The leverage ratio over the cycle

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Abstract

This paper analyses how the Basel III leverage ratio (TIER 1 capital over Exposure) behaves over the cycle. The analysis proposes a set-up that allows testing for the cyclical properties of bank capital taking into account structural shifts in banks' behaviour during the global financial crisis and its aftermath. Using a large dataset covering international banks headquartered in 14 advanced economies for the period of 1995-2012, we find that the Basel III leverage ratio is significantly more counter-cyclical 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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1. Introduction

The global financial crisis has highlighted the limits of risk-sensitive bank capital ratios (regulatory capital divided by risk-weighted assets). Despite numerous refinements and revisions over the last two decades, the weights applied to asset categories seem to have failed to fully reflect banks' portfolio risk causing an increase in systemic risk (Acharya and Richardson, 2009; Hellwig, 2010; Vallascas and Hagendorff, 2013). To tackle this problem 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 (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 measure (independently of how banks or regulators estimate their risks) 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 counter-cyclically, 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 and aims at capturing additional risks that are not covered by the simple leverage formula. 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'Hustler, 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). A leverage ratio requirement has been also introduced in Switzerland in 2010.

This paper is the first empirical investigation on how the new leverage ratio behaves over the cycle. In particular, we shed light on three questions: i) Is the new leverage ratio more counter-cyclical (less pro-cyclical) than other capital ratios (for example TIER1 to Total Assets or 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" with respect to a crisis period? From a policy point of view, the 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 models.[2]

[1] Following the business cycle theory, we consider as pro-cyclical (counter-cyclical) 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 pro-cyclicality (counter-cyclicality) 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.

[2] The definition of the Exposure measure at the denominator of the leverage ratio has been refined after a consultation period (BCBS, 2014) 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 migrate the leverage to a Pillar 1 (minimum capital requirement) treatment on 1 January 2018.

Our analysis has to overcome a number of challenges. First, bank-level data over a long time period is needed 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 of our sample operate across a wide range of jurisdictions, the cycle indicators have to be weighted according the location of banks' assets. And finally, we have to correct for differences in accounting standards across countries, when calculating the leverage ratio.

Against these backdrops, 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 is 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, i.e. 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 combined with our data, information derived from the Quantitative Impact Study of the Basel Committee on Banking Supervision (QIS database, BCBS (2013)) to calculate an internationally valid proxy for the "Exposure measure". Finally, to take into consideration the international activity and exposures of the banks in our dataset, 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 2008-2012 which accounts for differences in banks' capitalisation efforts in response to the crisis and the introduction of Basel III capital regulation. The structural change analysis allows us to disentangle leverage ratio movements in reaction to changes in normal cycle conditions, from those that simply reflect banks' need to reduce the overall riskiness of their portfolios, or to deleverage in reaction to the crisis.

Our main results are as follows: i) In normal times the leverage ratio based on the new Exposure measure is significantly more counter-cyclical than other capital ratios. The new definition of the leverage ratio is always more counter-cyclical (less pro-cyclical) than the other 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 securitization) in the Exposure measure (the denominator of the leverage ratio). iii) All capital ratios tend to be less counter-cyclical (more pro-cyclical) during the crisis period. This might be explained by the reduced correlation of the denominator (that includes lending) with cycle measures due to recognition of losses or deleveraging practices.

The remainder of the paper is organized as follows. The next section describes the data and some stylized facts on 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 summarizes 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 final sample of banks covers the major banks from the G10 countries, 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 size of the domestic banking systems. With this procedure, we identified in total 109 banking institutions that cover over 70% of worldwide banking assets reported in The Banker Magazine for the Top 1000 banks. The consolidation of the banking sectors during the last two decades makes it important to control for mergers and acquisitions (M&A). Doing so serves to exclude spurious bursts of individual balance sheet positions that only reflect banks' reorganizations.[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] 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 10% of claims on borrowers outside their home country for Austrian, Australian and US banks to around 50% for Belgian and Swiss banks. It is thus important to adjust our cycle measures for the location of bank assets in the form of a weighted average of the country-specific cycles in which banks operate. Finally, a total of 43 banks have received public recapitalisations during the global financial crisis (see Table 1 and 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. Capital to Risk Weighted Assets ratio (TIER 1/ Risk-weighted assets).

The three ratios have different denominators and relate to different concepts of solvency (see Annex A). Definition I) corresponds to the leverage ratio recently adopted by the Basel Committee on Banking Supervision (BCBS, 2014). 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) items[7]. Definition II) has at the denominator total assets (total balance sheet items). Definition III corresponds to the Capital to Risk

[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 columns III and IV of Table 3 in Gambacorta, 2005).

[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 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.

[7] Annex B provides more information on the calculation of the Exposure measure.

Weighted Assets Ratio (CRAR) and includes at the denominator banks' assets 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, banks reported lower capital ratios than the regulatory minimum.

Capital ratios increased after Lehman's default (September 2008) due to the impulse of market discipline effects, public recapitalisations, and the introduction of the Basel III capital regulation (December 2009). As indicated in Figure 2, the upward trend in capital ratios is evident for both Global Systemically Important Banks (GSIBs) and the other banks and it has been more pronounced for the risk-weighted capital ratio. While the median of the risk-weighted capital ratio increased from 7.7 to 13.0 percent between end-2007 and end-2012 at GSIBs and from 7.6 to 11.4 percent at smaller banks, the average Basel III leverage ratio increased from 2.6 to 3.5 percent at GSIBs and from 4.1 to 4.7 percent at smaller banks during the same period. This is consistent with the evidence in Cohen (2013) who finds 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 2009-2012.

