leverage ratio based on the new exposure measure is significantly more countercyclical than other capital ratios; (ii) The above result is driven by the inclusion of guarantees and other off-balance sheet positions (credit lines, acceptances and off-balance sheet items related to securitisation) in the exposure measure (the denominator of the leverage ratio); (iii) All capital ratios tend to be less countercyclical (more procyclical) during the crisis period. This might be explained by the reduced correlation of the denominator (which includes lending) with the cycle measures associated with the recognition of crisis-related losses or banks' need to deleverage resulting from debt-overhang.

It is worth stressing that, as the three ratios have the same numerator (Tier 1 capital), their different behaviour over the cycle largely depends on the denominators. In other words, the higher the correlation of the different denominators with the cycle, the tighter the corresponding regulatory ratio becomes in a boom and the looser it becomes in a bust. In contrast, our results show that Tier 1 capital is weakly correlated with GDP and credit: banks do not accumulate capital in expansions and tend to smooth capital consumption in recessions (Adrian and Shin (2010)).

2 The definition of the exposure measure at the denominator of the leverage ratio has been refined after a consultation period (BCBS (2014a)) but the ratio is not currently binding for banks. The final calibration, and any further adjustments to the definition, will be completed by 2017, with a view to migrating the leverage ratio to a Pillar 1 (minimum capital requirement) treatment on 1 January 2018.

The remainder of the paper is organised as follows. The next section describes the data and some stylised facts about bank capital ratios. Section 3 presents the econometric approach and the main hypotheses we seek to test. Section 4 reports the main results on the behaviour of the leverage and other capital ratios over the cycle. The final section summarises the main conclusions.

2. Data

Bank-level data are obtained from BankScope, a commercial database maintained by International Bank Credit Analysis Ltd (IBCA) and the Bureau van Dijk. We consider consolidated bank statements, in line with the view that the relevant economic unit is the internationally active bank taking decisions on its worldwide consolidated assets and liabilities. This is a natural choice, since capital adequacy is typically measured at the group level. Our sample adopts an annual frequency and includes major international banks.[3] It covers the 18 years from 1995 to 2012, a period spanning different economic cycles, a wave of consolidation, and the global financial crisis.

The sample of banks covers the major financial institutions from the G10 countries, plus those of Austria, Australia and Spain. To ensure consistently broad coverage, we select banks by country in descending order of size to cover at least 80% of the domestic banking system. With this procedure, we identified in total 109 banking institutions that cover over 70% of worldwide banking assets as reported in *The Banker* magazine for its Top 1,000 banks. The consolidation of the banking sectors during the last two decades makes it important to control for mergers and acquisitions. Doing so serves to exclude spurious bursts of individual balance sheet positions that reflect only banks' reorganisations.[4] In particular, we adjust for 159 mergers and acquisitions over the sample period by constructing pro-forma entities at the bank holding level.[5]

The banks in our sample tend to operate across a wide range of jurisdictions. This implies that an appropriate measure of the economic/financial cycle faced by a bank has to take into account where the activity and risks are located. For each country, Table 1 shows the number of banks in our sample that are headquartered in each jurisdiction, along with their combined asset size and location of clients. The columns on the "location of the ultimate borrower"[6] in the table show, unsurprisingly, that banks headquartered in different countries also differ in the level of international activity and exposure, ranging from less than 20% of claims on borrowers outside their home country for Italian and Japanese banks to more than 60% for Swiss banks. We adjust our cycle measures for the location

3 The quarterly frequency could, in principle, give better insight into the link between the leverage ratio and the business cycle. However, for most banks the quarterly data from other providers are available only for the most recent years. Moreover, the bias in the results obtained using annual data instead of quarterly data appears to be not significant: Gambacorta (2005) compares the two frequencies using a rich database for Italian banks and finds no significant differences (see Gambacorta (2005), Table 3, columns III and IV).

4 The same holds for accounting changes that introduce discontinuities in certain reported bank positions. Accounts reported under IFRS are appended to the earlier accounts reported under local GAAP, and reporting jumps are controlled for by a bank-specific dummy at the time of a bank's accounting change (occurring mostly in 2005).

5 We construct individual bank histories by drawing on the merger and acquisition dates of large banking institutions provided to us by central banks and complemented by Bureau van Dijk's Zephyr database. Starting with 267 consolidated banking groups, we adjust banks' financial statements backwards by aggregating the reported positions of the acquirer and the target bank prior to the merger or acquisition. This procedure creates a single pro-forma bank for each pair of banks prior to their merger. As BankScope deletes historical information on acquired banks after several years, we use archived releases of the database to obtain their financial statements.

6 The concept of "ultimate borrower" is based on the country where the ultimate risk or obligor resides, after taking into account risk transfers. The information for the location of the ultimate borrower is not available at the individual bank level and it has been estimated by merging BankScope data with data from the BIS consolidated international banking statistics.

of bank assets in the form of a weighted average of the country-specific cycles in which banks operate. Lastly, it is important to control for public recapitalisations which directly affect the numerator of the regulatory capital ratios. In total, 43 banks in our sample have received public recapitalisations during the global financial crisis (see Figure 1).

In the analysis we consider three capital ratios:

I. The new Basel III leverage ratio (Tier 1/Exposure measure);

II. The accounting leverage ratio (Tier 1/Total assets);

III. The capital-to-risk-weighted-assets ratio (Tier 1/Risk-weighted assets).

The three ratios have different denominators and relate to different concepts of solvency. Definition (I) corresponds to the leverage ratio recently adopted by the Basel Committee on Banking Supervision (BCBS (2014a)). A bank's exposure measure is the sum of the following components: (a) on-balance sheet exposures; (b) derivative exposures; (c) securities financing transaction (SFT) exposures; and (d) off-balance sheet (OBS) exposures.[7] Definition (II) has at the denominator total on-balance sheet assets. Definition (III) corresponds to the capital-to-risk-weighted-assets ratio (CRAR) and includes at the denominator on balance sheet and off-balance sheet exposures, weighted according to risk based on regulatory requirements (BCBS (1988, 2005)).

Table 2 reports the three capital ratios by country. A few patterns emerge. First, as expected, the level of the leverage ratio with the exposure measure at the denominator is structurally lower than the leverage ratio with total assets at the denominator. This is not surprising, since the exposure measure also takes into account certain off-balance sheet positions such as contingent liabilities. A statistical test indicates that this difference is also statistically significant at the 1% level in all countries. Second, leverage ratios vary importantly across countries. The lowest ratios have been reported by banks headquartered in Germany and France (2.9% and 2.5% on average over the period 1995–2012), while US and Spanish banks reported the highest ratios (5.8% and 5.4%, respectively). And third, banks hold on average significant (discretionary) Tier 1 capital in excess of the regulatory minimum of 4% of risk-weighted assets in all countries. Only in very few cases did banks report lower capital ratios than the regulatory minimum.

Capital ratios increased after the Lehman default (September 2008) owing to market discipline effects, public recapitalisations, and the introduction of the Basel III capital regulations (December 2009). As indicated in Figure 2, the upward trend in capital ratios is evident for both global systemically important banks (GSIBs) and other banks, and the trend has been even more pronounced for risk-weighted capital ratios. While the median of the risk-weighted capital ratio increased from 7.7% to 13.0% between end-2007 and end-2012 at GSIBs and from 7.6% to 11.4% at smaller banks, the average Basel III leverage ratio increased from 2.6% to 3.5% at GSIBs and from 4.1% to 4.7% at smaller banks during the same period. This is consistent with the evidence in Cohen and Scatigna (2014), who find that banks from advanced economies on the one hand increased capital through retained earnings, and on the other reduced their risk-weighted assets relative to total assets in the period 2009–12.

Table 3 slices the data set along three dimensions: global importance (GSIBs vs small banks), provisioning, and profitability. These bank-specific characteristics are controlled for in the econometric exercise (see next section). Over the period 1995–2012, GSIBs had lower capital ratios (relative to small banks), a larger portfolio of securities and a higher reliance on interbank lending. They also had higher profitability, lower provisions and lower non-performing loans. Interestingly, the difference in the capital ratios is more pronounced in the case of the two leverage ratios, while in terms of the risk-weighted capital ratio the difference appears much smaller (9.3% for GSIBs compared with 9.4% for smaller banks). During the crisis, GSIBs also received more support in the form of official

[7] Annex A provides more information on the calculation of the exposure measure.

recapitalisations (0.7% of total assets) than other banks did (0.4%). The second panel indicates that banks with a lower level of provisions have more diversified revenues (they have a higher incidence of non-interest income over total income) and they are smaller than those banks with a higher incidence of provisions over total loans. In terms of capitalisation the evidence is mixed. While banks with fewer provisions have a higher risk-weighted capital ratio, they appear less capitalised in terms of the two leverage ratios. The last panel indicates that profitable banks are smaller, more capitalised and with a higher level of diversification in their activities. They also show a much lower dependence on non-deposit funding compared with less profitable banks.

We consider the reaction of capital ratios to three cycle indicators:

(a) The annual growth rate of nominal GDP (expressed in national currency);

(b) The annual growth rate of real GDP; and

(c) The credit-to-GDP gap (the difference between the credit-to-GDP ratio and its trend).[8]

Business cycle indicators and the credit gap have to be calculated with reference to the macroeconomic environment in which each bank operates. For this reason, we calculate the cycle measures as a weighted average across the jurisdictions in which banks operate, using foreign claims data from the BIS consolidated banking statistics. The adjustment is intended to control for both domestic and international macroeconomic conditions so that the cycle indicators can capture the macroeconomic conditions in the major countries in which banks operate. Figure 3 shows the distribution of the three bank-specific cycle indicators in the sample. The financial cycle represented by the credit gap has a lower frequency (longer duration) than the real business cycle.

Table 4 summarises average bank features and business cycles by macro regions. While the risk-weighted capital ratios are comparable on average across the regions, the leverage ratios show more heterogeneity, and are lower for banks headquartered in the European region. With regards to our cycle measures, it seems that nominal and real GDP growth rates are comparable across the regions. In contrast, there are important differences in terms of the credit gap, ie the Asia-Pacific region shows on average a negative credit–to-GDP gap of –4.0%, while the euro area recorded a credit gap of 5.9% over the sample period.

3. The econometric model

The empirical specification is designed to test how capital ratios correlate to the cycle. In performing this exercise, we need to differentiate the cyclical properties of the ratios in normal times and during the crisis. We address this problem by interacting a dummy variable C_t (that takes the value of 1 in 2008–12 and 0 elsewhere) with the regression variables, thus allowing for a parameter shift in the estimated response depending on the state of the economy. The dummy C_t aims at capturing not only the effect of the financial crisis but also changes in banks' behaviour due to the Basel III regulatory reform and the anticipation of more stringent capital requirements in the future. Following Ayuso et al (2004), we estimate the following dynamic panel regression:

$$\begin{aligned} L_{ijt} &= \alpha_i + \alpha_j + \phi C_t + (\beta + \beta^* C_t) L_{ijt-1} + (\chi + \chi^* C_t) Y_{ijt} + \\ &(\delta + \delta^* C_t) X_{ijt-1} + \gamma IFRS_{ijt} + \varepsilon_{ijt} \end{aligned} \tag{1}$$

[8] Credit-to-GDP gaps are derived, in line with the Basel III guidelines for the countercyclical capital buffer, as the deviations of the credit-to-GDP ratios from their one-sided (real-time) long-term trend. Trends are calculated using a one-sided Hodrick-Prescott filter with a smoothing factor lambda of 400,000, taking account only of information up to each point in time. For more details see Drehmann (2013).

where L_{ijt} denotes the leverage (or risk-weighted capital) ratio in period *t* of bank *i* headquartered in country *j*. The theoretical framework for the econometric specification (1) with no structural change ($C_t = 0$) can be derived from a simple model in which a representative bank minimises its intertemporal costs for capital (see Section 2 in Ayuso et al (2004)). The lagged dependent variable (L_{ijt-1}) captures short-term adjustment costs that arise due to asymmetric information and rigidities in capital markets which make it difficult to raise capital at short notice in response to negative capital shocks (Myers and Majluf (1984)). The direct costs of remunerating shareholders and the risk profile of the banks are controlled for by means of bank-specific characteristics (X_{ijt-1}). The cycle variable Y_{ijt} captures the response of the capital ratios to changes in the economic or financial environment in which banks operate. Given that the capital ratios have the same numerator (Tier 1 capital) any differential response to the cycle indicators is likely to be determined by the denominators (banks' total activity or risk-weighted assets).

The variable α_j indicates country fixed effects that control for time-invariant differences in regulation and fiscal regimes across countries (Albertazzi and Gambacorta (2010)). Following the recent literature on the capital structure of financial and non-financial firms, we include bank-level fixed effects α_i, since it appears that capital ratios converge to bank-specific and time-invariant targets (Lemmon et al (2008), Gropp and Heider (2010)). The dummy IFRS takes into account changes in the measurement of certain balance sheet items and other differences in accounting due to the introduction of IFRS standards, notably, the rules concerning the offsetting of derivatives on the asset and liability side.[9] Most countries (except Canada, Japan and the United States) changed accounting standards from local Generally Accepted Accounting Practices (GAAP) to International Financial Reporting Standards (IFRS) in 2005–06.