Table 3 slices the dataset along three dimensions: global importance (GSIBs vs small banks), provisioning and profitability. These bank-specific characteristics are relevant to be controlled for in the econometric exercise (see next section). Over the period 1995-2012, GSIBs (relative to small banks) had lower capital ratios, 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 to 9.4% for smaller banks). During the crisis, GSIBs also received more support in the form of official recapitalisations (0.7% of total assets) than other banks (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 capitalization the evidence is mixed. While banks with fewer provisions have a higher risk-weighted capital ratio, they appear less capitalized in terms of the two leverage ratios. The last panel indicates that profitable banks are smaller, more capitalized and with a higher level of diversification in their activities. They also show a much lower dependence on non-deposit funding compared to 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;

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

[8] Credit-to-GDP gaps are derived, in line with the Basel III guidelines for the counter-cyclical 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

Business cycles indicators and the credit gap have to be calculated considering 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 seeks to ensure that we control for both domestic and international macroeconomic conditions so that the cycle indicators are able to 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 indicates average bank features and business cycles by macro regions. While the risk-weighted capital ratios are quite 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. On the contrary, there are important differences in terms of the credit gap, i.e. the Asia-Pacific region shows on average a negative credit gap to GDP ratio 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 react 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 C_t (that takes the value of 1 in 2008-2012 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:

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

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 empirical equation (1) with no structural change ($C = 0$) 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 on capital markets which make it difficult to raise capital on short notice in response to negative capital shocks (Myers and Majluf, 1984). 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} is added in order to determine whether it has an additional effect on the level of capital (the numerator of the ratio L_{ijt}) or banks' total activity (its denominator).

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

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).

effects α_i, since it appears that capital ratios are to a large extent driven by unobserved time-invariant and institution-specific factors (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) have changed accounting standards from local Generally Accepted Accounting Practices (GAAP) to International Financial Reporting Standards (IFRS) in 2005-2006.

As dependent variable (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); III) 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; 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 C 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 measure by bank profits. On one hand, high profits might reflect the direct cost of remunerating capital, and in this case one should expect a 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 are expected to face lower costs of issuing equity, since they are more likely to distribute dividends in the future. The relation between profits and capital during the recent financial crisis might have, however, changed since banks that faced large losses had more market pressures to increase capital ratios than the 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 associated with the 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 or future loan losses. 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 recognize 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).

[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 size increased from 1,433 to 2,027 billion USD, 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).

The variable size could either be influenced by the costs of failure or capital adjustment costs. In the first case, big banks might be thought to keep 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 react to the business cycle? Do they behave pro-cyclically ($\chi > 0$) or counter-cyclically ($\chi < 0$)?

(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 pro-cyclical 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 situation of the banking sector could also impact on the business and credit cycle. We have considered this potential problem in a number of ways.

One 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 presume that the conditions of the Swiss banking industry are more important for economic conditions in Switzerland and do not influence in the same way the US economy, where Swiss banks operate as well. Moreover, while it is probably true that aggregate leverage conditions could influence the business cycle (Phelan, 2014), the specific leverage condition 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 Generalized 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 in 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 (AR2 test) and that the instruments used are valid

[11] This approach has been applied in other areas of research in which the model 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 relation between financial development and economic growth. For an application to the analysis of the bank lending channel see Altunbas et al (2009).

(Hansen test). Both tests - reported at the bottom of each table - should not 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 counter-cyclical (pro-cyclical). In other words, it is tighter in a boom and looser in a bust. As for the interpretation of the size of the impact, a value of the coefficient on the cycle variable equal to 0.1 implies that, if the cycle indicator increases by 1 percentage point, then the leverage ratio increases by 0.1%.

A few patterns emerge.

(1) In normal times the new leverage ratio based on the Exposure measure is never statistically pro-cyclical. It is significantly counter-cyclical in most cases.

(2) The new definition of the leverage ratio is always more counter-cyclical (less pro-cyclical) than the other ratios.

(3) All capital ratios tend to be less counter-cyclical (more pro-cyclical) 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 pretty stable in 2008-2010 and declines strongly in 2011-12; on the contrary, the GDP measures have a trough in 2009 and recover afterwards.

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 important persistence in the capital ratios indicated by the positive and significant coefficient of the lagged capital ratios pointing to the presence of short-term capital adjustment costs. The analysis of the coefficients on bank-specific characteristics gives also some interesting insight. The positive link between provisions and capital ratios is in line 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 according to 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 focused on the statistical significance of the coefficients on the cycle indicators. However, what is more important is the economic significance. For example, considering 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 $L_{ijt} = L_{ijt-1} = L^*$.

[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 analog 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.