As dependent variables (L_{ijt}), we consider, one at the time, the three capital ratios described in the previous section: (I) the new Basel III leverage ratio (Tier 1/Exposure measure); (II) the accounting leverage ratio (Tier 1/ Total assets); and (III) the capital-to-risk-weighted assets ratio (Tier 1/risk-weighted assets). The cycle indicators (Y_{ijt}) are: (a) the annual growth rate of nominal GDP (expressed in national currency); (b) the annual growth rate of real GDP; and (c) the credit-to-GDP gap (the difference between the credit-to-GDP ratio and its trend).[10]

We include capital ratios and the credit gap in levels, while nominal and real GDP are in growth rates (see Annex B for unit root tests). The use of stationary variables in the regressions aims at mitigating spurious correlation problems.

The bank-specific characteristics included in the vector X_{ijt-1} are: bank size (log of total assets), bank provisions (provisions over loans) and bank profitability (return on assets, ROA). These control variables are typically used in studies that explain banks' choice of target capital ratios, because they tend to capture the direct cost of remunerating capital and the risk profile of the banks (Milne and Whalley (2001), Ayuso et al (2004), Gropp and Heider (2010)).

The direct costs of remunerating capital are measured by bank profits. On the one hand, high profits might reflect the direct cost of remunerating capital, and in this case one should expect a

9 In some extreme cases, total assets are much higher under IRFS. For instance when Deutsche Bank moved from US GAAP to IFRS in 2006, its balance sheet increased from USD 1,433 billion to USD 2,027 billion, mainly due to the different treatment of derivatives. On the other hand, Tier 1 capital remained constant, which would imply a much lower capital ratio under IFRS accounting standards.

10 Credit-to-GDP gaps are derived, in line with the Basel III guidelines for the countercyclical capital buffer, as the deviations of the credit-to-GDP ratios from their one-sided (real-time) long-term trend. Trends are calculated using a one-sided Hodrick-Prescott filter with a smoothing factor lambda of 400,000, taking account only of information up to each point in time. For more details see Drehmann (2013).

negative relationship with the capital buffer. On the other hand, high profits (ROA) at t–1 should have a positive relation with capital at t, if they are used to increase capital by retained earnings (Ayuso et al (2004), Heid et al (2004), Gropp and Heider (2010)). Moreover, banks with higher profits should incur lower costs when issuing equity, since they are more likely to distribute dividends in the future. However, the relation between profits and capital during the recent financial crisis might have changed since banks that faced large losses came under more market pressure to strengthen their capital ratios than did other banks.

Banks with a higher risk profile are expected to hold higher levels of capital. Holding capital in excess of the regulatory minimum reduces the probability of failure and therewith expected default costs, which include the loss of charter value and reputational costs (Acharya (1996)). Higher capital levels also reduce the costs arising from non-compliance with regulatory capital requirements (Ayuso et al (2004)). We measure bank risks by provisions over total loans. Typically, banks build up loan-loss provisions (LLP) in response to expected default. As such, a higher LLP ratio tends to be an indication of a riskier loan portfolio, although this depends on the timeliness with which banks recognise potential future losses. Therefore, if banks set their capital in line with the riskiness of their portfolios, then the relationship would be positive (Milne and Whalley (2001)).

The variable size could be influenced by the costs of either failure or capital adjustment. In the first case, big banks might be expected to maintain lower buffers, as according to the "too-big-to-fail" hypothesis they believe that in the event of difficulties they will receive support from the regulator (negative correlation). In the second case, large banks may hold larger buffers if they are more complex and, hence, asymmetric information is more important (positive correlation).

There are three main hypotheses that equation (1) seeks to test:

(i) How do leverage and risk-weighted capital ratios correlate to the business cycle? Do they behave procyclically ($\chi > 0$) or countercyclically ($\chi < 0$)?

(ii) Do effects differ systematically across the definitions of the leverage/capital ratios? In particular, is the new definition of the leverage ratio based on the exposure measure less procyclical than the other capital measures ($\chi_{Tier1/EXP} < \chi_{Tier1/TA} < \chi_{Tier1/RWA}$)?

(iii) Have effects (i) and (ii) changed in response to the financial crisis ($\chi^* \neq 0$)?

One possible identification problem is endogeneity. The state of the banking sector could also affect the business and credit cycle. We have considered this potential problem in a number of ways.

A first consideration is that we expect the endogeneity problem to be less important if we consider the business cycle measures as a weighted average across the jurisdictions in which banks operate. For example, we can assume that the state of the Swiss banking industry is more important for Switzerland's economic condition than it is for the US economy, even though Swiss banks also operate in the United States. Moreover, while it is probably true that aggregate leverage conditions could influence the business cycle (Phelan (2014)), the specific amount of leverage at the bank level is less likely to affect the global economic and financial cycle.

A second way to mitigate endogeneity has been the use of the dynamic System-Generalised Method of Moments (S-GMM) panel methodology to obtain consistent and unbiased estimates of the relationship between leverage (capital) ratios and the cycle. This methodology reduces endogeneity bias and takes into account the heterogeneity in the data caused by unobservable factors affecting individual banks. We use the instruments as in Blundell and Bond (1998): exogenous variables, transformed in first differences, are instrumented by themselves, and endogenous variables (also transformed in first differences) are instrumented by their lags in levels.[11]

As a final precaution, bank-specific characteristics are lagged by one year (t–1) in order to mitigate a possible endogeneity problem. Summary statistics of the specific variables used in the regressions are reported in Table 5.

4. Results

The main results are reported in Tables 6–9. Each table is divided into three panels, one for each cyclical indicator (Y_{ijt}). The S-GMM estimator ensures efficiency and consistency provided that the residuals are not subject to serial correlation of order two (AR(2) test) and that the instruments used are valid (Hansen test). Neither test (as reported at the bottom of each table) should fail to reject the null hypotheses (p-values should be above 0.10).[12]

Table 6 presents the results obtained from a baseline model that aims at capturing the pure effect of the cycle on the leverage/risk-weighted capital ratios, excluding from the regression the bank-specific characteristics ($\delta = \delta^* = 0$). In particular a negative (positive) sign of the coefficient on cycle variable Y_{ijt} indicates that the leverage/capital ratio is countercyclical (procyclical).

A few patterns emerge:

(1) In normal times the new leverage ratio based on the exposure measure is never statistically procyclical. It is significantly countercyclical in most cases.

(2) The new definition of the leverage ratio is always more countercyclical (less procyclical) than the other ratios.

(3) All capital ratios tend to be less countercyclical (more procyclical) during the crisis period. However, the effect is statistically significant only when the credit gap is considered. The different behaviour could depend upon the different shapes of the financial and the real cycles. As Figure 3 shows, the credit gap remains rather stable in 2008–10 and declines strongly in 2011–12; by contrast, GDP measures bottom out in 2009 and recover thereafter.

Table 7 presents the regression results for the complete equation (1) by also including bank-specific characteristics. Even in this case the main results (1)–(3) highlighted above do not change qualitatively. There is evidence of an important persistence in the capital ratios as indicated by the positive and significant coefficient of the lagged capital ratios, which point to the presence of short-term capital adjustment costs. The analysis of the coefficients on bank-specific characteristics also provides some interesting insights. The positive link between provisions and capital ratios is in line

11 This approach has been applied in other areas of research in which the econometric specification was affected by possible endogeneity biases. For instance Blundell and Bond (1998) use it to estimate a labour demand model while Beck et al (2000) apply it to investigate the relationship between financial development and economic growth. For an application in the analysis of the bank lending channel, see Altunbas et al (2009).

12 The consistency of the S-GMM estimator depends on the validity of the assumption that the error terms do not exhibit serial correlation and on the validity of the instruments. To address these issues we use two specification tests suggested by Arellano and Bond (1991) and Blundell and Bond (1998). The first is a Hansen test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analogue of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term ε_{ijt} is not serially correlated. We test whether the differenced error term is second-order serially correlated (by construction, the differenced error term is probably first-order serially correlated even if the original error term is not). Failure to reject the null hypotheses of both tests should give support to our models.

with the findings in Milne and Whalley (2001), who find evidence that banks set their capital according to the riskiness of their portfolios. The coefficient attached to the size of banks is negative and significant only during normal times indicating that, other things being equal, larger banks kept relatively lower buffers as postulated in the "too-big-to-fail" hypothesis (Ayuso et al (2004)). The impact of bank profitability on capital ratios in normal times is not statistically significant, indicating the absence of a positive channel via retained earnings.

The discussion presented so far has focused on the statistical significance of the coefficients on the cycle indicators. However, what is more important is the economic significance. For example, given the result in column I of Table 7, a coefficient of –0.054*** indicates that, if nominal GDP increases by 4.5% (its annual average growth rate over the sample period), then the leverage ratio drops by 0.243 percentage points on impact ($-0.054 * 4.5$) and 0.85 percentage points over the long run ($\frac{-0.054*4.5}{1-0.714}$), obtained by imposing the condition that in steady state $L_{ijt} = L_{ijt-1} = L^*$.

4.1 Robustness checks

We tested the robustness of these results in several ways. First, we considered possible differential impacts due to public recapitalisations during the financial crisis period and the existence of regulatory constraints on specific banks. To this end, we have included in equation (1) two additional controls: (i) a dummy variable that takes the value of 1 if a bank had public capital on its balance sheet in any given year and 0 elsewhere (dummy *Rescue*); and (ii) a dummy variable that takes the value of 1 if a bank's regulatory capital ratio buffer, the difference between the regulatory capital ratio and the regulatory minimum, is in the lowest decile of the distribution (dummy *Constrained*).[13] In particular we have estimated the model:

$$L_{ijt} = \alpha_i + \alpha_j + \phi C_t + (\beta + \beta^* C_t) L_{ijt-1} + (\chi + \chi^* C_t) Y_{ijt} + (\delta + \delta^* C_t) X_{ijt-1} + \gamma IFRS_{ijt} + \theta\ Rescued_{ijt} + \mu\ Constrained_{ijt} + \varepsilon_{ijt}, \qquad (2)$$

The results presented in Table 8 indicate that, after controlling for these effects, the countercyclical behaviour of capital ratios is even reinforced and the new definition of the leverage ratio is always more countercyclical (less procyclical) than the other ratios. As expected, the coefficient of the Rescue dummy is positive but not significant in the case of the risk-weighted capital ratio, while it is significant in the case of the leverage ratios. This result could indicate that rescue packages may not have translated directly into a greater level of capitalisation because of the contemporaneous re-pricing of risk. This result is also consistent with Brei, Gambacorta and von Peter (2013), who find evidence that recapitalisations did not translate into greater credit supply until bank balance sheets were sufficiently strengthened.

The second test was to control for a different behaviour of capital-constrained banks through the cycle. Indeed the existing literature suggests that banks with low capital buffers try to rebuild their capital buffer, while unconstrained banks tend to maintain their level of capital (Jackson et al (1999),

[13] We consider a bank as capital-constrained when the divergence of a bank's capital ratio from the regulatory minimum is below the 10th percentile of the distribution of distances, taking into account regulatory differences across countries. While all countries have minimum requirements for risk-weighted capital ratios (Tier 1/RWA > 4%, total capital/RWA >8%), additional limits were imposed on banks' leverage ratios in Canada and the United States over the sample period (Barth et al (2013)). Specifically, in Canada the minimum leverage ratio (total capital/(total assets + certain off-balance sheet assets) was 1/20=5%, and it was reduced in 2000 to 1/23=4.3%, mainly for large institutions. In the United States, the leverage ratio (Tier 1/total assets less certain deductions) should not be lower than 4% at all banks, and it should be higher than 3% in the case of banks with sufficiently high CAMELS ratings (Crawford et al (2009), D'Hulster (2009)). The introduction of a leverage ratio requirement for large banking groups has been announced in Switzerland in 2009 (FINMA (2009)). For more information see Annex C.

Heid et al (2004), Gropp and Heider (2010)). This suggests that the response of the capital ratios to the cycle might be asymmetrical and may depend on whether or not a bank is subject to regulatory pressure. The model was therefore further enriched by including interactions between the business cycle indicator and the dummy *Constrained*. We have:

$$L_{ijt} = \alpha_i + \alpha_j + \phi C_t + (\beta + \beta^* C_t) L_{ijt-1} + (\chi + \chi^* C_t + \chi^{**} Constrained_{ijt} + \chi^{***} Constrained_{ijt} C_t) Y_{ijt} + (\delta + \delta^* C_t) X_{ijt-1} + \gamma IFRS_{ijt} + \theta \, Rescued_{ijt} + \mu \, Constrained_{ijt} + \varepsilon_{ijt}, \quad (3)$$

The main conclusions are robust to these modifications. In particular, the results presented in Table 9 indicate that the new definition of the leverage ratio still tends to be more countercyclical (less procyclical) than the other ratios. Interestingly, after controlling for the differential cyclical effects of constrained banks, the capital ratios are less procyclical during the crisis period (following the point made before, in this case a drop in the growth rate of GDP does not go hand in hand with a statistically significant drop in the capital ratios).

The third test was to consider the response of leverage and RWA ratios to the output gap, ie the gap between actual and estimated potential output. Here the assessment is complicated by the high degree of uncertainty about the level and growth rate of potential output. Output levels below those implied by pre-crisis trends and persistent high unemployment rates in some advanced economies are often seen as an indication of significant economic slack. However, the output gains of many advanced economies during the pre-crisis booms might have been unsustainable as they were associated with large sectoral and financial imbalances (see BIS (2012)). Given the high degree of uncertainty, we have used for the test both OECD and IMF output gap estimates. The results (not reported for the sake of brevity) indicated that all capital ratios were negatively correlated with the output gap in the pre-crisis period but results were never statistically significant.

The fourth test was to disentangle the effects on the numerator (Tier 1) and the denominators (Exposure measure, total assets and risk-weighted assets). As mentioned in the introduction, a capital ratio may be changed by altering either the numerator or the denominator (Cohen and Scatigna (2014)). Depending on the ratio, the numerator can be adjusted by retained earnings or issuing equity, while the denominator can be adjusted by, for example, reducing exposures, securitising loans or shifting into assets that bear a relatively low risk weight such as residential mortgages, short-term interbank exposures or government securities (Dahl and Shrieves (1990), Jackson et al (1999), Heid et al (2004)). The way banks adjust their capital ratios is, of course, likely to depend on the business cycle. While, during booms, banks might find it easier to raise capital by issuing equity or retained earnings, during recessions they might prefer to adjust their asset portfolio. The higher the positive correlation of the denominator with the cycle, the tighter the corresponding regulatory ratio becomes in a boom and the looser it becomes in a bust. As these variables taken in logs turned out to be non-stationary, we used a model in growth rates to avoid the problem of spurious regressions.[14] We used the same specification as in equation (1), where the entire set of control variables is interacted with the structural break dummy C_t. As a precaution, having a growth rate as dependent variable (where

[14] We have calculated growth rates net of valuation effects. The banks in our sample run major international operations, often involving multiple currencies. However, BankScope reports financial statements in national currencies or current US dollars, regardless of the original currency in which assets were denominated. This introduces a valuation effect for positions denominated in currencies other than the US dollar. For instance, the rapid appreciation of the US dollar in late 2008 made euro-denominated positions shrink when expressed in dollars. This results in spurious asset contractions even for credit portfolios that remained constant in terms of euros. We reduce this potential bias by converting each bank's item to constant US dollars, using the currency composition of bank assets for banks headquartered in the respective country, as estimated from the BIS international banking statistics. The growth series used in the estimations are thus partially purged of exchange rate-driven contractions and expansions.

banks' assets at t–1 are involved), we replaced the variable $\log(\text{Assets})_{t-1}$ with dummy variables for global systemically important banks (GSIBs) and SMALL banks to capture the size effect. In particular, the dummy for small banks takes the value of 1 for the 20 smallest banks (in terms of assets in 2012) and 0 elsewhere, while GSIBs have been identified using the list published by the Financial Stability Board.

The results are presented in Table 10.[15] A few patterns emerge. In normal times (1995–2007), Tier 1 capital, the numerator for the ratios, is not correlated with any cycle indicator. This indicates that banks do not accumulate sufficient capital in good times and tend to smooth capital consumption in recessions (possibly by means of capital injections). The results do not change if we adjust the Tier 1 measure to consider the new (more conservative) definition of capital adopted in Basel III (see the results for Tier 1-adjusted growth in Table 10).[16]

As expected, all denominators (exposure measure, total assets and RWA) are positively correlated with cycle indicators. The correlation is somewhat lower during the crisis period, which might be explained by the effect of a sharp reduction in the value of loans and other investments among assets. The exposure measure is always more reactive to cycle movements with respect to total assets and RWAs.

Finally, we checked which of the different components of the exposure measure (not included in total assets) makes it more correlated with the cycle. The results presented in Table 11 indicate that guarantees and other off-balance sheet items (credit lines, acceptances and other off-balance sheet exposures due to securitisation) help to render the exposure measure more correlated with the cycle, while the correction for asset derivatives and securities financing transactions (SFTs) are weakly correlated with GDP and the credit gap. These findings suggest that it is important to account for banks' off-balance sheet activities, which are not explicitly reflected in the traditional leverage ratio, since this precaution would reduce the scope for banks to artificially inflate their capital ratios by shifting activities off-balance sheet.

5. Conclusions

This paper tries to provide an answer to three questions: (i) Is the Basel III leverage ratio more countercyclical (less procyclical) than other capital ratios?; (ii) What are the components included in the exposure measure definition (the denominator of the leverage ratio) that determine a different sensitivity to the cycle?; and (iii) Are results different in "normal times" as compared with a crisis period?

To this end, we compared the new definition of the leverage ratio using the exposure measure as the denominator with alternative ratios (Tier 1/Total assets and capital-to-risk-weighted assets ratio). To account for banks' international activity, we have calculated business cycle measures for each bank as a weighted average across the jurisdictions in which the bank operates, using foreign claims data from the BIS international banking statistics.

The analysis has been conducted with bank-level data over the period 1995–2012, for which we reconstructed the new exposure measure using corrections at the country level derived from the Basel Committee's Quantitative Impact Study database. The main results are the following: (i) In normal

15 Note that the lagged dependent variable is not statistically significant in most specifications. To test whether our results are robust to the exclusion of the autoregressive part, we re-estimated the regressions without the lagged dependent variables using the Hausman-Taylor estimator, which allows for the presence of both fixed effects and the time-invariant dummy variables for bank size. The results (not reported for the sake of brevity) are qualitatively similar.

16 The correction for the new definition of Tier 1 is discussed in Annex A.

times the new leverage ratio based on the exposure measure is always more countercyclical (less procyclical) than the other ratios; (ii) This result is driven by the inclusion of guarantees and other off-balance sheet items (credit lines, acceptances and other off-balance sheet items connected with securitisation activity) in the exposure measure definition (the denominator of the new Basel III leverage ratio); and (iii) All three capital ratios tend to be less countercyclical (more procyclical) during the crisis period, especially when the credit gap indicator is considered. This might be explained by the reduced correlation of the denominator (which includes lending) with cyclical measures due to the recognition of losses or deleveraging practices.

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Table 1: Composition of the database[1]

Countries	*ASSETS* (2012, USD bn)	*Location of the ultimate borrower* Domestic	*Other*	*No. of banks*	*No. of M&A*	*No. of rescued banks*
Austria	610	70.2	29.8	5	5	5
Australia	3073	74.2	25.8	7	4	0
Belgium	1169	57.9	42.1	3	7	3
Canada	3402	68.6	31.4	6	3	0
Switzerland	2753	37.0	63.0	6	5	1
Germany	5297	77.5	22.5	14	6	2
Spain	3542	67.4	32.6	14	14	2
France	8731	72.3	27.7	6	13	5
Italy	3177	80.8	19.2	12	35	6
Japan	3555	82.8	17.2	5	7	0
Netherlands	2711	60.4	39.6	3	1	2
Sweden	1921	58.3	41.7	4	5	1
United Kingdom	10730	62.7	37.3	7	15	2
United States	10273	73.8	26.2	17	39	14
Sum/average*	60944*	67.4	32.6	109*	159*	43*

Note: (1) Unweighted averages across banks per country. Average/sum* indicates unweighted averages or sums (*) over countries. Location of the ultimate borrower estimated by merging BankScope data with data from the BIS international banking statistics. No. of M&A indicates the number of mergers and acquisitions that have been taken into account in the construction of pro-forma banks.

Sources: BankScope; BIS international banking statistics; authors’ calculations.

Table 2: Average capital ratios by country

Country	Variable	Obs	Mean	Test[1]	Std. dev	Min	Max	Country	Variable	Obs	Mean	Test[1]	Std. dev	Min	Max
AT	Tier 1 / Exposure measure	67	4.07	***	1.08	1.99	6.40	FR	Tier 1 / Exposure measure	50	2.51	***	0.68	1.22	4.28
AT	Tier 1 / Total assets	67	4.39		1.16	2.05	6.88	FR	Tier 1 / Total assets	50	2.87		0.75	1.50	4.67
AT	Tier 1 / RWA	64	8.28		1.47	5.40	11.70	FR	Tier 1 / RWA	72	9.65		1.74	6.60	14.50
AU	Tier 1 / Exposure measure	148	4.82	***	1.16	2.28	8.01	IT	Tier 1 / Exposure measure	175	4.97	***	1.97	1.73	14.29
AU	Tier 1 / Total assets	148	5.22		1.19	2.59	8.05	IT	Tier 1 / Total assets	175	5.74		2.35	2.24	14.61
AU	Tier 1 / RWA	150	8.26		1.61	4.80	13.40	IT	Tier 1 / RWA	179	8.68		4.94	2.50	44.64
BE	Tier 1 / Exposure measure	25	3.25	***	1.09	1.58	5.89	JP	Tier 1 / Exposure measure	95	4.82	***	2.92	-0.49	13.47
BE	Tier 1 / Total assets	25	3.60		1.40	1.53	6.99	JP	Tier 1 / Total assets	95	5.04		3.00	-0.50	13.79
BE	Tier 1 / RWA	53	9.46		2.98	6.02	19.90	JP	Tier 1 / RWA	96	8.16		4.11	1.50	19.37
CA	Tier 1 / Exposure measure	124	3.91	***	0.46	2.94	5.29	NL	Tier 1 / Exposure measure	24	3.93	***	1.00	1.87	5.18
CA	Tier 1 / Total assets	124	4.55		0.54	3.48	6.17	NL	Tier 1 / Total assets	24	4.10		1.01	2.02	5.30
CA	Tier 1 / RWA	130	9.07		2.35	4.60	14.70	NL	Tier 1 / RWA	46	10.18		2.29	7.10	17.20
CH	Tier 1 / Exposure measure	52	3.53	***	2.03	0.59	7.20	SE	Tier 1 / Exposure measure	88	3.72	***	0.62	2.02	5.56
CH	Tier 1 / Total assets	52	4.04		2.16	1.44	8.61	SE	Tier 1 / Total assets	88	4.01		0.62	2.78	5.61
CH	Tier 1 / RWA	83	12.11		3.41	5.50	21.30	SE	Tier 1 / RWA	89	7.97		1.80	4.99	13.01
DE	Tier 1 / Exposure measure	128	2.88	***	1.51	0.17	11.92	UK	Tier 1 / Exposure measure	119	3.74	***	1.27	1.19	6.46
DE	Tier 1 / Total assets	128	3.08		1.63	0.18	13.69	UK	Tier 1 / Total assets	119	3.96		1.35	1.22	6.66
DE	Tier 1 / RWA	219	8.35		3.08	4.80	22.70	UK	Tier 1 / RWA	115	8.93		2.30	5.20	14.90
ES	Tier 1 / Exposure measure	212	5.36	***	1.46	2.75	10.31	US	Tier 1 / Exposure measure	285	5.84	***	1.67	1.60	10.98
ES	Tier 1 / Total assets	212	5.78		1.54	2.81	11.00	US	Tier 1 / Total assets	285	7.09		1.86	1.96	12.86
ES	Tier 1 / RWA	227	9.67		2.87	4.90	23.50	US	Tier 1 / RWA	302	10.00		2.55	4.74	20.50

Note: Unweighted averages over the period 1995–2012. (1) ***, **, * denote whether the t-test on the difference in the mean between Tier 1/Exposure measure and Tier 1/Total assets is significant, respectively, on the 1, 5, and 10% levels.

Table 3: Summary statistics by bank type

	GSIBs	Small	Difference		Low provisions	High provisions	Difference		Low ROA	High ROA	Difference		All banks
Number of banks	26	20			27	27			27	27			109
Observations	379	277			370	260			290	379			1540
Assets (USD bn)	1124.62	40.54	1084.08	***	273.54	400.72	-127.18	***	649.83	279.68	370.15	***	408.05
Tier 1 / Exposure measure	3.50	5.47	-1.97	***	4.17	4.37	-0.20	*	3.39	5.84	-2.45	***	4.57
Tier 1 / Total assets	4.04	5.98	-1.94	***	4.69	4.82	-0.13		3.62	6.91	-3.29	***	5.16
Tier 1 / RWA	9.29	9.40	-0.11		9.73	8.68	1.05	***	8.58	10.04	-1.46	***	9.25
Loans over assets	44.00	68.03	-24.03	***	58.49	54.52	3.97	***	50.56	58.65	-8.09	***	56.97
Securities over assets	34.30	17.17	17.13	***	20.77	25.52	-4.75	***	31.74	22.20	9.54	***	24.33
Due from banks over assets (1)	3.04	1.73	1.31	***	2.63	1.96	0.67	***	1.74	3.15	-1.41	***	2.19
Deposits over assets	44.41	44.93	-0.52		46.92	38.31	8.61	***	37.95	56.53	-18.58	***	47.04
Non-deposit funding over assets	49.75	47.54	2.21		47.05	55.21	-8.16	***	57.33	34.16	23.17	***	46.22
Equity over assets	4.97	6.75	-1.78	***	5.40	5.60	-0.20		3.62	8.15	-4.53	***	5.88
ROA	0.46	0.36	0.10	*	0.59	0.28	0.31	***	0.13	0.93	-0.80	***	0.53
ROE	7.43	2.69	4.74	**	11.15	4.60	6.55	***	1.61	11.01	-9.40	***	8.05
Non-interest income over income	29.19	17.15	12.04	***	24.77	17.68	7.09	***	16.47	30.47	-14.00	***	22.60
Provisions over loans	2.15	2.83	-0.68	***	1.00	3.98	-2.98	***	2.37	2.09	0.28	*	2.27
NPL over loans	2.94	4.52	-1.58	***	1.24	5.97	-4.73	***	4.40	2.11	2.29	***	3.09

Note: Unweighted averages over the period 1995–2012. "GSIB" denotes Global Systemically Important Banks, based on the list compiled by the Financial Stability Board. "Small" refers to the 20 smallest banks in terms of assets at end-2012. Banks with low and high provisions have been identified using the first and fourth quartile of the provisions ratio in 2006. A similar distinction has been made for banks with low and high return on assets (ROA). (1) Interest-earning balances with central banks, and loans and advances to banks net of impairment value including loans pledged to banks as collateral. ***, **, * indicate that means are significantly different across two groups of banks at the 1%, 5%, and 10% level, based on a t-test.