4.1 Robustness checks

We tested the robustness of these results in several of 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 in a given year public capital on its balance sheet 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:

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

Results presented in Table 8 indicate that, after controlling for these effects, the counter-cyclical behaviour of capital ratios is even reinforced and the new definition of the leverage ratio is always more counter-cyclical (less pro-cyclical) than the other ratios. As expected the coefficient on 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 greater level of capitalization 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; Heid et al., 2004; Gropp and Heider, 2010). This suggests that the response of the capital ratios to the cycle might be asymmetric and depend on the fact whether a bank faces regulatory pressure or not. The model was therefore further enriched by including interactions between the business cycle indicator and the dummy *Constrained*. We have:

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

Also in this case the main conclusions were confirmed. In particular the results presented in Table 9 indicate that the new definition of the leverage ratio still tends to be more counter-cyclical (less pro-cyclical) than the other ratios. Interestingly, controlling for differential cyclical effects of constrained banks, the capital ratios are less pro-cyclical during the crisis period (following the point made before,

[13] We consider a bank as capital constrained, when the distance 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 on risk-weighted capital ratios (Tier 1 / RWA > 4%, total capital / RWA >8%), there are additional limits 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)) has been 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 higher than 3% in the case of banks with sufficiently high CAMELS ratings (Crawford et al. (2009), D'Hustler (2009)). A leverage ratio requirement has been introduced in Switzerland in 2010. For more information see Annex D.

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 leverage and RWA ratios reaction to the output gap, i.e. 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-crises trends and persistent high unemployment rates in some advanced economies are often seen as 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 (TIER1) 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, 2013). 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, securitizing 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 will 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 correlation of the denominator with the cycle, the tighter the corresponding regulatory ratio becomes in a boom and looser 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 banks' assets at t-1 are involved), we replaced the variable $\log(\text{Assets})_{t-1}$ with dummy variables for 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.

Results are presented in Table 10.[15] A few patterns emerge. In normal times (1995-2007), TIER1 capital, the numerator of 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 capital injections). The results do not change if we adjust the TIER1 measure to consider the new (more conservative) definition of capital adopted in Basel III (see the results for TIER adjusted growth in Table 10).[16]

[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, estimated from the BIS international banking statistics. The growth series used in the estimations are thus partly purged of exchange rate-driven contractions and expansions.

[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 TIER1 is discussed in Annex A.

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 one 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 securitization) contribute to render the Exposure measure more correlated with the cycle, while the correction for asset derivatives and SFTs are weekly correlated with GDP and the credit gap. The 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 eventually circumvents that banks increase 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 counter-cyclical (less pro-cyclical) 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? iii) Are results different in "normal times" with respect to a crisis period?

To this end we compared the new definition of the leverage ratio with the Exposure measure at the denominator, with alternative ratios (TIER1/Total assets and Capital to Risk Weighted Assets Ratio). To account for their 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 where we reconstructed the new Exposure measure using corrections at the country level derived from the QIS database. The main results are the following: i) In normal times the new leverage ratio based on the Exposure measure is always more counter-cyclical (less pro-cyclical) 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 securitization activity) in the Exposure measure definition (the denominator of the leverage ratio). iii) All capital ratios tend to be less counter-cyclical (more pro-cyclical) 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 cycle measures due to the recognition of losses or deleveraging practices.

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Table 1: Composition of the database(1)

Countries	ASSETS (2012, bil. USD)	Location of the ultimate borrower		No. of banks	No. of M&A	No. of rescued banks
		Domestic	Other			
Austria	610	92.0	8.0	5	5	5
Australia	3073	92.2	7.8	7	4	0
Belgium	1169	55.9	44.1	3	7	3
Canada	3402	76.0	24.0	6	3	0
Switzerland	2753	47.9	52.1	6	5	1
Germany	5297	71.1	28.9	14	6	2
Spain	3542	83.6	16.4	14	14	2
France	8731	68.2	31.8	6	13	5
Italy	3177	81.9	18.1	12	35	6
Japan	3555	83.5	16.5	5	7	0
Netherlands	2711	58.1	41.9	3	1	2
Sweden	1921	90.8	9.2	4	5	1
United Kingdom	10730	73.9	26.1	7	15	2
United States	10273	90.6	9.4	17	39	14
Sum/average*	60944*	76.1	23.9	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 own 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 (bil. USD)	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	ASSETS	Number of observations	Number of banks
	(%)	(%)	(%)	(log of assets)	(% of assets)	(% of assets)	(%)	(%)	(%)	(2012, bil. USD)		
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 US; and Europe, other indicates CH, UK, and SE. "Average/sum*" indicates unweighted averages or sums (*) over countries.

Sources: BankScope.

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					
$\Delta NGDP_{t-1}$	Growth rate of nominal GDP adjusted	2646	4.52	2.80	-5.43	16.01
$\Delta RGDP_{t-1}$	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.

Source: BankScope; National central banks; BIS consolidated international banking statistics; own calculations.