Table 4: Average bank features, by macro region (1995–2012)[1]

Region	Tier 1 / Exposure measure	Tier 1 / Total assets	Tier 1 / RWA	SIZE	PRO-VISIONS	ROA	Nom. GDP growth	Real GDP growth	Credit gap	Total assets	Number of observations	Number of banks
	(%)	(%)	(%)	(log of assets)	(% of loans)	(% of assets)	(%)	(%)	(%)	(2012, USD bn)		
Asia-Pacific	4.8	5.1	8.2	4.8	1.8	0.5	4.2	2.4	-4.0	6628	247	12
Euro area	4.4	4.8	9.0	4.6	3.2	0.4	4.5	1.9	5.9	23695	1141	57
Europe, other	3.7	4.1	9.6	5.5	1.6	0.5	4.4	2.1	0.6	15403	370	17
North America	5.3	6.3	9.7	5.0	1.9	1.0	4.7	2.4	1.4	13675	461	23
*Average/sum**	4.6	5.1	9.1	5.0	2.1	0.6	4.5	2.2	0.9	60944*	2261*	109*

Note: (1) Unweighted averages across banks per region. Asia-Pacific indicates AU and JP; Euro area represents AT, BE, DE, ES, FR, IT and NL; North America is CA and the United States; and Europe, other indicates CH, UK, and SE. "Average/sum*" indicates unweighted averages or sums (*) over countries.

Source: BankScope; authors' calculations.

Table 5: Summary statistics for the regression variables

Variable name	Variable description	Number of observations	Mean	Std. Dev.	Min.	Max.
		Endogenous variables				
Tier 1 / Exposure measure $_t$	Tier 1 over exposure measure	1592	4.54	1.84	-0.49	14.29
Tier 1 / Total assets $_t$	Tier 1 over total assets	1592	5.12	2.11	-0.50	14.61
Tier 1 / RWA $_t$	Tier 1 over risk-weighted assets	1825	9.17	3.10	1.50	44.64
		Bank-specific characteristics in vector X				
$SIZE_{t-1}$	Logarithm of total assets	2261	4.89	1.51	-1.43	8.24
$PROV_{t-1}$	Provisions ratio	1786	2.36	2.33	0.00	49.54
ROA_{t-1}	Return on assets	2251	0.52	0.73	-10.60	3.70
		Cycle indicators				
$\Delta NGDP_t$	Growth rate of nominal GDP adjusted	2646	4.52	2.80	-5.43	16.01
$\Delta RGDP_t$	Growth rate of real GDP adjusted	2646	2.08	1.86	-5.28	5.92
C_GAP_t	Credit gap adjusted	2206	2.97	10.00	-25.65	42.93
		Other controls				
C_t	Dummy that takes the value of 1 in the years 2008–12 and 0 otherwise.	2646	0.21	0.40	0.00	1.00
$IFRS_t$	Dummy that takes the value of 1 if a bank reported under IFRS and 0 elsewhere.	2646	0.26	0.44	0.00	1.00

Note: (1) The sample period goes from 1995 to 2012. “Adjusted” refers to the adjustment of the macroeconomic variables for the location of international claims on a consolidated basis.

Sources: BankScope; national central banks; BIS consolidated international banking statistics; authors’ calculations.

Table 6: Baseline regressions

Dependent variable L(t):	(1) Tier 1/ Total exposure		(2) Tier 1/ Total assets		(3) Tier 1/ RWA		(4) Tier 1/ Total exposure		(5) Tier 1/ Total assets		(6) Tier 1/ RWA		(7) Tier 1/ Total exposure		(8) Tier 1/ Total assets		(9) Tier 1/ RWA	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted						Y(t)=Real GDP growth, adjusted						Y(t)=Credit gap, adjusted					
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.769***	0.088	0.791***	0.057	0.839***	0.058	0.764***	0.087	0.787***	0.057	0.828***	0.058	0.758***	0.088	0.779***	0.059	0.816***	0.062
L(t-1)*C	-0.018	0.027	-0.022	0.020	0.007	0.027	-0.009	0.027	-0.0133	0.020	0.020	0.027	0.001	0.033	-0.003	0.0244	0.0327	0.030
Y(t)	-0.049**	0.021	-0.046**	0.023	-0.027	0.036	-0.009	0.024	-0.008	0.023	-0.030	0.041	-0.008**	0.004	-0.005	0.004	-0.006	0.005
Y(t)*C	0.008	0.026	-0.002	0.025	-0.035	0.046	-0.028	0.032	-0.036	0.034	-0.037	0.052	0.016***	0.005	0.013**	0.005	0.023**	0.011
C	0.216	0.184	0.392**	0.191	1.143***	0.301	0.352**	0.163	0.486***	0.143	1.021***	0.262	0.246	0.167	0.385**	0.156	0.909***	0.286
IFRS dummy	-0.154	0.095	-0.280***	0.0851	-0.159	0.103	-0.208**	0.092	-0.297***	0.081	-0.179*	0.099	-0.153*	0.088	-0.300***	0.0727	-0.203**	0.098
Constant	0.945**	0.386	0.895***	0.249	1.619***	0.587	0.827**	0.344	0.761***	0.261	1.710***	0.567	0.845**	0.339	0.830***	0.238	1.843***	0.517
Observations	1331		1331		1331		1331		1331		1331		1331		1331		1331	
Banks	109		109		109		109		109		109		109		109		109	
AR(2)	0.150		0.268		0.569		0.151		0.259		0.568		0.121		0.181		0.579	
Hansen	0.311		0.373		0.158		0.246		0.346		0.182		0.192		0.308		0.230	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and fixed effects are not reported.

Table 7: Controlling for bank-specific characteristics

Dependent variable L(t):	(1) Tier 1/ Total exposure		(2) Tier 1/ Total assets		(3) Tier 1/ RWA		(4) Tier 1/ Total exposure		(5) Tier 1/ Total assets		(6) Tier 1/ RWA		(7) Tier 1/ Total exposure		(8) Tier 1/ Total assets		(9) Tier 1/ RWA	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted						Y(t)=Real GDP growth, adjusted						Y(t)=Credit gap, adjusted					
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.714***	0.063	0.758***	0.052	0.861***	0.036	0.693***	0.077	0.753***	0.053	0.861***	0.036	0.718***	0.069	0.761***	0.052	0.873***	0.035
L(t-1)*C	-0.084*	0.050	-0.0807**	0.039	-0.065	0.055	-0.065	0.053	-0.070*	0.039	-0.064	0.056	-0.072	0.051	-0.068*	0.040	-0.068	0.051
Y(t)	-0.056***	0.017	-0.048**	0.019	-0.025	0.033	-0.046*	0.024	-0.032	0.026	-0.022	0.040	-0.001	0.003	0.005	0.003	0.005	0.005
Y(t)*C	0.008	0.024	0.006	0.025	0.023	0.042	0.005	0.034	0.024	0.037	0.006	0.055	0.015***	0.004	0.011**	0.005	0.020**	0.008
C	0.264*	0.144	0.404**	0.164	1.046***	0.270	0.299***	0.116	0.426***	0.132	0.905***	0.223	0.252**	0.106	0.379***	0.128	0.839***	0.213
IFRS dummy	-0.071	0.064	-0.192***	0.067	-0.075	0.084	-0.117*	0.067	-0.197***	0.066	-0.072	0.079	-0.078	0.073	-0.234***	0.072	-0.152*	0.081
Log(assets) (t-1)	-0.152***	0.045	-0.116***	0.034	-0.036	0.033	-0.172***	0.052	-0.123***	0.036	-0.044	0.034	-0.171***	0.046	-0.128***	0.036	-0.046	0.031
Log(assets) (t-1)*C	0.034	0.028	0.026	0.027	0.121	0.112	0.031	0.027	0.032	0.026	0.127	0.109	0.055**	0.0263	0.052**	0.025	0.153	0.094
Provisions (t-1)	0.107***	0.036	0.124***	0.044	0.153***	0.038	0.119***	0.040	0.129***	0.0458	0.150***	0.038	0.105***	0.040	0.132***	0.049	0.153***	0.040
Provisions (t-1)*C	0.121	0.075	0.098	0.077	0.082	0.140	0.119	0.076	0.086	0.077	0.085	0.139	0.108	0.073	0.074	0.079	0.094	0.145
ROA (t-1)	0.147	0.127	0.015	0.142	-0.070	0.140	0.173	0.136	0.0115	0.139	-0.075	0.141	0.085	0.126	-0.022	0.136	-0.163	0.136
ROA (t-1)*C	-0.252	0.163	-0.149	0.185	-0.513**	0.213	-0.231	0.153	-0.149	0.182	-0.500**	0.202	-0.205	0.154	-0.122	0.175	-0.423**	0.208
Constant	1.465***	0.392	1.198***	0.288	1.109***	0.405	1.500***	0.449	1.147***	0.304	1.179***	0.402	1.465***	0.383	1.171***	0.300	1.204***	0.380
Observations	1331		1331		1331		1331		1331		1331		1331		1331		1331	
Banks	109		109		109		109		109		109		109		109		109	
AR(2)	0.123		0.262		0.796		0.174		0.242		0.787		0.157		0.207		0.819	
Hansen	0.507		0.384		0.271		0.526		0.353		0.256		0.316		0.165		0.276	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and fixed effects are not reported.

Table 8: Controlling for public recapitalisations and capital constrained banks

Dependent variable L(t):	(1) Tier 1/ Total exposure		(2) Tier 1/ Total assets		(3) Tier 1/ RWA		(4) Tier 1/ Total exposure		(5) Tier 1/ Total assets		(6) Tier 1/ RWA		(7) Tier 1/ Total exposure		(8) Tier 1/ Total assets		(9) Tier 1/ RWA	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted						Y(t)=Real GDP growth, adjusted						Y(t)=Credit gap, adjusted					
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.652^{***}	0.075	0.705^{***}	0.058	0.844^{***}	0.043	0.657^{***}	0.072	0.695^{***}	0.059	0.845^{***}	0.041	0.678^{***}	0.067	0.710^{***}	0.055	0.848^{***}	0.040
L(t-1)*C	-0.061	0.048	-0.0657^{*}	0.039	-0.042	0.061	-0.052	0.048	-0.0590	0.040	-0.042	0.059	-0.004	0.043	-0.052	0.041	-0.043	0.055
Y (t)	-0.076^{***}	0.018	-0.059^{***}	0.021	-0.055	0.043	-0.047^{**}	0.023	-0.046^{**}	0.023	-0.026	0.043	-0.005^{*}	0.003	0.004	0.004	0.003	0.004
Y (t)*C	0.033	0.022	0.010	0.026	0.006	0.048	-0.001	0.030	-0.004	0.033	0.018	0.049	0.018^{***}	0.004	0.012^{**}	0.005	0.023^{**}	0.009
Constrained	-0.519^{***}	0.096	-0.475^{***}	0.094	-0.773^{***}	0.113	-0.483^{***}	0.085	-0.546^{***}	0.099	-0.772^{***}	0.135	-0.522^{***}	0.099	-0.527^{***}	0.102	-0.771^{***}	0.149
Rescued	0.221^{*}	0.126	0.250^{**}	0.127	0.325	0.231	0.208^{*}	0.121	0.265^{**}	0.130	0.301	0.221	0.329^{***}	0.116	0.287^{*}	0.147	0.283	0.285
C	0.023	0.153	0.191	0.171	0.665^{*}	0.349	0.195^{*}	0.115	0.225^{*}	0.126	0.696^{***}	0.262	0.053	0.109	0.217	0.135	0.565^{**}	0.255
IFRS dummy	-0.072	0.074	-0.176^{**}	0.076	-0.062	0.087	-0.082	0.074	-0.183^{**}	0.079	-0.062	0.079	-0.145^{**}	0.073	-0.215^{**}	0.089	-0.132	0.101
Log(assets) (t-1)	-0.182^{***}	0.046	-0.136^{***}	0.036	-0.025	0.034	-0.180^{***}	0.046	-0.154^{***}	0.038	-0.037	0.033	-0.157^{***}	0.040	-0.152^{***}	0.038	-0.027	0.040
Log(assets) (t-1)*C	0.029	0.028	0.020	0.028	0.080	0.123	0.028	0.029	0.035	0.026	0.0819	0.117	0.060^{***}	0.021	0.046^{*}	0.027	0.116	0.103
Provisions (t-1)	0.101^{***}	0.031	0.097^{**}	0.040	0.127^{***}	0.035	0.107^{***}	0.033	0.127^{***}	0.040	0.131^{***}	0.030	0.053	0.034	0.128^{***}	0.044	0.132^{***}	0.035
Provisions (t-1)*C	0.110	0.081	0.091	0.088	0.0765	0.116	0.099	0.082	0.082	0.080	0.069	0.121	-0.010	0.053	0.071	0.079	0.096	0.149
ROA (t-1)	0.180	0.122	-0.020	0.129	-0.129	0.139	0.154	0.113	0.0167	0.133	-0.145	0.135	0.071	0.122	-0.025	0.127	-0.207^{*}	0.117
ROA (t-1)*C	-0.270^{**}	0.131	-0.072	0.174	-0.441^{***}	0.169	-0.239^{*}	0.123	-0.133	0.168	-0.435^{***}	0.166	-0.199	0.165	-0.097	0.164	-0.375^{**}	0.182
Constant	2.012^{***}	0.460	1.732^{***}	0.335	1.593^{***}	0.472	1.756^{***}	0.427	1.648^{***}	0.345	1.601^{***}	0.447	1.777^{***}	0.355	1.628^{***}	0.317	1.570^{***}	0.450
Observations	1331		1331		1331		1331		1331		1331		1331		1331		1331	
Banks	109		109		109		109		109		109		109		109		109	
AR(2)	0.132		0.302		0.776		0.130		0.278		0.757		0.126		0.243		0.796	
Hansen	0.576		0.297		0.333		0.613		0.345		0.355		0.267		0.149		0.245	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and fixed effects are not reported.

Table 9: Controlling for different behaviour of capital-constrained banks during the financial crisis

Dependent variable L(t):	(1) Tier 1/ Total exposure		(2) Tier 1/ Total assets		(3) Tier 1/ RWA		(4) Tier 1/ Total exposure		(5) Tier 1/ Total assets		(6) Tier 1/ RWA		(7) Tier 1/ Total exposure		(8) Tier 1/ Total assets		(9) Tier 1/ RWA	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted						Y(t)=Real GDP growth, adjusted						Y(t)=Credit gap, adjusted					
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.647***	0.070	0.702***	0.061	0.780***	0.068	0.641***	0.073	0.697***	0.058	0.775***	0.069	0.679***	0.077	0.709***	0.058	0.847***	0.039
L(t-1)*C	-0.054	0.051	-0.063	0.039	0.033	0.074	-0.055	0.047	-0.059	0.039	0.040	0.073	-0.026	0.049	-0.052	0.041	-0.045	0.053
Y (t)	-0.091***	0.020	-0.087***	0.020	-0.041	0.032	-0.062***	0.024	-0.056**	0.025	-0.029	0.040	-0.007*	0.004	0.002	0.004	0.001	0.005
Y (t)*C	0.043*	0.022	0.039	0.025	-0.028	0.045	0.008	0.028	0.003	0.034	0.008	0.053	0.017***	0.004	0.014***	0.005	0.026***	0.009
Y(t)*Constrained	0.065**	0.032	0.089**	0.039	0.200**	0.084	0.009	0.036	0.046	0.050	0.160**	0.079	0.007	0.010	0.013*	0.008	0.011*	0.006
Y(t)*Constrained*C	0.028	0.045	0.039	0.047	0.089	0.126	0.133*	0.080	0.099	0.072	0.255	0.301	0.004	0.012	-0.015	0.016	-0.077**	0.037
Constrained	-0.810***	0.167	-0.952***	0.201	-1.738***	0.406	-0.515***	0.121	-0.627***	0.156	-1.244***	0.232	-0.493***	0.113	-0.546***	0.108	-0.758***	0.146
Rescued	0.242*	0.134	0.267*	0.144	0.858***	0.316	0.208*	0.120	0.250*	0.132	0.850***	0.317	0.359***	0.123	0.301**	0.143	0.287	0.307
C	-0.041	0.147	0.009	0.167	0.570*	0.293	0.123	0.108	0.213*	0.125	0.445*	0.231	0.047	0.115	0.206	0.133	0.576**	0.268
IFRS dummy	-0.079	0.075	-0.195***	0.069	-0.071	0.099	-0.082	0.077	-0.186**	0.077	-0.070	0.101	-0.104	0.087	-0.208**	0.090	-0.124	0.099
Log(assets) (t-1)	-0.182***	0.048	-0.146***	0.041	-0.066	0.043	-0.182***	0.041	-0.153***	0.036	-0.078*	0.042	-0.161***	0.043	-0.149***	0.039	-0.027	0.041
Log(assets) (t-1)*C	0.018	0.028	0.020	0.025	-0.005	0.127	0.032	0.027	0.032	0.026	0.009	0.124	0.063***	0.022	0.038	0.027	0.111	0.100
Provisions (t-1)	0.101***	0.032	0.104***	0.036	0.131***	0.041	0.103***	0.037	0.127***	0.039	0.141***	0.042	0.024	0.040	0.121***	0.043	0.131***	0.036
Provisions (t-1)*C	0.109	0.076	0.107	0.077	0.093	0.164	0.118	0.073	0.089	0.0803	0.074	0.174	0.013	0.054	0.077	0.078	0.112	0.160
ROA (t-1)	0.136	0.125	0.011	0.134	-0.112	0.164	0.149	0.121	0.020	0.135	-0.108	0.160	0.030	0.130	-0.046	0.125	-0.197*	0.117
ROA (t-1)*C	-0.216	0.148	-0.138	0.157	-0.468**	0.183	-0.230*	0.125	-0.127	0.160	-0.493***	0.188	-0.155	0.206	-0.074	0.159	-0.375**	0.178
Constant	2.165***	0.446	1.929***	0.373	2.089***	0.588	1.885***	0.414	1.667***	0.329	2.160***	0.606	1.850***	0.377	1.651***	0.329	1.566***	0.452
Observations	1331		1331		1331		1331		1331		1331		1331		1331		1331	
Banks	109		109		109		109		109		109		109		109		109	
AR(2)	0.110		0.224		0.845		0.105		0.222		0.835		0.138		0.236		0.811	
Hansen	0.866		0.431		0.200		0.715		0.410		0.164		0.200		0.164		0.218	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and fixed effects are not reported.

Table 10: Disentangling the effect on the numerator and the denominator

Dependent variable L(t):	(1) Tier 1 growth		(2) Tier 1 adj growth		(3) Total exposure growth		(4) Total assets growth		(5) Risk-weighted assets growth		(6) Tier 1 growth		(7) Tier 1 adj growth		(8) Total exposure growth		(9) Total assets growth		(10) Risk-weighted assets growth	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted										Y(t)=Real GDP growth, adjusted									
	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	-0.045	0.041	-0.042	0.041	0.023	0.0566	0.120*	0.063	-0.053	0.130	-0.055	0.041	-0.053	0.041	0.033	0.052	0.109**	0.045	-0.077	0.128
L(t-1)*Dummy	-0.098**	0.047	-0.127**	0.052	-0.048	0.099	-0.249***	0.084	-0.029	0.135	-0.091*	0.048	-0.12**	0.052	-0.057	0.094	-0.179**	0.077	-0.002	0.136
Y (t)	-0.672	0.544	-0.461	0.565	1.287***	0.494	0.666**	0.314	0.145	0.419	0.857	0.703	1.011	0.709	1.443**	0.619	0.712*	0.404	0.767	0.587
Y (t)*C	-0.554	0.499	-0.788	0.525	-0.615	0.566	-0.308	0.343	0.260	0.440	-2.298***	0.861	-2.48***	0.869	-0.562	0.666	0.058	0.457	-0.163	0.607
C	-1.443	3.285	0.778	3.381	-3.256	3.094	-4.124**	2.040	-12.20***	2.919	2.178	2.564	3.633	2.572	-4.840**	2.461	-5.244***	1.865	-10.11***	2.226
IFRS dummy	4.309***	1.434	4.173***	1.472	4.880***	1.113	5.688***	0.926	4.707***	1.300	4.087***	1.433	3.950***	1.463	5.362***	1.061	6.338***	0.959	6.345***	1.793
GSIB	0.589	1.549	0.092	1.560	3.195*	1.678	3.198**	1.387	-1.055	2.034	0.661	1.554	0.096	1.563	2.839**	1.431	2.514*	1.412	-0.206	1.895
GSIB*C	3.228	2.980	3.692	2.967	-2.922	2.178	-2.980*	1.678	0.649	2.647	3.001	2.879	3.617	2.858	-2.901	2.047	-3.982**	1.962	-0.778	2.495
SMALL	3.839*	2.035	3.584*	2.093	2.464	1.957	2.158*	1.248	4.633***	1.363	4.049*	2.122	3.790*	2.173	2.952*	1.545	3.361**	1.324	4.620***	1.317
SMALL*C	-7.162**	3.586	-7.899**	3.707	-3.816	3.302	-0.106	1.880	-4.744*	2.509	-7.641**	3.642	-8.35**	3.743	-5.152*	2.816	-5.471**	2.631	-4.516	2.846
Provisions (t-1)	-0.132	0.679	-0.242	0.703	-1.225**	0.477	-1.074***	0.321	-1.346**	0.595	-0.0343	0.709	-0.195	0.738	-1.341***	0.458	-1.151***	0.344	-1.163**	0.567
Provisions (t-1)*C	-1.374*	0.753	-1.104	0.757	-0.435	0.511	-0.105	0.320	-0.320	0.553	-1.437**	0.729	-1.116	0.734	-0.256	0.467	-0.280	0.361	-0.346	0.622
ROA (t-1)	-2.625	2.042	-2.912	2.093	-0.548	1.284	1.120	0.997	2.253	1.932	-3.535	2.171	-3.773*	2.199	-0.239	1.364	1.472	1.128	3.226*	1.843
ROA (t-1)*C	-2.499	2.936	-2.646	2.928	2.111	1.591	1.120	1.156	1.190	2.067	-1.365	2.938	-1.569	2.912	1.741	1.441	0.247	1.319	-0.754	2.032
Constant	8.950***	3.216	8.883***	3.242	-0.962	3.702	1.262	3.069	7.156**	3.247	4.435	3.003	5.045*	3.067	1.864	2.723	1.952	2.293	3.613	2.612
Observations	1176		1176		1176		1176		1176		1176		1176		1176		1176		1176	
Banks	109		109		109		109		109		109		109		109		109		109	
AR(2)	0.490		0.476		0.133		0.113		0.562		0.278		0.293		0.135		0.101		0.659	
Hansen	0.431		0.299		0.346		0.701		0.225		0.414		0.258		0.377		0.188		0.212	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and bank fixed effects are not reported.

Table 10 (continued): Disentangling the effect on the numerator and the denominator

Dependent variable L(t):	(11) Tier 1 growth		(12) Tier 1 adj growth		(13) Total exposure growth		(14) Total assets growth		(15) Risk-weighted assets growth	
Business cycle measures:	Y(t)=Credit gap, adjusted									
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	-0.053	0.0407	-0.049	0.041	0.056	0.051	0.150**	0.061	-0.051	0.129
L(t-1)*C	-0.120**	0.0480	-0.144***	0.052	-0.103	0.099	-0.285***	0.091	-0.035	0.135
Y (t)	0.023	0.088	-0.003	0.0877	0.099*	0.059	0.018	0.051	-0.043	0.074
Y (t)*C	0.316**	0.141	0.239*	0.142	-0.288***	0.073	-0.200***	0.065	-0.139	0.109
C	-4.379*	2.493	-2.446	2.547	-6.291***	1.697	-4.760***	1.642	-10.27***	2.434
IFRS dummy	3.340**	1.544	3.525**	1.568	5.312***	1.016	6.604***	0.985	5.348***	1.435
GSIB	-0.380	1.663	-0.733	1.649	2.427*	1.349	2.812**	1.338	-0.569	1.994
GSIB*C	4.972	3.241	5.239*	3.155	-2.945	2.137	-3.121*	1.752	-0.137	2.685
SMALL	3.240	2.205	3.090	2.245	2.127	1.846	3.027**	1.282	4.974***	1.430
SMALL*C	-6.246*	3.717	-7.206*	3.837	-4.069	3.439	-2.059	1.998	-5.295**	2.617
Provisions (t-1)	-0.424	0.810	-0.612	0.830	-0.884*	0.503	-0.900**	0.353	-1.287**	0.598
Provisions (t-1)*C	-0.743	0.767	-0.561	0.786	-0.654	0.536	-0.575	0.374	-0.629	0.569
ROA (t-1)	-4.802**	2.272	-4.599**	2.271	0.630	1.402	2.157**	1.006	3.214*	1.939
ROA (t-1)*C	-0.150	2.887	-1.036	2.895	1.236	1.713	0.248	1.334	0.114	2.035
Constant	11.26***	3.491	11.09***	3.566	1.680	2.641	2.008	2.960	5.287*	3.052
Observations	1176		1176		1176		1176		1176	
Banks	109		109		109		109		109	
AR(2)	0.331		0.214		0.162		0.152		0.604	
Hansen	0.314		0.206		0.259		0.497		0.282	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and bank fixed effects are not reported.