Table 6: Baseline regressions

Dependent variable L(t):	(1) TIER1/ Total Exposure		(2) TIER1/ Total Assets		(3) TIER1/ RWA		(4) TIER1/ Total Exposure		(5) TIER1/ Total Assets		(6) TIER1/ RWA		(7) TIER1/ Total Exposure		(8) TIER1/ Total Assets		(9) TIER1/ 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 goes 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) TIER1/ Total Exposure		(2) TIER1/ Total Assets		(3) TIER1/ RWA		(4) TIER1/ Total Exposure		(5) TIER1/ Total Assets		(6) TIER1/ RWA		(7) TIER1/ Total Exposure		(8) TIER1/ Total Assets		(9) TIER1/ 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 goes 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 recapitalizations and capital constrained banks

Dependent variable L(t):	(1) TIER1/ Total Exposure		(2) TIER1/ Total Assets		(3) TIER1/ RWA		(4) TIER1/ Total Exposure		(5) TIER1/ Total Assets		(6) TIER1/ RWA		(7) TIER1/ Total Exposure		(8) TIER1/ Total Assets		(9) TIER1/ 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 goes 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) TIER1/ Total Exposure		(2) TIER1/ Total Assets		(3) TIER1/ RWA		(4) TIER1/ Total Exposure		(5) TIER1/ Total Assets		(6) TIER1/ RWA		(7) TIER1/ Total Exposure		(8) TIER1/ Total Assets		(9) TIER1/ 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 goes 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) TIER1 growth		(2) TIER1 adj growth		(3) Total exposure growth		(4) Total assets growth		(5) Risk-weighted assets growth		(6) TIER1 growth		(7) TIER1 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 goes 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) TIER1 growth		(12) TIER1 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 goes 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 goes 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	-0.0294	0.0570
L(t-1)*C	-0.019	0.080	0.001	0.115	-0.079	0.066	0.0345	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	0.0120	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 goes 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

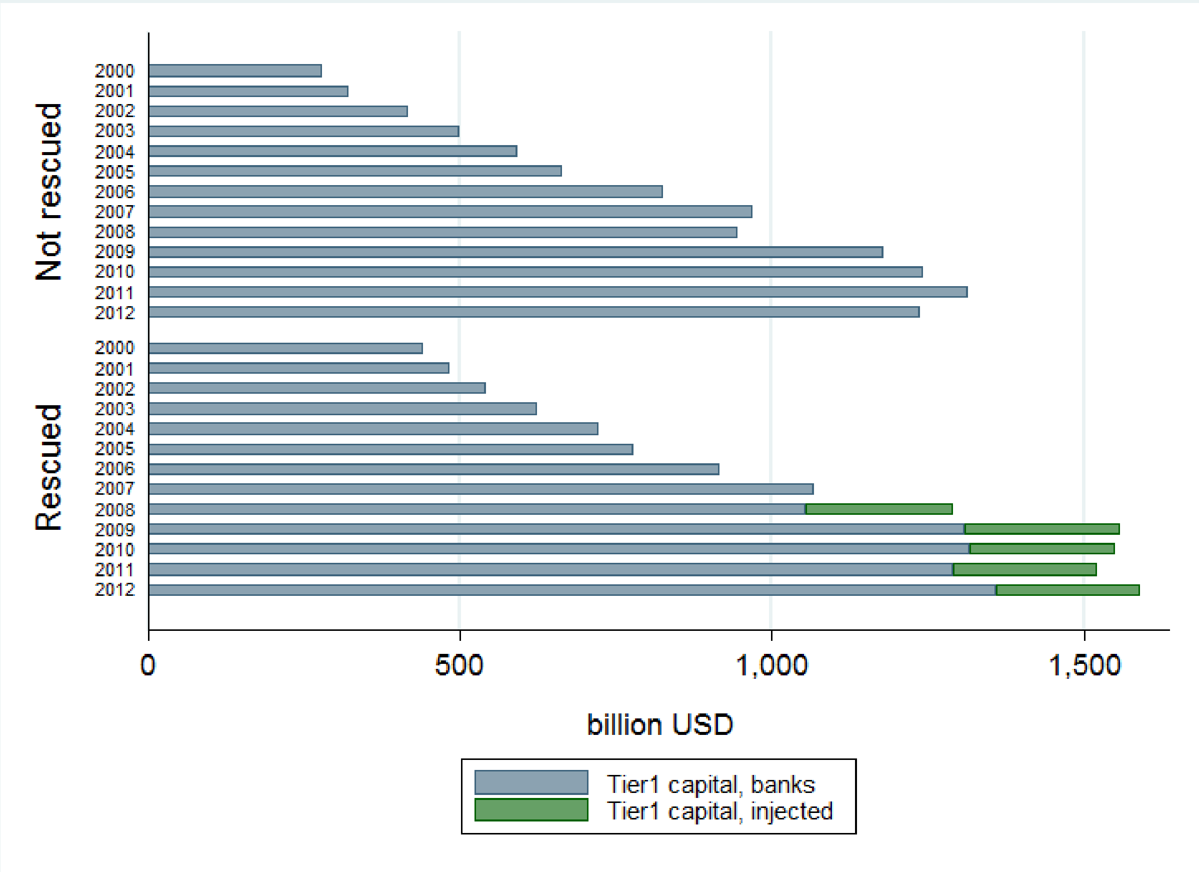
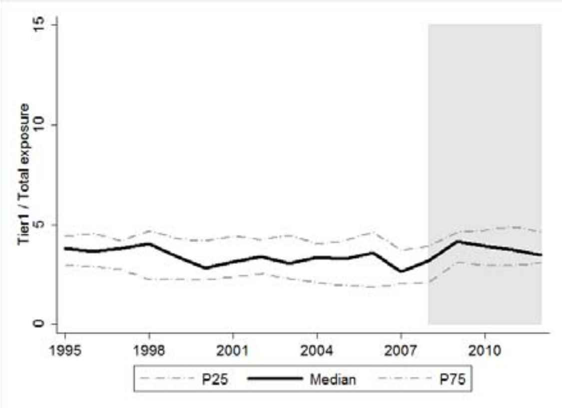
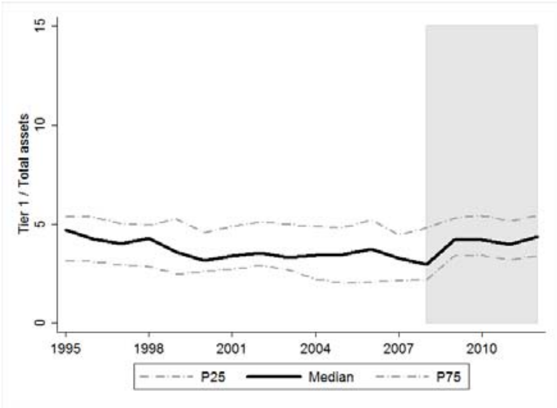


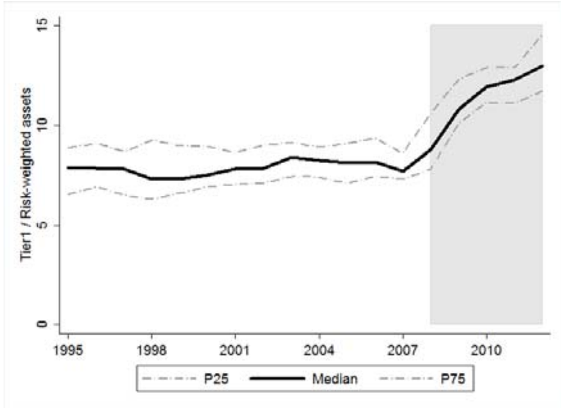
Figure 2: The capital ratios across Global Systemically Important Banks (GSIBs) and non-GSIBs

A) GSIBs

Tier 1 / Total Exposure | Tier 1 / Total Assets | Tier1 / RWA

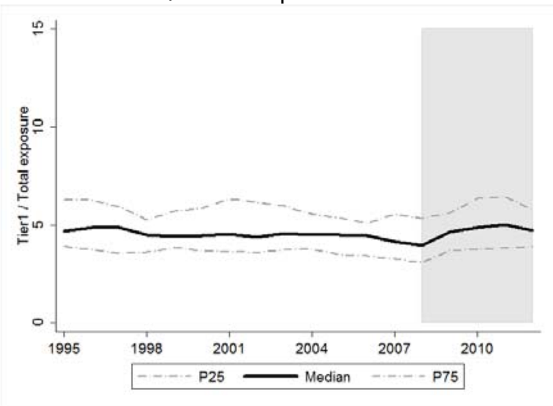


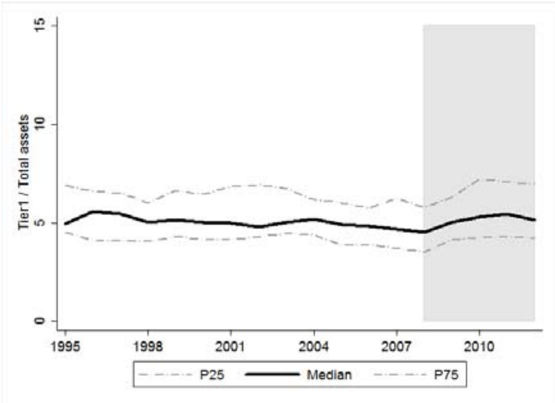




B) Non-GSIBs

Tier 1 / Total Exposure | Tier 1 / Total Assets | Tier1 / RWA





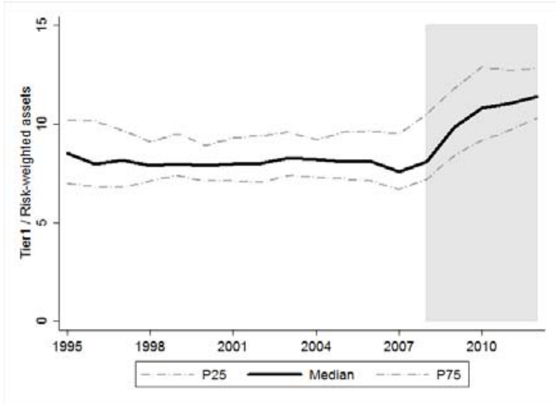
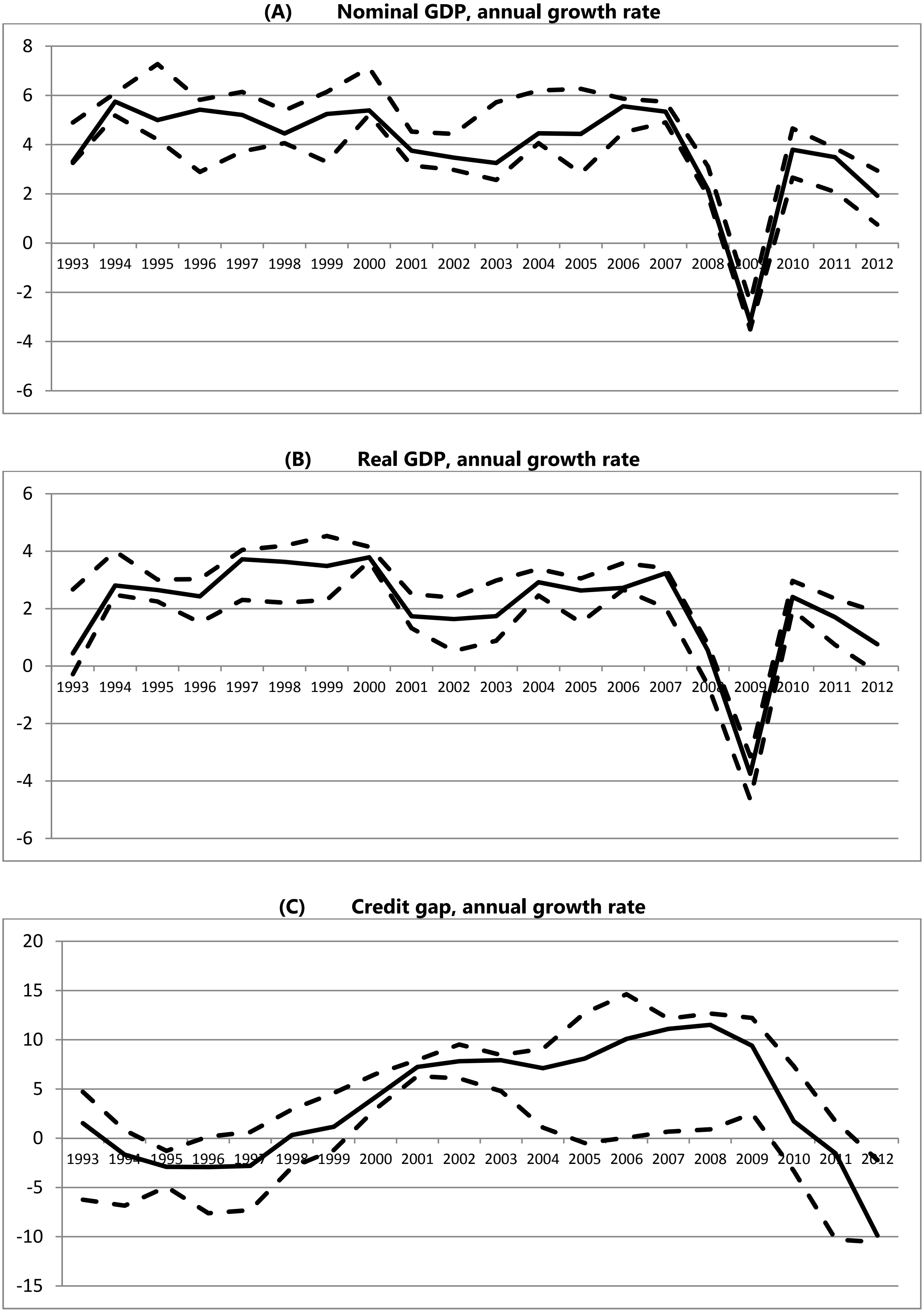


Figure 3: Cycle indicators



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. Capital to Risk Weighted Assets Ratio vs Leverage Ratio[17]

The Capital to Risk Weighted Assets Ratio (CRAR) indicates a bank's capacity to *absorb potential losses*. To this end it recognizes that assets can have different levels of risk and probability of default. We can illustrate this characteristic by reference to a very simple balance sheet. Take a bank that funds risky assets (A) with deposits (D), which have a fixed nominal value, and equity (E), which is the only loss absorbing liability.[18] Let us assume that assets A have a probability α to go into default and that for simplicity loss given default (LGD) is 100%. The CRAR is given by:

$$CRAR = \frac{E}{\alpha A} = \frac{Equity}{Risk\ Weighted\ Assets}$$

For example, a $CRAR$ equal to 5% indicates that a bank can absorb up to 5 cents loss for each euro of estimated risk-weighted exposures.

The Leverage ratio (LR) is an indicator of solvency that represents the *maximum loss that can be absorbed by equity*. LR represents the size of loss absorbing capacity relative to the size of the overall balance sheet.

$$LR = \frac{E}{A} = \frac{Equity}{Total\ Assets}$$

For example, if a bank has a LR equal to 5%, then the bank can absorb up to 5 cents loss for each euro of total assets.

In this simple case, the correct measure of exposure is the current value of assets. Put it differently, the total value of assets equals the maximum exposure of the bank (ie the maximum potential loss). However, bank balance sheets are not as simple as the one in the example above. For our purpose here, the main complication arises from exposure to derivative contracts and/or contingent liabilities (liabilities that are not fixed in value but that are themselves risky).

To fix ideas consider a credit default swap (CDS) written by the bank offering protection to a holder of a risky government bond with notional value N. We will assume that the CDS is fairly priced in the market and that the bank has not hedged this exposure. This means that initially the bank receives a premium p in exchange for the obligation to buy the bond at price N in the event of a default. At every point afterwards the market price of the CDS represents the fair value of the bank's liability. However, the potential cost to the bank is equal to the amount it might be asked to pay in the event of a government default. The maximum potential loss would be equal to the notional value N minus the minimum market price of the bond at the event of default (ie assuming the maximum loss-given-default).