Table 11: Disentangling the effect on the components of total exposure

Dependent variable L(t):	(1) Asset derivatives Correction growth		(2) Securities financing transactions growth		(3) Off-balance sheet items growth		(4) Guarantees growth		(5) Asset derivatives Growth		(6) Securities financing transactions growth		(7) Off-balance sheet items growth		(8) Guarantees growth	
Business cycle measures:	Y(t)=Nominal GDP growth, adjusted								Y(t)=Real GDP growth, adjusted							
	Coeff.	Std.err	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.080	0.056	-0.079	0.075	-0.005	0.050	-0.033	0.0543	0.095	0.062	-0.083	0.073	0.086*	0.048	-0.031	0.055
L(t-1)*C	-0.005	0.077	0.006	0.116	-0.076	0.065	0.051	0.0875	-0.017	0.082	0.011	0.116	-0.128	0.093	0.050	0.088
Y (t)	0.487	0.565	-1.339	0.989	1.890*	1.140	2.265**	0.889	0.713	0.536	-0.281	0.858	1.247**	0.633	2.925**	1.196
Y (t)*C	0.316	0.605	0.619	0.994	-0.036	1.215	-1.246	0.817	-0.358	0.822	-0.390	1.107	-0.305	0.780	-1.871	1.212
C	5.113	3.993	-18.48***	6.914	0.030	6.698	-0.414	5.034	6.812*	3.530	-13.44***	4.660	-5.679*	3.216	-2.173	5.150
IFRS dummy	-1.323	2.538	8.102***	2.097	-5.636	3.434	-0.804	2.821	-0.905	2.269	7.896***	2.071	-0.893	2.025	-0.500	2.785
GSIB	5.228***	1.707	8.095***	2.537	6.247**	3.042	1.376	2.865	6.542***	1.721	8.334***	2.538	3.679**	1.750	1.236	2.904
GSIB *C	-12.45***	3.178	6.912	7.089	-5.327	6.228	-2.642	4.247	-13.79***	3.014	6.115	6.944	-1.405	3.201	-1.947	4.462
SMALL	4.576***	1.687	6.947***	2.303	4.053	5.295	3.867	3.372	5.667***	1.764	7.082***	2.369	5.541	4.034	3.992	3.396
SMALL *C	-3.589	5.379	-2.524	7.736	-9.676	6.848	-3.336	5.261	-3.808	4.946	-3.171	7.767	-3.705	5.632	-3.245	5.197
Provisions (t-1)	-0.957*	0.493	-1.535**	0.776	-3.676***	1.013	-0.277	0.777	-0.877*	0.467	-1.360*	0.753	-1.652**	0.716	-0.477	0.789
Provisions (t-1)*C	1.311*	0.681	0.562	1.137	0.627	1.087	-1.199	0.944	1.181**	0.557	0.386	1.140	0.115	0.871	-1.094	0.959
ROA (t-1)	4.989**	2.047	2.503	2.902	-0.182	2.983	-0.846	2.800	4.853***	1.835	1.749	2.982	2.321	1.931	-0.316	2.755
ROA (t-1)*C	-1.586	2.490	0.648	3.588	4.856	3.164	-1.181	2.952	-2.141	2.054	1.478	3.666	1.667	2.013	-1.922	2.858
Constant	2.789	5.372	5.993	5.452	10.20	7.782	-2.349	5.075	2.424	3.757	0.912	3.733	3.707	3.866	0.066	5.087
Observations	1176		1176		1176		1176		1176		1176		1176		1176	
Banks	109		109		109		109		109		109		109		109	
AR(2)	0.390		0.731		0.874		0.851		0.379		0.748		0.877		0.849	
Hansen	0.396		0.331		0.508		0.428		0.213		0.318		0.373		0.270	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and bank fixed effects are not reported.

Table 11 (continued): Disentangling the effect on the components of total exposure

Dependent variable L(t):	(9) Asset derivatives correction growth		(10) Securities financing transactions growth		(11) Off-balance sheet items growth		(12) Guarantees growth	
Business cycle measures:	Y(t)=Credit gap, adjusted							
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
L(t-1)	0.088	0.060	-0.092	0.078	0.001	0.049	-0.029	0.057
L(t-1)*C	-0.019	0.080	0.001	0.115	-0.079	0.066	0.034	0.103
Y (t)	-0.107	0.077	-0.032	0.151	0.440***	0.142	0.198*	0.117
Y (t)*C	0.122	0.180	0.593**	0.275	-0.809***	0.172	-0.321**	0.159
C	4.342	3.328	-18.72***	4.542	1.252	3.852	-7.438	4.602
IFRS dummy	-0.208	2.312	6.960***	2.560	-5.928*	3.425	0.012	3.065
GSIB	6.426***	1.871	7.555***	2.594	6.724**	2.977	1.522	2.871
GSIB *C	-12.78***	3.633	8.320	7.191	-6.790	5.881	-4.352	4.596
SMALL	5.501***	1.677	6.724***	2.347	3.886	5.227	3.083	3.961
SMALL *C	-2.683	4.827	-2.133	7.520	-9.757	6.887	-2.692	6.011
Provisions (t-1)	-0.996*	0.579	-1.855**	0.781	-2.499***	0.921	-0.0579	0.914
Provisions (t-1)*C	1.277**	0.649	1.334	1.154	-0.358	1.193	-0.753	1.133
ROA (t-1)	5.732***	1.953	-0.0542	2.722	2.386	2.894	1.283	2.516
ROA (t-1)*C	-3.007	2.335	3.799	3.518	2.707	3.087	-3.375	2.516
Constant	4.115	3.777	6.959*	4.209	10.23*	5.268	4.065	5.611
Observations	1176		1176		1176		1176	
Banks	109		109		109		109	
AR(2)	0.199		0.799		0.924		0.874	
Hansen	0.232		0.339		0.164		0.335	

Note: The sample period is from 1995 to 2012. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported. ***, **, * indicate significance at the 1%, 5%, and 10% level. Country dummies and bank fixed effects are not reported.

Figure 1: Tier 1 capital across rescued and non-rescued banks

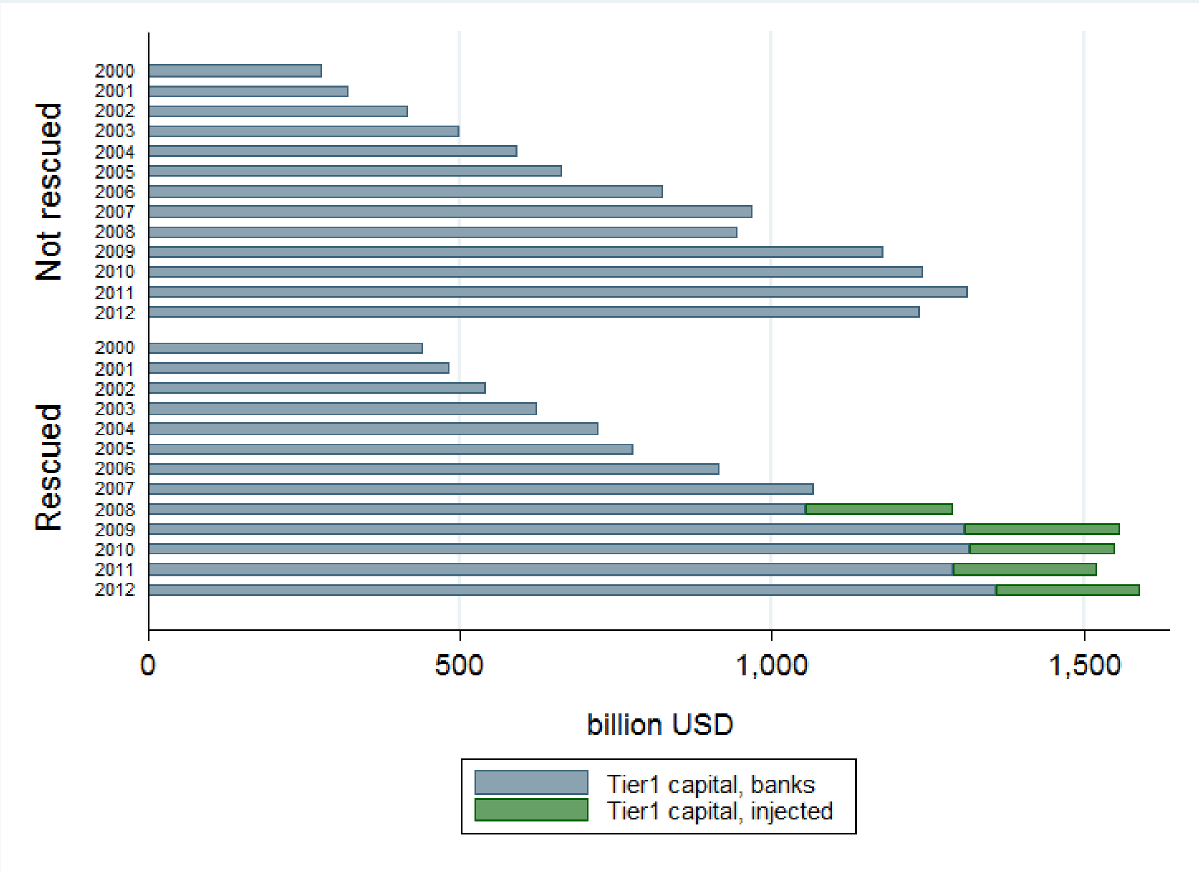
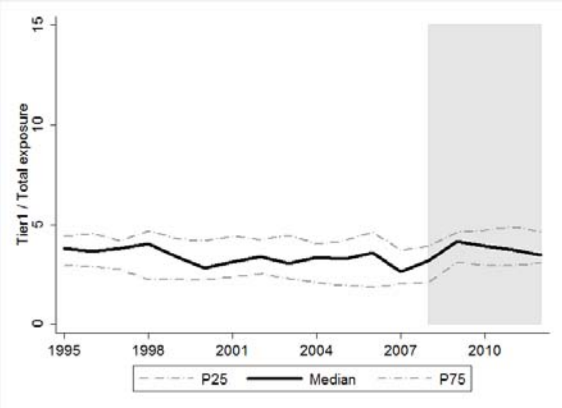


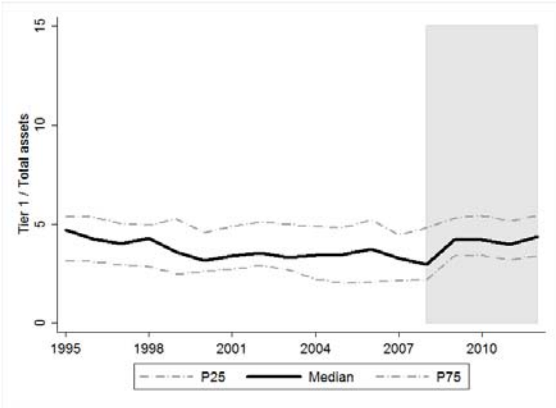
Figure 2: The capital ratios across Global Systemically Important Banks (GSIBs) and non-GSIBs

A) GSIBs

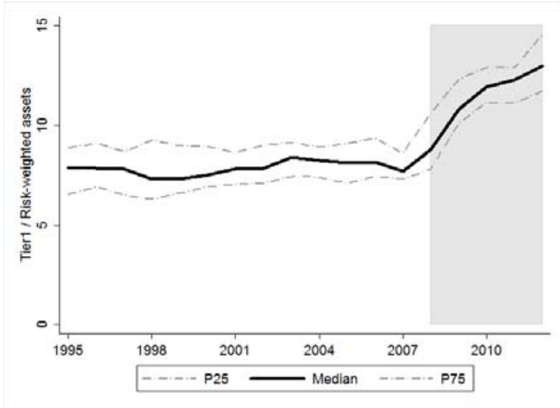
Tier 1 / Total exposure



Tier 1 / Total assets

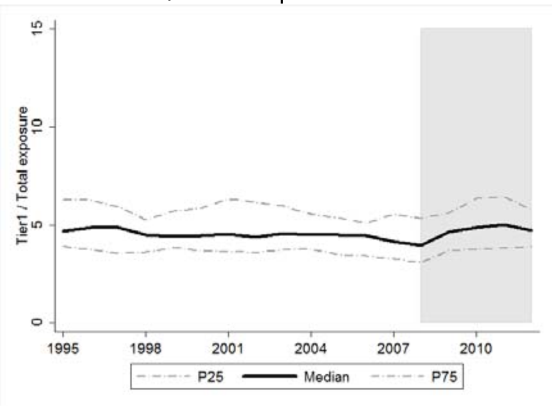


Tier 1 / RWA

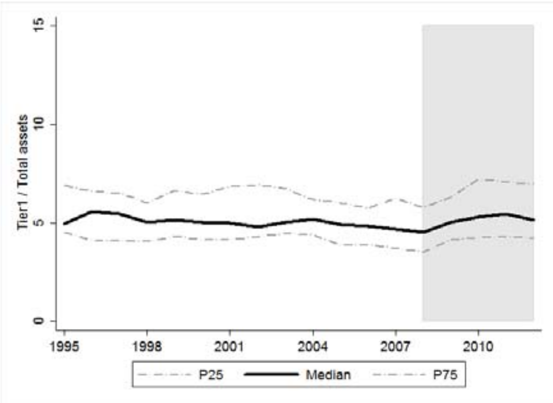


B) Non-GSIBs

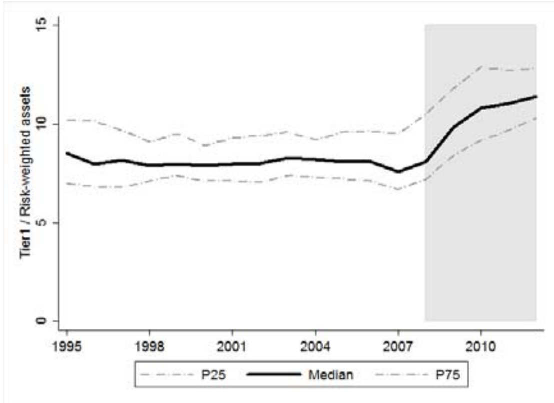
Tier 1 / Total exposure



Tier 1 / Total assets



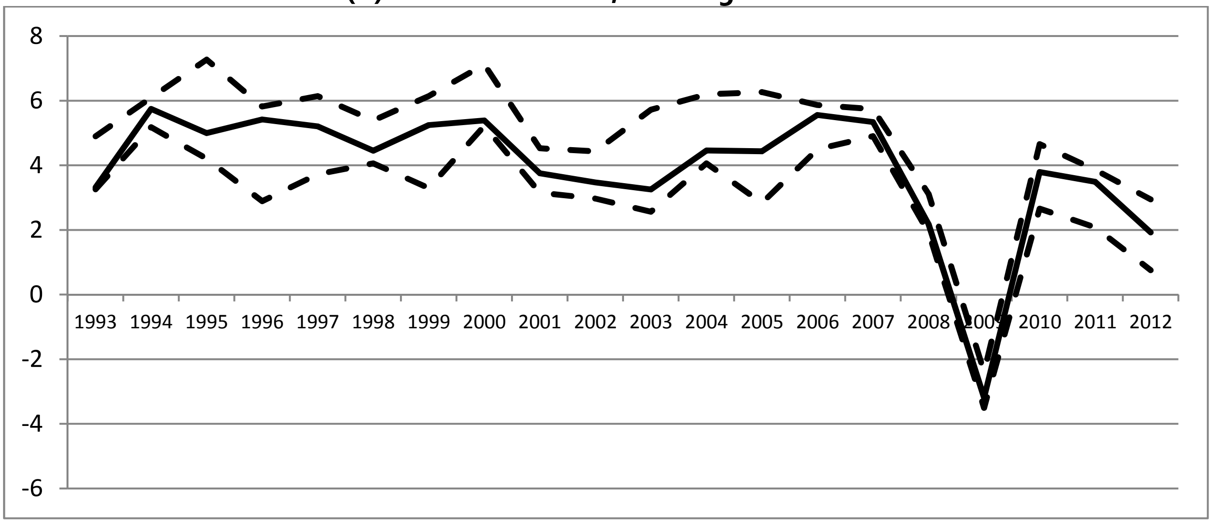
Tier 1 / RWA



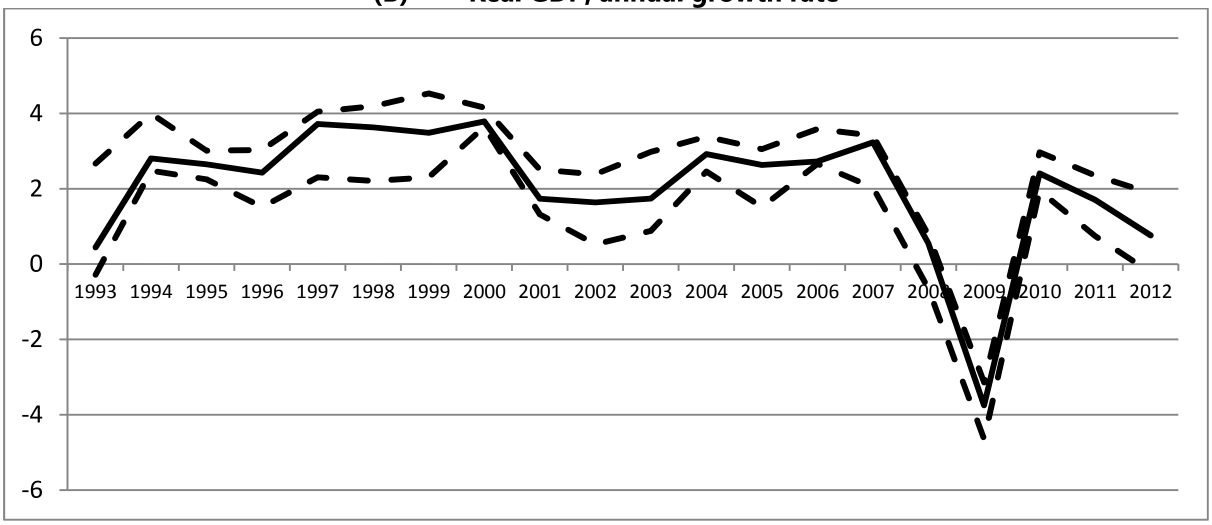
Note: The solid lines represent the median value of each ratio over the distribution of banks in the sample. The dotted lines indicate the first and the last quartile of the distribution.

Figure 3: Cycle indicators

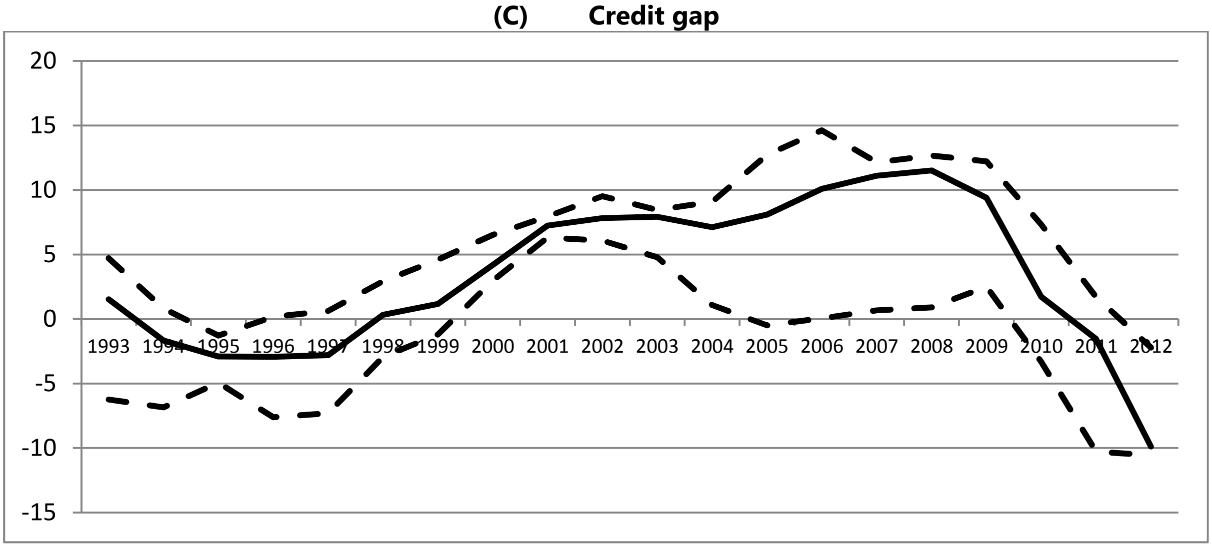
(A) Nominal GDP, annual growth rate



(B) Real GDP, annual growth rate



(C) Credit gap



Note: The solid lines represent the median value of each bank-specific cycle indicator over the distribution. The dotted lines indicate the first and the last quartile of the distribution.

Annex A: How to calculate a proxy for the "exposure measure".[17]

The new Basel III leverage ratio is calculated as Tier 1 capital over the exposure measure. The exposure measure for the leverage ratio generally follows the accounting measure, according to the following general principles:

- on-balance sheet, non-derivative exposures are included in the "exposure measure" net of specific provisions and valuation adjustments (eg credit valuation adjustments);
- netting of loans and deposits is not allowed; and
- physical or financial collateral, guarantees or credit risk mitigation purchased are not allowed to reduce on-balance sheet exposures.

The Basel III framework provides specific treatments for derivatives, securities financing transactions (SFTs) and off-balance sheet items.

In particular, a bank's exposure measure is the sum of: (a) on-balance sheet exposures (other than SFTs and derivatives); (b) derivatives exposures; (c) SFT exposures; and (d) other off-balance sheet exposures. This makes the "exposure measure" different from the "total asset" measure, generally used to calculate the denominator of the (accounting) leverage ratio. This is further complicated by the fact that accounting rules in some countries differ significantly and not all the information is available on-balance sheet. For example, derivatives positions are included at the gross level (both among assets and liabilities) using IFRS and directly at the net level using US GAAP.

BankScope data do not have a sufficient level of detail to reconstruct directly a bank's "exposure measure".[18] However, the high level of detail of the information derived from the Quantitative Impact Study of the Basel Committee on Banking Supervision (QIS database, BCBS (2013)) allows us to calculate coefficients of correction to be applied to BankScope items to "proxy" the effect of the Basel III methodology. Confidentiality issues do not allow us to reconstruct the coefficients of correction at the bank level but only at the country level. Therefore we can correct balance sheet items – on average – for differences in accounting measures across countries but we cannot capture bank-specific heterogeneities. Another important caveat is that QIS data are only available for the period 2011–12 so that, to correct data backward, one has to rely on the (strong) hypothesis that applicable accounting rules have not changed through time.

In particular, we use the following formula to proxy the "exposure measure" (BankScope item codes are indicated in brackets, while the cells of the reconciliation templates used for the correction coefficients are indicated after the acronym "LR"). The rationale of the formula below is to start with the (accounting) measure of total assets and to add/subtract correction components.

Exposure measure=

Total assets (11350) +

Asset derivatives (11160) * (A+B) +

[17] We thank Luca Serafini (Bank of Italy) and James Haas (FDIC) for useful comments and suggestions. Gabriele Gasperini and Markus Zoss provided excellent research assistance on QIS data.

[18] BankScope moved in 2009 from reporting three spreadsheets for bank analysis (global, liquidity, and universal format) to a universal spreadsheet (Fitch Ratings (2009)). It appears that some items from the off-balance sheet and regulatory capital sections have not been carried over historically for certain banks to the new universal spreadsheet and, thus, we complement the information using the global and liquidity format of historical, archived BankScope releases. Moreover, in some particular cases the information on the two mentioned sections is missing, although it is reported in the years before and thereafter. In these cases, we use information from banks' published annual reports and, if we do not find any information, we interpolate linearly the items concerned for a maximum of four years.

Reverse repos and cash collateral (11145) * C +

[Other off-balance sheet exposure to securitisation (18310) + Acceptances and documentary credits reported off-balance sheet (18320) + Committed credit lines (18325)] * D +

Guarantees (18315) – Goodwill (11300) – Other intangibles (11310) +

[Total assets (11350) – Asset derivatives (11160) – Reverse repos and cash collateral (11145)] * E

where:

$$A = \frac{Counterparty\ exposure\ with\ Basel\ II\ netting\ rules\ (LR{:}F9)}{Derivatives\ accounting\ balance\ sheet\ value\ (LR{:}D9)} - 1$$

$$B = \frac{Derivatives\ potential\ future\ exposures\ (LR{:}E36)}{Derivatives\ accounting\ balance\ sheet\ value\ (LR{:}D9)}$$

$$C = \frac{SFT\ counterparty\ exposure\ with\ Basel\ II\ netting\ rule\ method\ 1\ (LR{:}F13)}{SFT\ accounting\ balance\ sheet\ values\ (LR{:}D13)}$$

$$D = \frac{\begin{array}{c} Off{-}balance\ sheet\ items\ with\ 0\%\ CCF\ (LR{:}G43)*0.10 + Off{-}balance\ sheet\ items\ with\ 20\%\ CCF\ (LR{:}G43)*0.20 + \\ Off{-}balance\ sheet\ items\ with\ 50\%\ CCF\ (LR{:}G47)*0.50 + Off{-}balance\ sheet\ items\ with\ 100\%\ CCF\ (LR{:}G48) \end{array}}{Total\ off{-}balance\ sheet\ items\ at\ notional\ amount\ (LR{:}G49)}$$

$$E = \frac{Other\ assets\ gross\ value\ assuming\ no\ netting\ or\ credit\ risk\ mitigation\ (LR{:}E16)}{Other\ assets\ accounting\ value\ (LR{:}D16)} - 1$$

The coefficient A corrects for the difference in derivatives netting. For banks that use IFRS or Japanese GAAP, counterparty exposure to derivatives with Basel II netting rules is lower than derivatives accounting balance sheet value and we have A≤0. In other words, the value that is reported in the BankScope database is larger than that used to calculate the exposure measure. In contrast, A≥0 for banks that apply US GAAP.

The coefficient B≥0 corrects for the additional add-on derivatives for potential future exposures. In particular it is an amount for potential future credit exposure over the remaining life of the contract calculated by applying an add-on factor to the notional principal amount of the derivative.

The coefficient C≥0 takes into account corrections for securities financing transactions. In particular, it considers a measure of counterparty credit risk calculated as current exposure without an add-on for potential future exposure.

The coefficient 0≤D≤1 corrects for the particular treatment of other off-balance sheet (OBS) exposures, as defined under the risk-based framework, which could be a source of potentially significant leverage. The OBS items include commitments (including liquidity facilities), unconditionally cancellable commitments, direct credit substitutes, acceptances, standby letters of credit, trade letters of credit, failed transactions and unsettled securities. These items have to be included using different credit conversion factors (CCF) that go from 10% to 100%. In particular, the coefficient D indicates a CCF weighted average that can be applied to OBS exposures.

A final correction with the coefficient E takes into account mitigation factors for other assets not considered in the corrections above. However, the value of E is very close to zero.

The mean and the median values of the coefficients are reported in Table A1 for different accounting standards. The corrections have been computed by considering different coefficients for big banks (those with Tier 1 capital larger than 3.9 billion dollars) with respect to "small" banks (with Tier 1 capital lower than 3.9 billion dollars). Roughly 80% of the banks in the sample are considered to be "big". Figure A1 shows over time the relative weight of each correction components in the calculation of the exposure measure when applying this concept to BankScope data.[19] On average,

[19] QIS information is available for 2011 and 2012 only. First, we checked the reliability of the applied corrections over these two years using both BankScope and QIS data. We then applied the average correction coefficients for the period 2011–12 backwards on the BankScope data for 1995–2010.

off-balance items account for almost 48% of the correction (the difference between the exposure measure and net total assets), repos for 27% and guarantees for 20%. The impact of the correction applied to derivative exposures is limited to 5% of the total corrections.