What is the metric of loss absorbency that corresponds to the LR in this case? Now the denominator of the accounting LR no longer has the property of being equal to the maximum potential loss for the bank. A ratio with this property can be defined as $\widehat{LR}$, where the denominator is equal to the sum of assets (A) and the potential loss from the CDS (N), a measure of *Exposure*:

$$\widehat{LR} = \frac{E}{A + N} = \frac{Equity}{Exposure\ measure}$$

This analysis suggests that, depending on how one wants to interpret the leverage ratio, an appropriate measure would include in the denominator either a measure of the balance sheet value of the risky components or the maximum loss associated with risky liabilities, as in many cases it will not be possible to do both. Similar considerations to those in our CDS example apply to the case of other exposures such as acceptances, standby letters of credit, unsettled securities, etc.

[17] This Annex is based on Gambacorta and Tsatsaronis (2013).

[18] For ease of exposition we will refer to equity as regulatory capital (TIER1, for example).

Annex B: How to calculate a proxy for the "Exposure measure".[19]

The Basel III leverage ratio is calculated as Tier 1 capital over 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;
- physical or financial collateral, guarantees or credit risk mitigation purchased are not allowed to reduce on-balance sheet exposures.

The Basel III framework provides then 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) SFTs exposures, and (d) other off-balance sheet exposures. This makes the "Exposure measure" different with respect to 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 cases 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".[20] 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 2011-2012 so that in order 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 to it correction components.

Exposure measure=

Total assets (11350) +

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

[19] We thank Luca Serafini (Banca d'Italia) and James Haas (FDIC) for useful comments and suggestions. Gabriele Gasperini and Markus Zoss provided excellent research assistance on QIS data.

[20] 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 concerned items for a maximum of 2 years.

Reverse Repos and cash collateral (11145) * C +

[Other off-balance sheet exposure to securitization (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:

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

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

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

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

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

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. On the contrary, 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 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 as Big. Figure B1 shows over time the relative weight of each correction components in the calculation of the Exposure measure when applying this concept to BankScope data.[21] On average, off-balance items account for

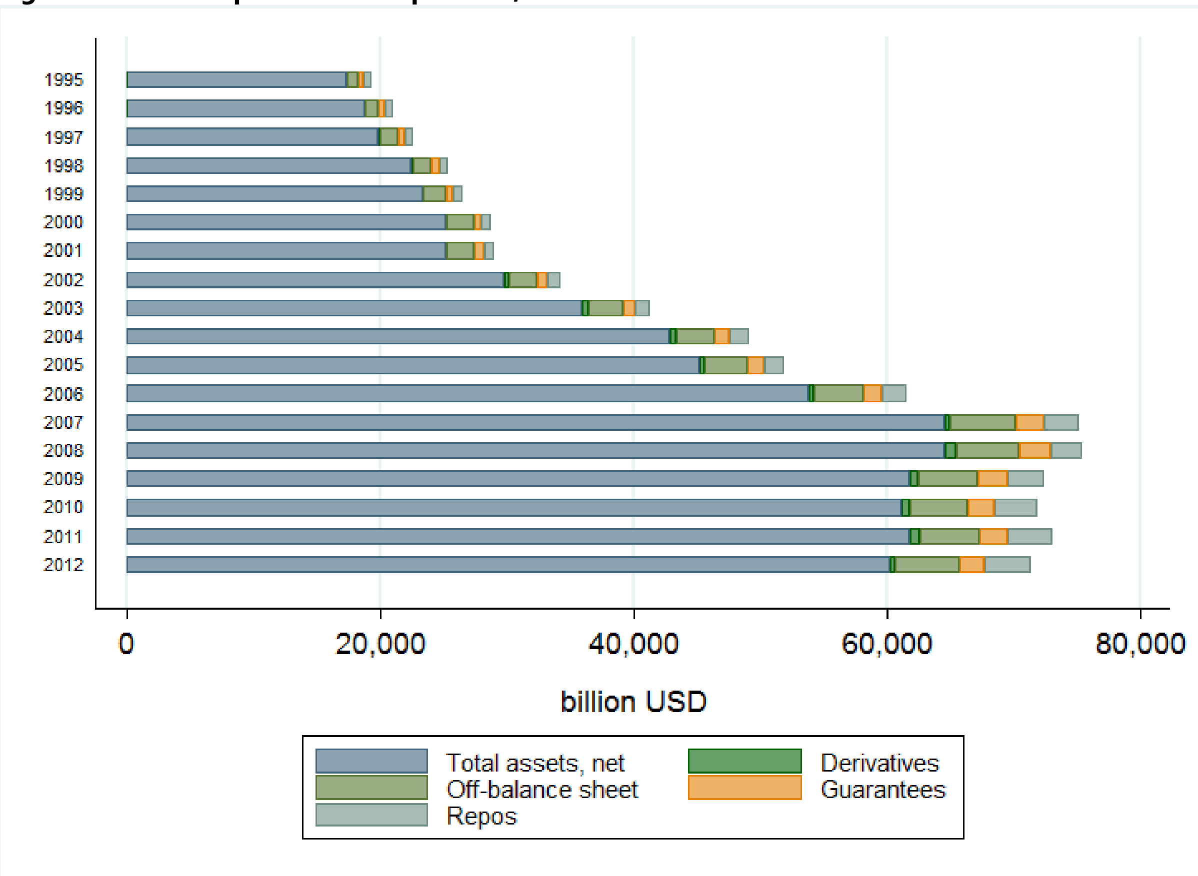
[21] QIS information is available for 2011 and 2012 only. First, we checked the reliability of the applied corrections over these two years using both BankScope and QIS data. We then applied the average correction coefficients for the period 2011-12 backwards on the BankScope data for 1995-2010.

almost 48% of the correction (the difference between Exposure measure and net total assets), Repos for 27% and guarantees for 20%. The impact of corrections for derivative exposures is limited to 5%.