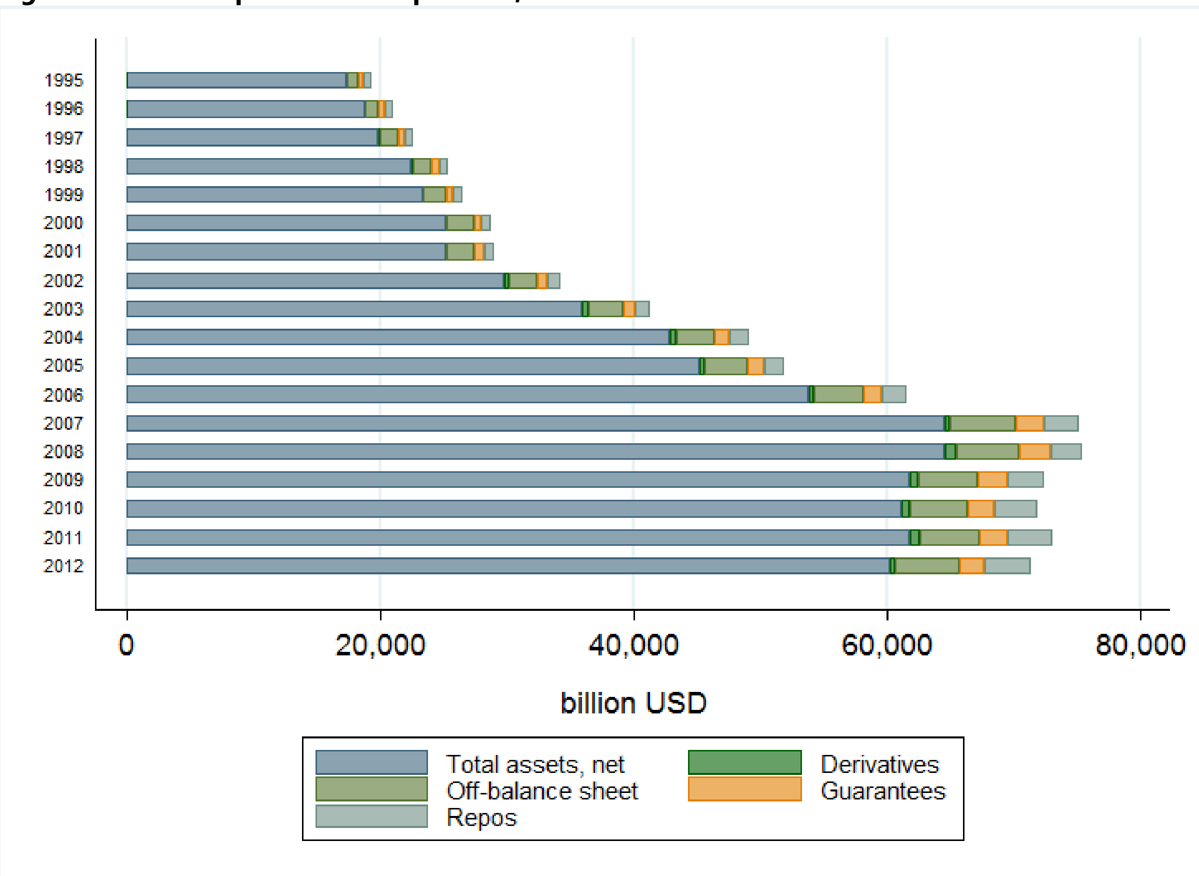
Figure A2 compares, for each macro-region, the (reconstructed) new measure of the leverage ratio (bold line) and the accounting measure of leverage with total assets at the denominator (dotted line) over the period 1995–2012. The shaded area indicates the post-Lehman period.

In Table 10 we consider an adjusted measure of Tier 1 (fully phased-in) that is based on a more conservative definition for capital (see BCBS (2009) for details). In particular, we have considered: Tier 1 adjusted= H*Tier 1 (values of H are reported in Table A1).

Table A1: Correction coefficients used for the exposure measure formula

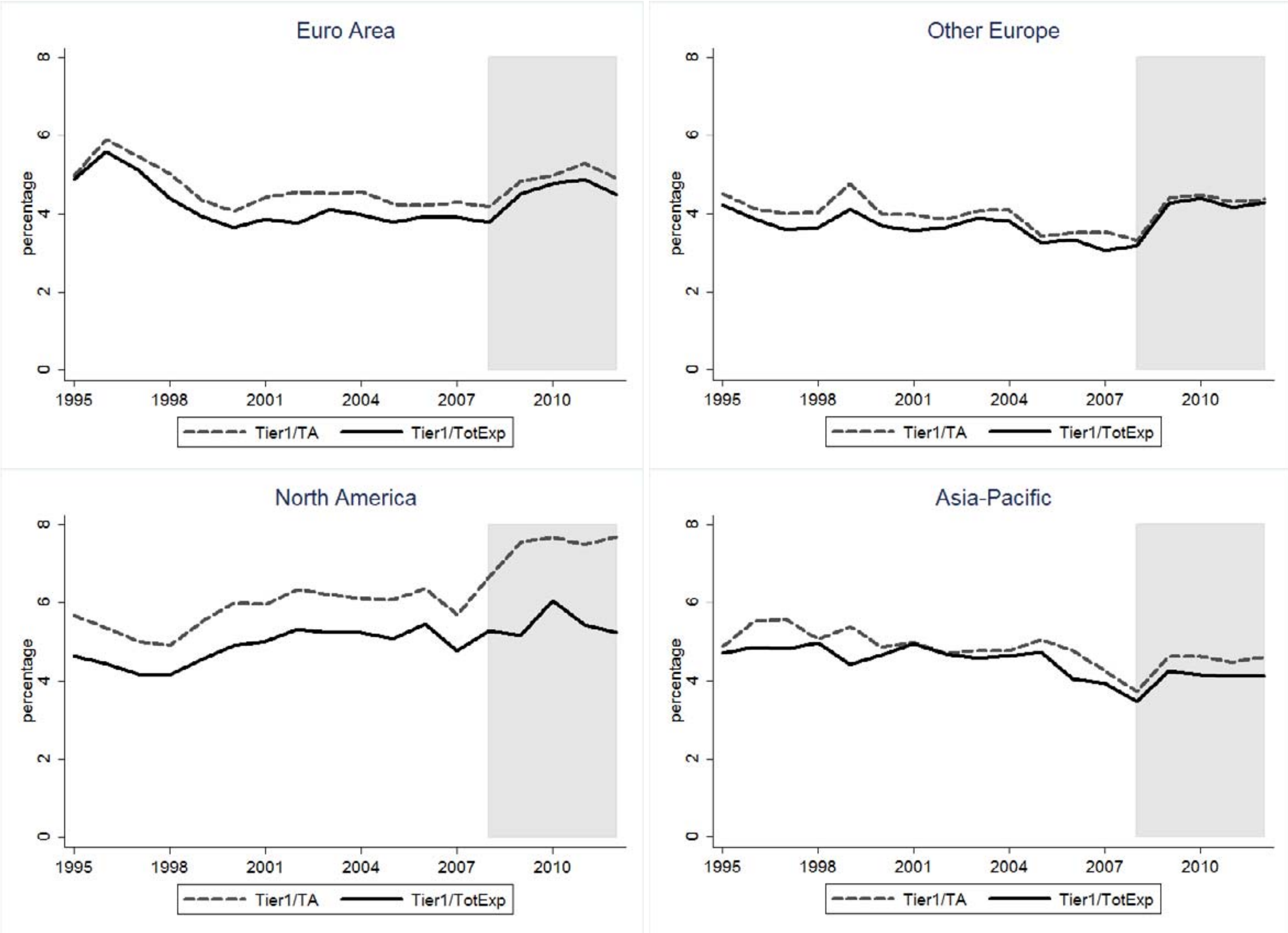
Accounting standards	mean values						median values					
	A	B	C	D	E	H	A	B	C	D	E	H
2011												
IFRS	-0.512	0.532	0.519	0.389	0.004	0.794	-0.524	0.373	0.481	0.368	0.000	0.843
US GAAP	0.685	2.483	0.551	0.561	0.001	0.826	0.364	1.346	0.570	0.509	0.000	0.866
Other national standards	-0.226	0.937	0.585	0.408	0.009	0.835	0.000	0.729	0.988	0.370	0.000	0.946
2012												
IFRS	-0.525	0.581	0.314	0.384	0.005	0.834	-0.583	0.313	0.074	0.365	0.000	0.873
US GAAP	0.591	2.873	0.395	0.548	0.000	0.887	0.268	1.991	0.347	0.473	0.000	0.937
Other national standards	-0.210	1.444	0.298	0.405	0.003	0.907	0.000	0.840	0.002	0.333	0.000	0.971

Figure A1: Total exposure decomposition, all banks



Note: Total assets, net = Total assets – Goodwill – Intangibles.

Figure A2: Tier 1 over total exposure versus Tier 1 over total assets, median by macro region



Note: Asia-Pacific indicates AU and JP; Euro area includes AT, BE, DE, ES, FR, IT and NL; North America is CA and US; and Other Europe represents CH, UK, and SE.

Annex B: Unit root tests on the variables

As the panel is not perfectly balanced, we have performed tests for unit roots (or stationarity) using the approach followed by Im, Pesaran and Shin (2003). In particular this approach relaxes the assumption of a common autoregressive coefficient for all cross sections allowing for cross section-specific coefficients. The results, reported in Table B1 below, indicate that, when nominal and real GDP are transformed in growth rates, the null hypothesis that all panels have a unit root is always rejected. On the contrary, the null hypothesis is always accepted when variables are used in levels or transformed by the logarithm.

The credit gap variable and the capital ratios appeared borderline stationary and further investigation was needed. To corroborate the results we have therefore also calculated Fisher-type tests (Choi (2001)) for each country individually, and then combined the p-values from these tests to produce an overall test. In this case the credit gap variable and the capital ratios are strongly stationary.

Table B1: Im-Pesaran-Shin unit root tests

Variables	Number of panels	Transformations					
		Levels			Growth rates		
		Lags average (1)	W-t-bar (2)		Lags average (1)	W-t-bar (2)	
			Stat	p-value		Stat	p-value
Nominal GDP (3)	14	0.64	-0.2550	0.3994	0.36	-5.641	0.000
Real GDP (3)	14	0.79	0.0040	0.5016	0.36	-7.4983	0.000
Credit gap (3)	14	0.86	-1.2020	0.1148	0.14	-3.5461	0.000
Tier 1 / Exposure measure	14	0.21	-1.6140	0.0533	0.29	-13.042	0.000
Tier 1 / Total assets	14	0.43	-2.8633	0.0021	0.21	-13.659	0.000
Tier 1 / RWA	14	0.21	-1.2403	0.0939	0.21	-14.072	0.000

Notes: (1) In the Im-Pesaran-Shin test, the number of lags in the ADF regression is allowed to be different for each panel. The number of optimal lags is selected using the Akaike Information Criteria (AIC). The column indicates the average number of lags used in the Augmented Dickey-Fuller (ADF) regressions performed when computing the test statistic. (2) The null hypothesis of the Im-Pesaran-Shin test is that all panels have a unit root. The alternative hypothesis is that the fraction of panels that are stationary is non-zero. Following Levin, Lin and Chu (2003), prior to performing the test, we have first subtracted the cross-sectional averages from the series. This allows the impact of cross-sectional dependence to be mitigated. W-t-bar statistic is asymptotically normally distributed when first T tends to infinity followed by N tending to infinity. (3) The test on the cyclical variables is computed on the raw data (not the weighted cyclical measures).

Annex C: Capital-constrained banks

Table D1: Capital ratios and regulatory minimum, by macro region (1995–2012)

Region (1)	(I) Tier 1 / RWA	(II) Tier 1 / RWA	(III) Total capital / RWA	(IV) Total capital / RWA	(V) Tier 1 / Total assets	(VI) Tier 1 / Total assets	(VII) Tier 1 / Total exposure	(VIII) Tier 1 / Total exposure	(IX) Tier 1/ TA (US, Canada, Switzerland)	(X) Dummy constrained (2)
	Distance to 4% <10th percentile	< 4%	Distance to 8% <10th percentile	< 8%	Distance to 3% <10th percentile	< 3%	Distance to 3% <10th percentile	< 3%	Distance to minimum <10th percentile	
Asia-Pacific	52	3	38	4	11	15	10	26	-	61
Euro area	71	1	77	8	100	127	92	156	-	107
Other Europe	19	0	17	1	44	49	49	64	0	28
North America	16	0	19	2	4	6	8	12	42	63
Total	158	4	151	15	159	197	159	258	42	259
As a % of total observations	10.3	0.3	9.8	1.0	10.3	12.8	10.3	16.8	2.7	16.4

Note: (1) Number of year/bank observations per region. Asia-Pacific indicates AU and JP; euro area represents AT, BE, DE, ES, FR, IT and NL; North America is CA and US; and Other Europe indicates CH, UK, and SE. "Total" indicates the total number of observations over countries. Percentiles have been calculated for 109 banks and 1,539 observations. (2) Because RWA capital ratios are in place in all countries, we first assign a value of 1 to those banks that are close (<10th percentile) to Tier 1/RWA=4% (see column I). Then we include those banks that have not been included in step 1, but which were close to Total capital/RWA=8% (see column III). Finally, for US and CA we include in addition (if they have not already been included before) those banks that were close to their country-specific leverage minimum (<10th percentile in the country), which is 3% in the United States and 5% in Canada prior to 2000 and 4.3% thereafter. The introduction of a leverage ratio requirement for large banking groups has been announced in Switzerland in 2009 (see column IX).

Source: BankScope.