Figure B2 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.

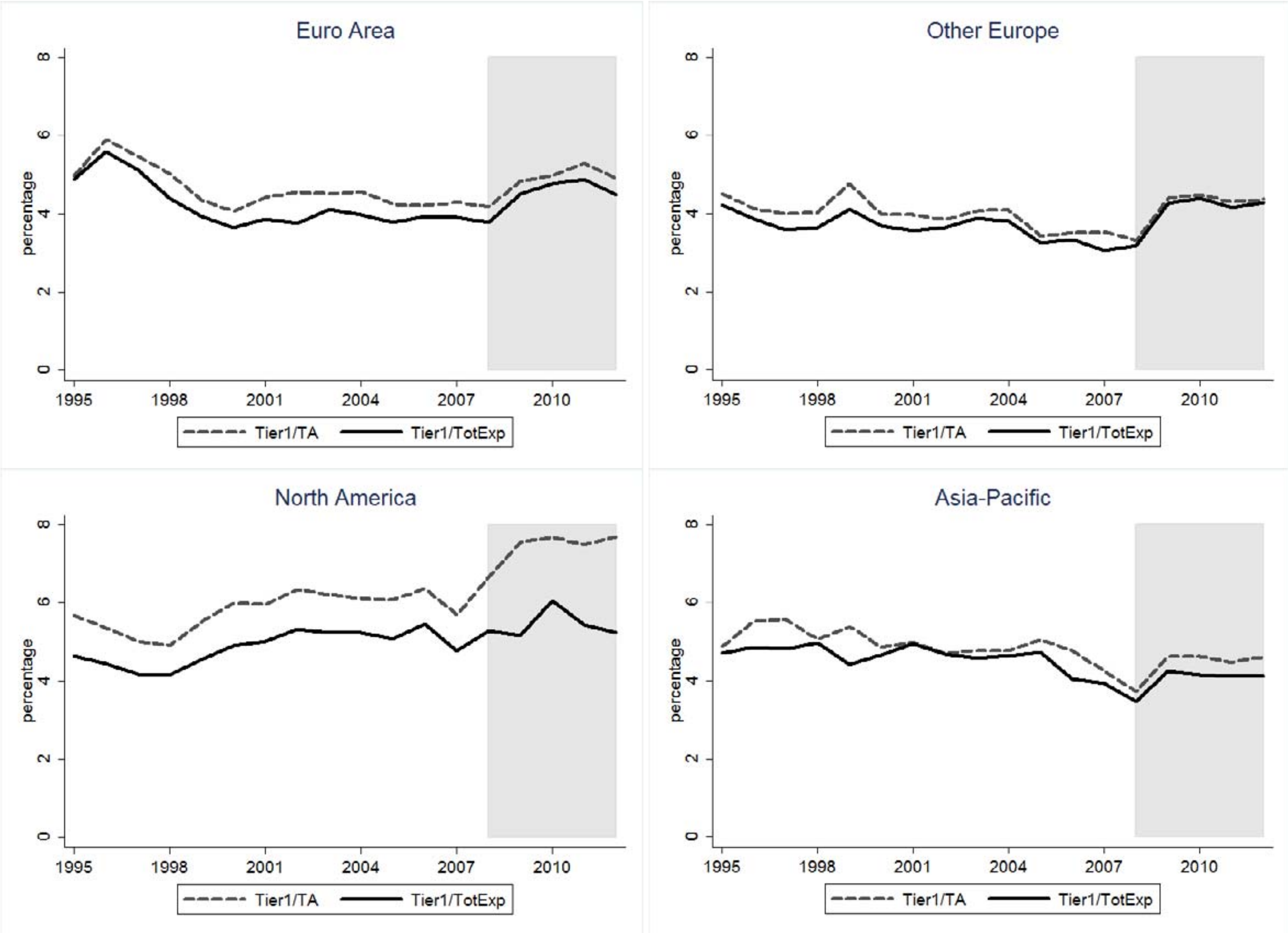
In Table 10 we consider an adjusted measure of TIER1 (fully faced in) that is based on a more conservative definition for capital (see BCBS, 2009 for details). In particular, we have considered: TIER 1 adjusted= H*TIER1.

Figure B1: Total exposure decomposition, all banks



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

Figure B2: 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 C: 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 C1 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 C1: Im-Pesaran-Shin unit root tests

Variables	Number of panels	Transformations					
		Levels			Growth rates		
		Lags ave (1)	W-t-bar (2)		Lags ave (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 mitigating the impact of cross-sectional dependence. 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 are computed on the raw data (not the weighted cyclical measures).

Annex D: 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) TIER1/ 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
Europe, other	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 Europe, other 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 Tier1/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 US and 5% in Canada prior to 2000 and 4.3% thereafter. For Switzerland the leverage ratio regulation was introduced in 2010 for 2 big banks (see column IX).

Sources: BankScope.